National Oceanography Centre

CLASS and OSNAP report for JC238

12th July – 31st July 2022

RRS *James Cook*

Research Expedition JC238

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Yvonne Firing 2022

Research Expedition Report No. 78

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Title

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Reference

Southampton, UK: National Oceanography Centre, Southampton, 164 pp. (National Oceanography Centre Cruise Report, No. 78)

Abstract

The aim of this expedition was to recover and redeploy all moorings in the OSNAP array and to obtain a CTD section of hydrographic, nutrients, dissolved oxygen and dissolved organic carbon observations along the OSNAP section.

The specific measurement objectives of the cruise were:

1. Recover and redeploy 4 existing mooring along the Ellett Array (EB1, WB1, WB2, RH ADCP) and 3 existing moorings in the Iceland Basin (IB5, IB4, IB3)
2. Deploy new drift-free pressure recorder (Sonardyne Fetch AZA) at EB1.
3. Conduct CTD stations and capture water samples for oxygen, total carbon, alkalinity and nutrients analysis. Data from the CTD stations was provided in near-real time (<12 hours) to the UK Met. Office to be assimilated into their short-range ocean forecast models: global 0.25 degree, North Atlantic 1/12th degree and AMM15 (European NW Shelf, ~ 1.5 km).
4. Recover and redeploy a sediment trap mooring on the Darwin Sea Mounds (DMLTM) as part of the UK Marine Protected Area habitat monitoring programme.
5. Deploy three BGC-Argo floats to maintain the UK contribution to the global ARGO network.
6. Using ship-based instrumentation to measure underway meteorology, sea-surface temperature and salinity, ocean currents from the surface to ~400m depth and water-depth using a Kongsberg multibeam echo sounding system

Keywords

CLASS, OSNAP, AMOC, Moorings, North Atlantic, mooring array, CTD,

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1 Scientific and Ship's Personnel

Name	Position	Affiliation
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Iain Macleod	Chief Officer	
Bryn Beurain	2nd Officer	
Jordan Greenhow	3rd Officer	
Keith Sneddon	Chief Engineer	
Michael Murren	2nd Engineer	
Keith Richie	2nd Engineer	
John Lee	3rd Engineer	
George Palmer	3rd Engineer	
David Hawksworth	ETO	
David Bergin	ERPO	
Paual McDougall	Purser	
Mark Squib	CPOS	
John Hopely	CPOS	
William McLennan	COPD	
Peter Smyth	POD	
Oleg Avdejev	SG1A	
Robert McKeown	SG1A	
Wayne Critten	SG1A	
Darren Caines	Head chef	
Michael Leigh	Chef	
Melissa McMahon	Steward	
Denzil Williams	Steward	
Ben Moat	Chief Scientist	NOC
Kristin Burmeister	Co-Chief Scientist	SAMS
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Lewis Drysdale	Scientist	SAMS
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Thomas Ballinger	Technician (Moorings)	NOC/NMFSS
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Stephen Corless	Technician (Engineering)	NOC/NMFSS
Dean Cheesman	Technician (Engineering)	NOC/NMFSS
Daniel Phillips	SST	NOC/NMFSS
Tina Thomas	Trainee	NOC/NMFSS

2 Cruise Narrative

Date	Operation	Start time	End time	Durat. (hrs:min)	Latitude (°N)	Long. (°W)	Notes
Tue 12 Jul	Depart Southampton	08:00					
	Transit to CTD test site						
Thu 14 Jul	CTD1	21:09	22:31	1:22	56°46.23	9°10.32	Test CTD 1000m 1 microCAT
	Transit RTEB1						
Fri 15 Jul	CTD2	01:14	02:58	1:44	57°05.27	9°32.78	Pre RTEB1 – 1790m
	CTD 3	04:55	07:41	2:46	57°13.94	10°02.85	For calibration of deployed MicroCATS (station N) – 2100 m
	Recover RTEB1	11:06	13:35	2:29	57°05.92	09°33.57	
	RTEBL1 test comms						Tested RTEBL1 comms at RTEB1 site
	CTD 4	16:41	19:27	2:46	57°13.87	10°02.89	For calibration of deployed MicroCATS and releases (station N) - 2101m
	CTD 5	23:12	23:45	0:33	56°59.97	08°59.81	Station R – 135 m
Sat 16 Jul	CTD 6	00:43	01:23	0:40	57°03.07	09°13.07	Station Q – 314 m
	CTD 7	02:18	03:48	1:30	57°06.07	09°25.08	Station P – 1407 m
	Deply RTEB1	08:12	11:32	3:20	57°06.01	09°33.85	
	Deploy RTEBL1	12:51	12:30	0:21	57°05.90	09°33.16	
	Trilaterate moorings						
	CTD 8	05:02	06:47	1:45	57°08.99	09°41.99	Station O – 1808 m

	CTD 9	13:50			57°06.69	09°34.72	Post RTEB1 – 1925 m
	CTD 10	18:54	21:04	2:10	57°18.10	10°22.90	Station M – 2207 m
	Argo float deployment	22:14	-	-	57°18.30	10°22.80	Navis float F1102 @ Station M
	CTD 11	22:38	00:43	2:05	57°22.02	10°39.97	Station L – 2085 m
Sun 17 Jul	CTD 12	02:10	03:22	1:12	57°23.95	10°52.04	Station K – 785 m
	CTD 13	04:23	05:20	0:57	57°26.88	10°05.17	Station J - 586 m
	RTWB2 recovery	09:55	10:40	0:45	57°28.29	12°18.86	
	RTWB2 Deployment	12:56	14:20	1:24	57°28.24	12°18.69	
	Trilaterate moorings						
	CTD 14	18:46	19:47	0:51	57°28.09	11°19.11	Station I – 748 m
	CTD 15	20:46	22:36	1:50	57°28.96	11°31.93	Station H – 2015 m
	CTD 16	23:53	01:42	2:49	57°29.55	11°50.95	Station G – 1790 m
Mon 18 Jul	CTD 17	03:21	05:08	1:47	57°30.47	12°14.76	Station F – 1800 m
	CTD 18	07:42	09:30	1:48	57°31.98	12°37.98	Station E – 1630 m
	CTD 19	10:29	11:53	1:24	57°32.52	12°51.97	Station D – 1089 m
	RTWB1 recovery	13:35	15:44	2:09	57°28.17	12°42.17	
	CTD 20	17:27	18:07	0:40	57°32.95	12°59.97	Station C – 295 m
	CTD 21	19:32	20:02	0:30	57°34.03	13°19.96	Station B – 176 m
	CTD 22	21:14	21:32	0:18	57°35.00	13°37.89	Station A – 113 m
	CTD 23	23:59	00:15	0:16	57°35.55	14°16.02	Station RAG160 – 198 m
Tue 19 Jul	RTWB1 deployment	07:18	09:42	2:24	57°28.17	12°42.29	
	CTD 24	18:21	19:05	0:44	57°36.24	14°53.94	Station RAG159 – 477 m

	CTD 25	21:43	23:05	1:22	57°36.85	15°31.83	Station RAG158 – 1054 m
Wed 20 Jul	CTD 26	04:25	05:39	1:14	57°38.06	16°47.68	Station RAG156 – 1194 m
	Recover RHADCP	10:02	10:27	0:25	57°36.89	15°24.66	
	Deploy RHADCP	13:21	13:35	0:14	57°36.87	15°24.70	
	CTD 27	17:13	18:18	1:05	57°37.40	16°09.98	Station RAG157 – 1171 m
	CTD 28	22:26	23:50	1:24	57°38.80	17°25.92	Station RAG155 – 1226 m
Thu 21 July	CTD 29	01:57	03:10	1:13	57°39.39	18°03.85	Station RAG154 – 1060 m
	Recover IB5	06:42	08:03	1:21	57°48.08	21°10.28	
	Deploy IB5	09:21	10:55	1:34			
	CTD 30	13:54	14:49	0:55	57°39.95	18°41.86	Station OSNAP17 – 712 m
	CTD 31	16:56	17:57	1:01	57°43.73	19°13.65	Station OSNAP18 – 909 m
	CTD 32	19:53	21:19	1:26	57°47.49	19°44.75	Station OSNAP19 – 1303 m
Fri 22 July	CTD 33	01:58	06:07	4:09	57°58.84	21°09.85	Pre IB4 – 2937m
	Recover IB4	06:56	10:20	3:33	57°59.39	21°08.77	
	Deploy IB4	12:36	16:02	3:26			
	CTD 34	16:41	18:57	2:16	57°58.90	21°09.77	Post IB4 – 2945m
	CTD 35	22:03	00:43	2:40	57°50.14	20°08.50	Station OSNAP20 – 1569 m
Sat 23 July	CTD 36	02:03	04:43	2:40	57°52.68	20°29.81	Station OSNAP21 – 2240 m
	CTD 37	06:22	08:33	2:11	57°54.91	20°51.21	Station OSNAP22 – 2000 m
	CTD 38	11:39	14:41	3:02	57°57.45	21°51.45	Station OSNAP24 – 3016 m
	CTD 39	17:03	19:29	2:26	57°57.46	22°30.82	Station OSNAP25 – 2981 m
	CTD 40	23:36	02:14	2:48	57°57.52	23°50.12	Station OSNAP27 – 2929 m

Sun 24 July	CTD 41	04:32	07:09	2:37	57°57.66	24°29.27	Station OSNAP28 – 2929 m
	Recover IB3	08:29	11:24	2:55	58°00.77	24°25.54	
	Deploy IB3	12:49	15:19	2:30			
	CTD 42	20:21	-		57°57.63	23°10.39	Station OSNAP26 – 2987 m Aborted at 100m due to pump blockage
	CTD 43	20:45	23:39	2:54	57°57.63	23°10.39	Station OSNAP26 – 2987 m
	Trilateration						
	Deploy 2xArgo floats SBS-Navis NKE-Provor	 23:49 23:55			 57°57.63 57°57.63	 23°10.39 23°10.39	
	Transit Darwin Mounds						
Wed 27 July	Recover Darwin mounds mooring	07:45	09:11		59°51.68	07°02.66	Wire snapped
	Deploy Darwin mounds mooring	10:25	10:33		59°51.68	07°02.63	
	CTD 44	11:05	12:08	1:03	59°51.21	7°03.36	Calibration for Darwin mounds MicroCats
	trilateration						
	Transit SAMS						
Thu 28 July	SAMS						Drop off SAMS scientists and technicians
Sun 31July	Dock Southampton						

Table 2.1 Cruise Itinerary (time in GMT)

3 Introduction

This cruise contributes to the International Overturning in the Subpolar North Atlantic Programme (OSNAP, http://o-snap.org/). OSNAP began in 2014, with the aim of continuously measuring the strength and structure of the subpolar North Atlantic circulation between Newfoundland and Scotland using a purposefully designed mooring array. The array is supplemented by Seaglider missions and makes use of data from a number of measurement programmes such as Argo and satellite measured sea-surface heights. Using these measurements, the OSNAP programme can quantify the strength of the Atlantic meridional overturning circulation and associated transports of energy and elements (fresh-water, carbon, nutrients). The AMOC is a major component of Earth's climate system and has been predicted to slow in 21st Century under the influence of global warming. Such a slowing represents a major shift in Earth's climate. Severe impacts throughout the North Hemisphere are expected on sea-levels, rainfall patterns, temperatures, sea-ice distribution, atmospheric weather patterns and agricultural productivity. It is considered vital to obtain a better understanding of the dynamics and variability inherent in this system and provide the data necessary for building confidence in predictions of climate evolution in the 21st Century.

3.1 Cruise Objectives

This cruise is the second cruise of five cruises to recover and redeploy all moorings in the OSNAP array between June-September 2022 and to obtain a section of hydrographic, nutrients, dissolved oxygen and dissolved organic carbon observations along the OSNAP line. The specific measurement objectives of the cruise were:

1. Recover and redeploy 4 existing mooring along the Ellett Array (EB1, WB1, WB2, RH ADCP) and 3 existing moorings in the Iceland Basin (IB5, IB4, IB3)
2. Deploy new drift-free pressure recorder (Sonardyne Fetch AZA) at EB1. A similar instrument will be deployed a the western boundary in August 2022. The bottom pressure data will be used to reconstruct volume transport of the Atlantic Meridional Overturning Circulation.
3. Conduct CTD stations and capture water samples for oxygen, total carbon, alkalinity and nutrients analysis. Data from the CTD stations was provided in near-real time (<12 hours) to the UK Met. Office to be assimilated into their short-range ocean forecast models: global 0.25 degree, North Atlantic 1/12th degree and AMM15 (European NW Shelf, ~ 1.5 km).
4. Recover and redeploy a sediment trap mooring on the Darwin Sea Mounds (DMLTM) as part of the UK Marine Protected Area habitat monitoring programme. Data from this mooring was secured but not processed on this cruise.
5. Deploy three BGC-Argo floats to maintain the UK contribution to the global ARGO network.
6. Using ship-based instrumentation to measure underway meteorology, sea-surface temperature and salinity, ocean currents from the surface to ~400m depth and water-depth using a Kongsberg multibeam echo sounding system

3.2 Data Management Plan

The Data Management Plan was prepared in discussion the British Oceanographic Data Centre; BODC). BODC will be involved through the life of the project to ensure consistent and safe data management. For research expeditions, a BODC Data Manager will oversee the on-board completion of the *Cruise Summary Report* detailing the measurements.
A cruise report (this report) will be published within six months of cruise end. Following appropriate quality control all data will be submitted to the BODC archive within 12 months of collection. BODC curates the UK-OSNAP mooring data and the Extended Ellet Line (EEL) data set. Richenda Houseago- Stokes is the BODC Data Manager for this cruise.

UK-OSNAP data: http://dx.doi.org/10/c7qv
EEL data: https://www.bodc.ac.uk/resources/inventories/edmed/report/644/

3.3 Environmental Impact Assessment

An assessment of the interaction of NERC marine science with the environment (NERC Marine Environment Interaction Policy, 12/7/2018) was conducted prior to the cruise by Anna Bird, NERC Marine Environment Appraiser (March 2022). The purpose of the Environmental Impact Assessment (EIA) is to assess the environmental impacts associated with the scientific research activities during the research cruise JC238 occurring in the North East Atlantic Ocean. A set of recommended mitigation measures Marine Environmental Mitigation Integration Policy (MEIP) was produced for the purpose of undertaking the project in a way that will be of minimal detriment to the marine environment, and in a way that is reasonable and commensurate with achieving the stated scientific objectives. This EIA and associated MEIP have been prepared based on the information provided by the Principal Investigator in the SME and associated questionnaire. A copy is available from Anna Bird.

3.4 Funding statement

This work contributes to U.K. Natural Environment Research Council National Capability program the Extended Ellett Line (EEL) and Climate Linked Atlantic Sector Science (CLASS) (NE/ R015953/1), and NERC grants U.K. Overturning in the Subpolar North Atlantic (OSNAP) (NE/K010875/1, NE/K010875/ 2, and NE/K010700/1) and U.K. OSNAP Decade (NE/T00858X/1 and NE/T008938/1) and to the European Union's Horizon 2020 Research and Innovation Programme Grant Agreement No. 210522255 Integrated Assessment of Atlantic Marine Ecosystems in Space and Time (iAtlantic).

3.5 Previous OSNAP-CLASS cruises

Cruise	Vessel	Year	Report
KN221-02	*R/V Knorr*	2014	Cunningham, S. A. (2015), R/V Knorr Cruise KN221-02, 9th July - 1st August 2014. OSNAP Mooring Cruise Report *Rep.*, 1-54 pp, Scottish Association for Marine Science.
DY017	*RRS Discovery*	2014	Painter, S. C. (2015), RRS Discovery Cruise DY017, 20 OCT -06 NOV 2014, Outer Hebrides process cruise, *Cruise Report Rep.*, National Oceanography Centre, Southampton.

JR302	*RRS James Clark Ross*	2014	King, B., and N. P. Holliday (2015), RRS James Clark Ross Cruise 302. 06 JUN - 21 JUL 2014. The 2015 RAGNARRoC, OSNAP and Extended Ellett Line cruise Report, *Cruise Report Rep. 35*, National Oceanography Centre.
PE399	*R/V Pelagia*	2015	Cunningham, S. A. (2016), R/V Pelagia Cruise PE399 16th June to 8th July 2015, Southampton, UK to Reykjavic, Iceland. Scottish Association for Marine Science, Oban.
DY053	*RRS Discovery*	2016	Cunningham, S. A. (2016), RRS Discovery Cruise DY053 16 JUNE - 23 JULY 2016. Scottish Association for Marine Science, Oban.
DY078	*RRS Discovery*	2017	Holliday, N. P. (2017), RRS Discovery Cruise DY078/079 06-28 May 2017. Extended Ellett Line 2017 occupation and OSNAP Rockall Trough mooring refurbishment cruise *Rep.*, National Oceanography Centre, Southampton.
AR30-04	*R/V Armstrong*	2018	Cunningham, S. A. (2018), RV Neil Armstrong Cruise AR30-04 01-29 JUL 2018 OSNAP moorings cruise report. Scottish Association for Marine Science, Oban.
DY108	*RRS Discovery*	2019	Huvenne, V. A. I., and B. Thornton (2020), RRS Discovery Cruise 108, 6 September - 2 October 2019. Darwin Mounds Marine Protected Area habitat monitoring, BioCAM equipment trials and BLT pilot study, *Cruise Rep.*, 224 pp, National Oceanography Centre, Southampton.
DY120	*RRS Discovery*	2020	Cunningham, S. A. (2020), RRS Discovery Cruise DY120 8 - 24 October 2020. OSNAP moorings cruise report. Scottish Association for Marine Science, Oban.
JC238	*RRS James Cook*	2022	This report.

4 Ships Systems Computing and Underway Instruments

Juan Ward and Daniel Phillips

4.1 Introduction

The information in this section has been taken from the NMF Scientific Ship Systems Cruise Report where full details can be found.

The ship-fitted instruments are listed in Table 4.1, the data were logged by the Techsas 5.11 data acquisition system. The system creates NetCDF and ASCII output data files. Data were additionally logged onto the legacy RVS Level-C format and raw NEMA strings from the instruments were time stamped and logged.

Manufacturer	**Model**	**Function/data types**	**Logged?** **(Y/N)**	**Comments**
Steatite	MM3S	GPS network time server (NTP)	N	Not logged
Applanix	POS MV	DGPS and attitude	Y	Heading re-calibrated 26/07/2022
C-Nav	3050	DGPS and DGNSS	Y	
Kongsberg Seatex	DPS116	Ship's DGPS	N	Uninstalled
Kongsberg Seatex	Seapath 330+	DGPS and attitude	Y	
Sonardyne	Ranger2 USBL	USBL	Y	For AZA BPR deployment and test dips.
Sperry Marine		Ship gyrocompasses x 2	Y	
Chernikeef Instruments	Aquaprobe Mk5	Electromagnetic speed log	N	Needs Calibration
Kongsberg Maritime	Simrad EA640	Single beam echo sounder (hull)	Y	
Kongsberg Maritime	Simrad EM122	Multibeam echo sounder (deep)	Y	Run continuously
Kongsberg Maritime	Simrad EM710	Multibeam echo sounder (shallow)	N	

Kongsberg Maritime	Simrad SBP120	Sub bottom profiler	N	
Kongsberg Maritime	Simrad EK60	Scientific echo sounder (fisheries)	N	
NMFSS	CLAM	CLAM system winch log	Y	
NMFSS	Surfmet	Meteorology suite	Y	
NMFSS	Surfmet	Surface hydrography suite	Y	
		Skipper log (ship's velocity)	Y	
Rutter OceanWaveS GmbH	WaMoS II Sigma S6	Wave Radar	Y	
RSaqua	Rex2	Wave height sensor	Y	
Teledyne RD Instruments	Ocean Observer 75 kHz	UHDAS	Y	
Teledyne RD Instruments	Ocean Observer 150 kHz	UHDAS	Y	
DGS	AT1M	Gravity	N	
Micro g LaCoste	S84	Gravity	N	

Table 4.1 Ship-fitted instruments.

4.2 GPS Position and attitude

GPS and attitude measurement systems were run throughout the cruise.

The ***Applanix POSMV*** system is the vessel's primary GPS system, outputting the position of the ship's common reference point in the gravity meter room. The POSMV is available to be sent to all systems and is repeated around the vessel. The position fixes attitude and gyro data are logged to the Techsas system. True Heave is logged by the Kongsberg EM122 & EM710 systems.

The ***Kongsberg Seapath 330+*** system is the vessel's secondary GPS system. This was the position and attitude source that was used by the EM122 & EM710 due to its superior real-time heave data. Position fixes and attitude data are logged to the Techsas system.

The ***CNav 3050*** GPS system is the vessel's differential correction service. It provides the Applanix POSMV and Seapath330+ system with RTCM DGPS corrections (greater than 1m accuracy). The position fies data are logged to the Techsas system.

4.3 Meteorology and sea surface monitoring package

The NMF Surfmet system was run throughout the cruise, excepting times for cleaning, entering and leaving port and whilst alongside (Table 5.2).

The Surfmet system is comprised of:

- Hull water inlet temperature probe (SBE38).
- Sampling board conductivity, temperature salinity sensor (SBE45).
- Sampling board transmissometer (CST).
- Sampling board fluorometer (WS3S)
- Met platform temperature and humidity probe (HMP45).
- Met platform port and starboard ambient light sensors (PAR, TIR).
- Met platform atmospheric pressure sensor (PTB110).
- Met platform anemometer (Windsonic).

The underway water system was cleaned before sailing and on return to port in Southampton.

4.4 Hydro-acoustic systems

The EA640 single-beam echo-sounder was run throughout the cruise apart from during release and ranging of moorings when it was turned off to avoid interference. Both the 10 kHz and 12 kHz were run in active mode triggered by K-Sync. Pulse parameters were altered during the cruise in response to changing depth. It was used with a constant sound velocity of 1500 ms^{-1} throughout the water column to allow it to be corrected for sound velocity in post processing.

The EM122 multibeam echo sounder was run throughout the cruise apart from during release and ranging of moorings triggered by K-sync. The position and attitude data were supplied from the Seapath 330+ due to its superior real-time heave. Applanix PosMV position and attitude data is also logged to the .all files as the secondary source and True Heave *.ath file are logged to allow for inclusion during reprocessing. Sound velocity profiles were derived from a statistical model using SHOM & Ifremer's DORIS programme, derived from CTD data.

The surface Sound Velocity (SV) sensor (AML SmartSV) mounted on the drop keel was used throughout providing SV data to the EM122. The port drop keel remained flush with the hull for the duration of the cruise.

Both the 75 and 150 kHz ship ADCP's were run consistently during the cruise.

4.5 Other systems

The single axis bridge Skipper Log was logged throughout the cruise.

5 Scientific Computing Systems

Yvonne Firing and Lewis Drysdale

5.1 Workstation Setup and Archiving

Scientific data processing was done on Linux workstation 'koaekea', a Dell T5820 running Centos 7, with workstation 'akeake', a Dell T3420, configured the same way and set up as a backup machine.

In the home directory, /local/users/pstar, the cruise data were processed under ~/osnap/moor and ~/osnap/cruise_data/jc238 (pointed to by symbolic link at ~/jc238). A user area, ~/osnap/cruise_data/jc238/users/, was available for working files and programs. The Cook's network data drive (containing e.g. CTD data and ship underway data and documentation) and public drive were mounted using script mount_commands_jc (see below) and linked in ~/mounts/. User-compiled programs were installed in ~/bin/, while scripts and functions were placed in ~/programs/. The crontab was configured to automatically back up the data and programs directories to two external hard drives (every two hours, alternating) and to sync them to akeake every three hours. In addition to serving as a backup, akeake was used for testing major modifications to processing code before merging them into the main branches.

Data processing software is described below; external software and libraries used included:
Matlab 2021b
Python 3.9.7
Miniconda3
Postgresql
CODAS (currents.soest.hawaii.edu, version installed November 2021)
Gibbs Seawater toolbox v3.03
Seawater toolbox v3.3.1
M_map v1.4
LDEO_IX LADCP processing toolbox, v. 13

Because the LDEO_IX toolbox and the mooring processing toolbox contain several functions with the same names, the Matlab startup script was configured to prompt the user to choose which type of processing would be done in a particular session, before adding only the relevant paths (by running *m_setup.m* with MEXEC_G.ix_ladcp = 1 in the first case, or by running *startupjc238.m* in the second case).

5.2 Remote Desktop Connection

Most users worked on koaekea remotely via ssh -Y. This worked smoothly for those on Windows or Linux machines. It also worked from some Macs running XQuartz 2.8.0, but from others, including RAPID's relatively new Mac Mini, what appears to be a bug in the handling of java-using applications meant that Matlab windows were unreadable. This issue also came up on DY146 in February and as it appears to be longstanding and not yet resolved, in future there may need to be another alternative for users with Macs.

5.3 MEXEC Data Processing

The mexec set of scripts and functions for processing and QC of CTD and underway data as well as interfacing with LADCP and VMADCP is split between two toolboxes: **mexec_exec** (shell scripts) and **ocp_hydro_matlab** (Matlab scripts and functions, formerly known as mexec_processing_scripts and mexec). We used the jc238 branch of **mexec_exec** (git.noc.ac.uk/OCP/mexec_exec.git) and the master (commit 4b5ac23) through jc238 (created at the end of the cruise) branch of **ocp_hydro_matlab** (git.noc.ac.uk/OCP/mexec_processing_scripts.git).

On starting CTD casts, ctd_syncscript and lad_linkscript_ix were updated to point to the current cruises's data and name formats. The data directories under ~/osnap were added to cruise_backup and keep_workstation2_in_sync, the latter of which also had ~/Documents/MATLAB/startup.m and ~/instructions_info/ added to its tasks.

The basic data processing steps to be carried out for CTD, bottle sample, and underway data are detailed in the manual (found in ocp_hydro_matlab/docs) and are as described in the DY146 cruise report with the exception that *m_daily_proc.m* has been renamed to *uway_daily_proc.m*. Significant changes to data processing or setup on this cruise include:

1) CTD data: default method for gridding to 2 dbar changed from median to midpoint of linear fit, reducing the distortion of the profile for grid points including bottle stops; default method for extracting Niskin firing time CTD values changed from interpolation to averaging over 5 s.
2) Underway data: increased automation of the process of generating a list of RVDAS tables and mapping them to mexec table and variable names, via *mrjson_get_list.m*, *mrjson_load_all.m*, and *mrjson_show.m* (along with new cruise options).

5.4 Mooring Processing Toolbox

All moored instrument processing including shipboard calibrations on instruments pre- and post-deployment was done using the version-controlled **m_moorproc_toolbox**, which is a SAMS based library for reading, processing, and QC of mooring data (including calibration dips). A branch of this toolbox was created prior to the cruise and a copy of that branch was put on the pstar@koaekea.local directory in ~/programs/m_moorproc_toolbox. Some changes made at NOC for RAPID, and additional code for presenting ship underway data to help with mooring operations (rapid_widgit_lite), were added in on this cruise. The post-cruise version of this will be merged back to its original Git repository.

All moored instrument data were uploaded to //cookfs.cook.local/Sensors_and_Moorings, which were backed up every six hours to two hard SAMS disk drives: Elements (Kristin) and Transcend (Lewis).

6 NMF CTD Operations

Tom Ballinger and Dougal Mountifield

6.1 CTD Summary

JC238 CTD work supported the turnaround of the OSNAP, Ellet Array and Darwin Mounds moorings with the CTD being utilised for pre and post recovery calibration casts while also giving the opportunity to test acoustic releases prior to deployment. Fourty four CTD casts were undertaken with an NMF 24-way Stainless Steel CTD frame with 12 off 10l Niskin water samplers. Only the odd bottles were fitted leaving 12 bottle positions free for Microcat clamps which were utilised for calibrations casts. Dual SBE 43 dissolved oxygen sensors were used. The primary temperature, conductivity and dissolved oxygen sensors were fitted to the 9 plus with the secondary sensors mounted on the vane. A SBE 35 was mounted to a vertical stanchion of the CTD frame and programmed to average 8 samples which supplemented the CTD temperature data.

Due to requirement to use the AMT deep PH sensor the Deep Tow was used as the main deployment wire, utilising the inner insulated cores for signal and return, unlike the CTD wire with which the inner armour is used for signal return. CTD 2 was terminated as a backup however, should there have been a requirement to land the CTD within the sampling annex it would have been necessary to switch to the CTD wire. When connected to the Deep Tow it is not possible to safely move the CTD into the sampling annex, the Hydro boom was designed to deploy and recover the CTD from the sampling annex using the CTD wire.

The winch system Active Heave Compensation was used on all casts showing significant improvements in package stability and reducing spiking in wire tension. The system on the James Cook is markedly better than that on the Discovery.

There was a fouling event in cast 038, during the upcast the primary SBE43 started to drift at approximately 2000m this drift then became apparent in the primary 3P and 4C suggesting a blockage within the ducting. Upon inspection a fish was found stuck in the entrance to the ducting on the 3P, see figure 6.1. Both primary and secondary sensors were flushed with a Triton – x solution and a bleach solution followed by a thorough MilliQ rinse.

After each cast the primary and secondary sensors were flushed three times with MilliQ. Periodically the optical sensors were cleaned with MilliQ and Optic Prep wipes. The SBE 32 Latch assembly was rinsed well during extended periods out of the water, due to a sticky latch the whole assembly was taken apart and cleaned thoroughly. When rebuilding particular attention was paid to latch alignment, s/n 32-19817-0243 was used, it was noticed that the latch fit seemed a lot tighter than normal.

There were no major issues with the Stainless Steel CTD suite during the cruise with only one sensor requiring changing. Transmissometer CST-1718TR was changed after cast 3, suspected point of failure is the light sensor leaving its mounting. After cast CTD041 it was noticed that Niskin bottle 1 was leaking, point of failure found to be the handle glue joint.

Figure 6.1 Fish blocking primary SBE 3P inlet.

6.2 CTD Configuration

One CTD system was prepared with frame geometry and CTD sensor locations shown in Figure 6.2. The water sampling arrangement was a 24-way stainless steel frame system fitted with 12 off 10 ltr Ocean Test Equipment (OTE) Niskin bottles (positions 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21 and 23 with remaining positions reserved for 12 brackets for attaching SBE37's) and MDS titanium CTD swivel. Sensor information and serial numbers for all underwater components are given in Appendix A.

6.3 SBE setup and processing

The configuration file used is in Appendix B. Preliminary CTD data processing in the SeaBird Electronics software followed that on DY146.

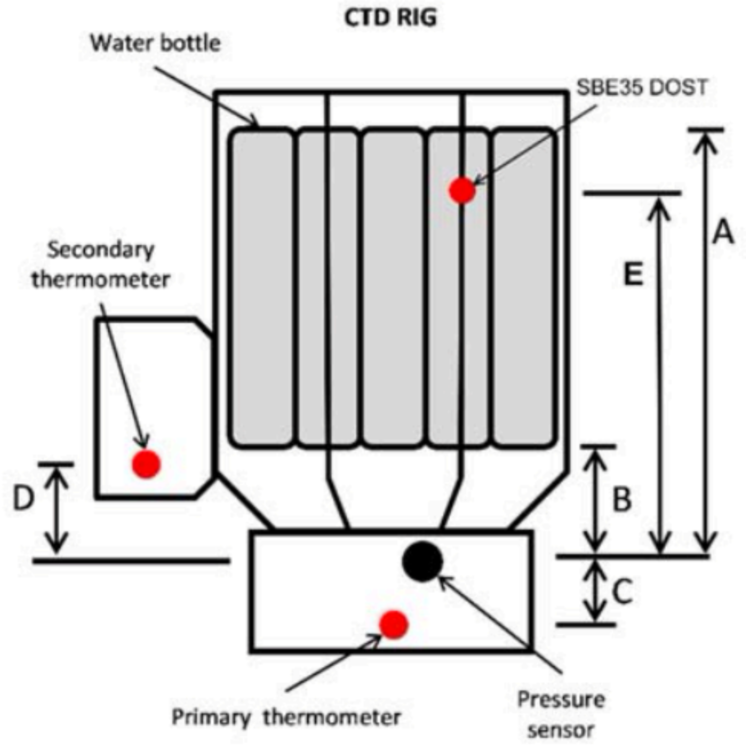


Figure 6.2: CTD system geometry. Vertical distance from pressure sensor [m]: A 1.50; B 0.10; C 0.07; D 0.07.

7 Salinometry

Tom Ballinger and Dougal Mountfied

7.1 Salinometry

A Guildline Autosal 8400B, s/n 72227, was installed in the Electronics Workshop as the main instrument for salinity analysis. The Autosal temperature set point was 24°C and the temperature of the laboratory was kept around 21-22.5°C. A spare Autosal was also installed and setup but not used during this cruise. The salinometer was standardised at the beginning of the cruise. Once standardised the Autosal was not adjusted.

7.2 Salinity sampling

Salinity samples from the CTD were collected from each of the Niskin bottles fired at each station. The procedure was to rinse the sample bottle three times with water from the Niskin with cap on, fill bottle, insert a clean plastic stopper, wipe the bottle neck and inside of cap (to avoid the formation of salt deposits) and put the bottle cap on.

Salinity samples were taken from the ship's underway system three to four times a day (nominally at 08:00, 12:00, 16:00 and 20:00) throughout the cruise, following the same protocol as above. Samples were not taken while the ship was on station due to poor data quality at those times.

7.3 Salinity Analysis

The salinometer was standardised once at the start of the cruise, then bottles of standard seawater (OSIL batch P165, K15 = 0.99986) were analysed throughout the salinometer runs to monitor instrument drift. The samples were stored in crates equilibrate to the temperature-controlled laboratory for at least 24 hours before analysis. For CTD samples, SSW was analysed at the start and end of each cast (7 to 12 bottles for each cast). For underway samples a SSW was run at the start and end of each crate (24 bottles). In total 17 CTD crates were run and three TSG crates. Thus, each crate of up to 24 salinity samples, three SSWs was used and each CTD station is tied to a start and end SSW.

8 Underway Data and Processing

8.1 Overview

A watch keeping log was filled out every 4 hours (around the clock during most of the cruise or between 0800 and 2000 ship time when on daytime-only operations) to check that a number of the underway systems were functioning as expected over the course of the day. Bottle samples from the underway system were taken every 4 hours.

Access to the RVDAS database of underway data streams, and the list of streams and variables to process, was configured at the start of the cruise (see Section 5Section 5 and DY146 cruise report). Each day, *uway_daily_proc.m* was run in Matlab to process the data from the previous day, applying preliminary quality control and appending the day's data to a file. Further processing was run on multiple days' data, as described below. Data were acquired and processed from 9 - 29 July.

8.2 Navigation

Margarita Markina

The data acquisition system was started whilst docked at Southampton during the mobilization and Covid-19 isolation. This allowed 3 days of data to be collected whilst the ship was stationary. Between the 9th July and 11th July each of the three main navigation streams (POSMVPOS, SEAPOS and CNAV) were compared with the aim of deciding the most accurate system. Mean positions were very similar for the systems: 50.8917°N, 1.3948 °W (lat±0.1236m, lon±0.2030m), for CNAV, 50.8918°N, 1.3949°W (lat±0.4103m, lon±0.3574m) for POSMVPOS, and 50.8918°N, 1.3949°W (lat±0.4584m, lon±0.3371m) for SEAPOS. CNAV was the system with the lowest standard deviation (Figure 8.1).

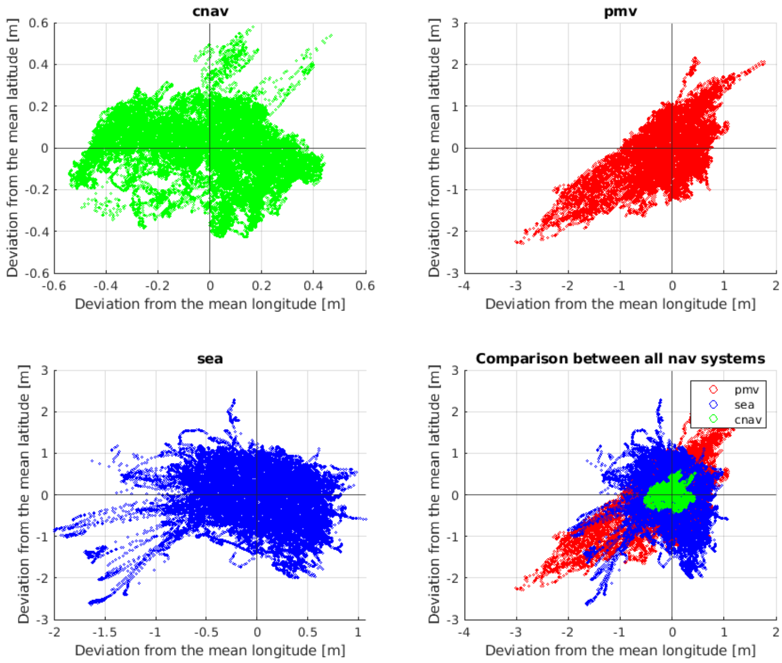


Figure 8.1: Comparison of navigation systems at RSS James Cook during dock time (9th July-11th July 2022).

8.3 Bathymetry

Margarita Markina and Yvonne Firing

Bathymetric data were collected by the EA640 single beam echosounders (10 kHz) and the EA122 multibeam echosounder (12 Khz). All echo sounders were turned off during the mooring operations, because their signal may disrupt communication with moorings releases. Climatological speed of sound profiles for the multibeam were updated regularly, while the singlebeam data was corrected in post-processing using the Carter tables.

The bathymetry along the cruise track based on preliminary data processing is shown on Figure 8.2. The raw bathymetry data are saved in ~/jc238/mcruise/data/bathy. The raw bathymetry data had a large number of spikes, especially in the singlebeam, which had a tendency to a comb pattern that would lead to averages being biased deep. A new script, *mbathy_edit_av.m*, developed at the end of the cruise allowed for manual editing of data from both streams, with several runs through improving the agreement in the 10-minute averaged data (Figure 8.3, top panel), although clearly outliers still remain, and there are two periods when the two echosounders are offset by several metres, either due to the imprecision in the Carter table correction for speed of sound applied to the singlebeam data or to inaccuracy of the multibeam speed of sound profiles.

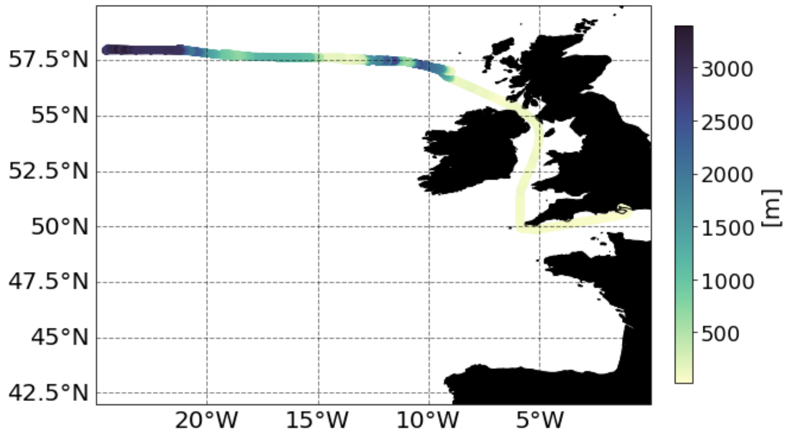


Figure 8.2. Bathymetry along the cruise track from the single beam echosounder data.

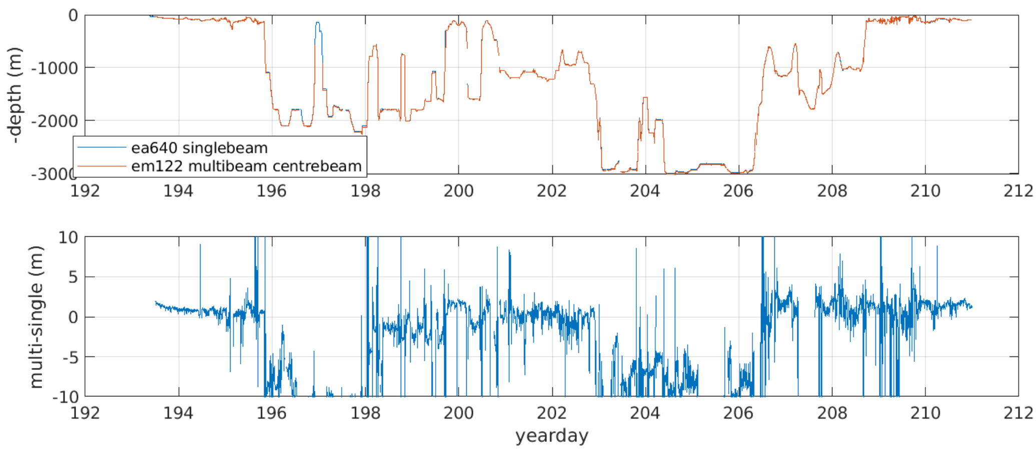


Figure 8.3. Comparison between bathymetric data from single beam and multi beam echosounders.

8.4 Meteorology and SURFMET calibrations

Yvonne Firing

Factory calibration coefficients for fluorometer, transmissometer, PAR and TIR were applied to these data by entering them in *opt_jc238.m* before running *uway_daily_proc.m*. PAR (Figure 8.4) and TIR (not shown) are measured by both port and starboard sensors; the difference between the readings suggests a remaining calibration likely including a scale factor requiring further investigation.

Within *uway_daily_proc.m*, *mwind_true.m* combines wind speed and direction data with navigation data (Section 8.2) to produce true wind. Figure 8.5 shows the time series of eastward and northward components of true wind along with atmospheric temperature, pressure, and humidity. Wind speed and direction was also measured by a sonic anemometer, and the (ship-relative) values are compared to those from the Surfmet system in Figure 8.6.

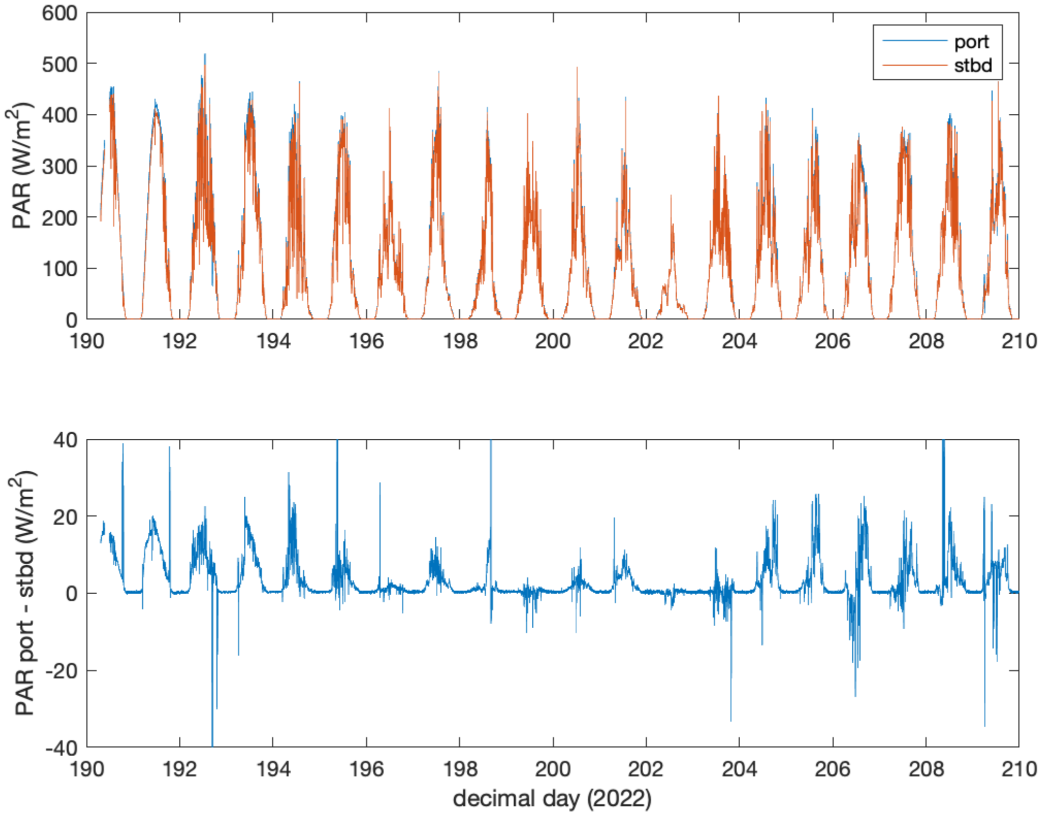


Figure 8.4. Photosynthetically active radiation (PAR) from port and starboard sensors, and difference between them.

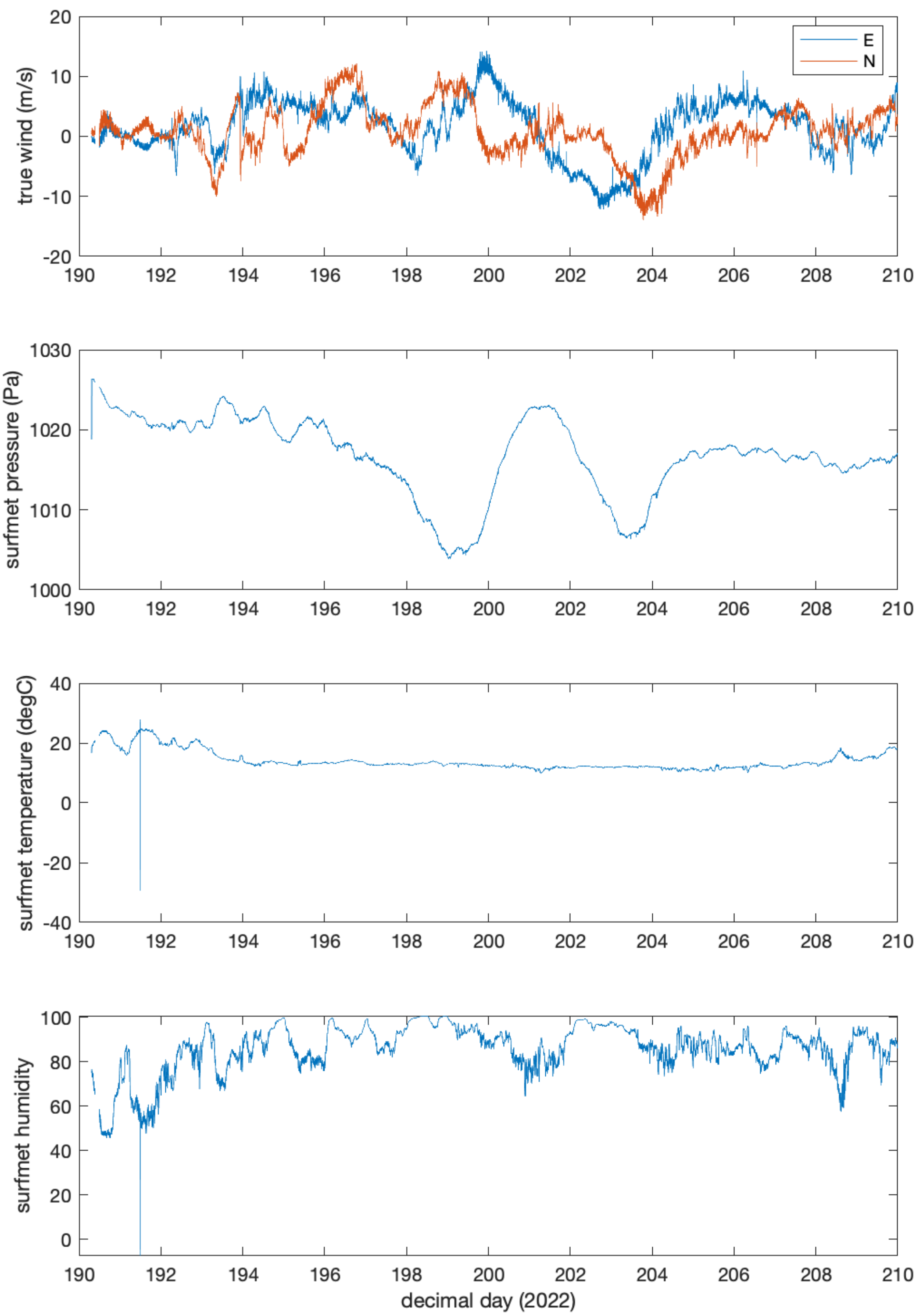


Figure 8.5. Time series of wind vector components (relative wind vectors – ship velocity, averaged to 1 minute), with raw air pressure, temperature, and humidity.

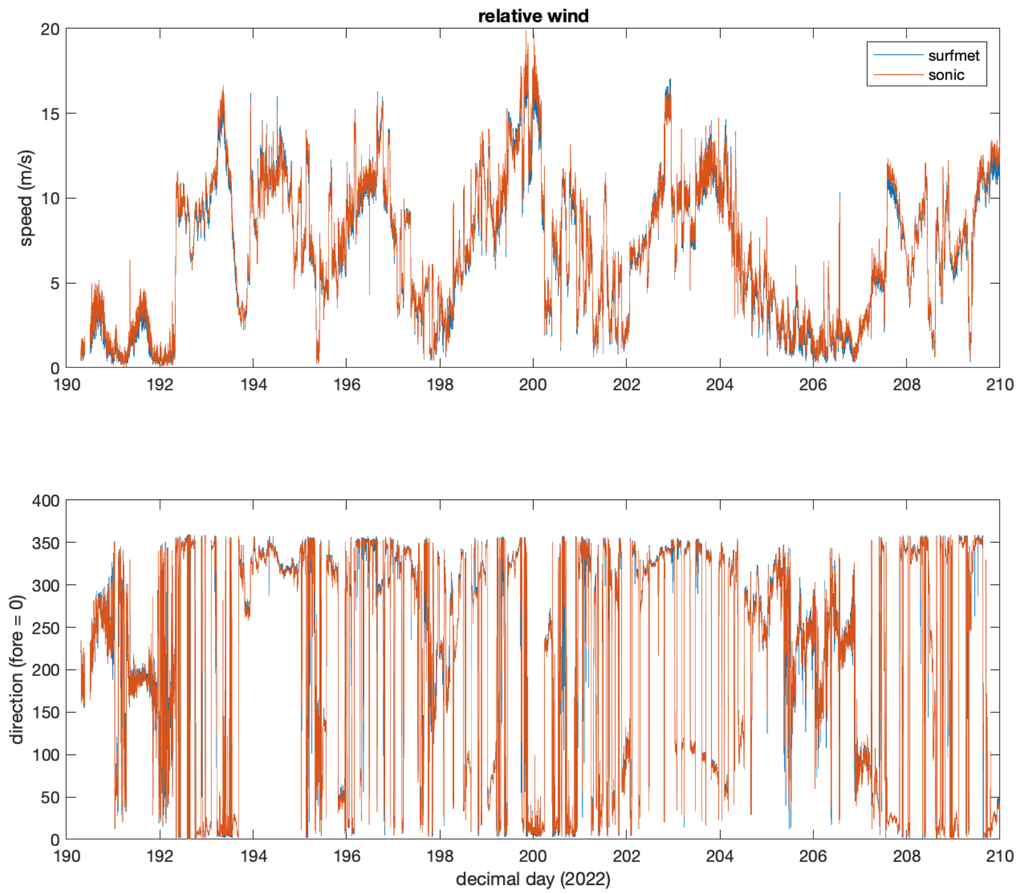


Figure 8.6. Comparison of surfmet and sonic anemometer wind measurements (both transformed to vectors for averaging then converted back to speed and direction).

8.5 TSG processing and salinity calibration to water samples

Phoebe Hudson

Over the expedition, 109 bottle samples were collected for TSG calibration. Water samples were taken every 4 hours during the day (approximately 0800, 1200, 1600 and 2000 UTC) over yeardays 193-208. For the portion of the cruise where the night watch was active (days 196-204), samples were also taken overnight at 0000 and 0400 UTC. After collection, samples were left in the temperature controlled electronics workshop for a minimum of 24 hours before analysis (Section 7). The conductivity (and salinity) of bottles was measured using the same Autosal as the CTD samples and compiled with the times and dates of samples, then read in using *msal_01.m* and saved in tsgsal_jc238_all.nc.

Script *mtsg_bottle_compare.m* was used to compare the salinity calculated from the bottles to the salinity from the TSG samples (Figure 8.7). Residuals were calculated and plotted against yearday, TSG housing temperature and sea surface salinity.

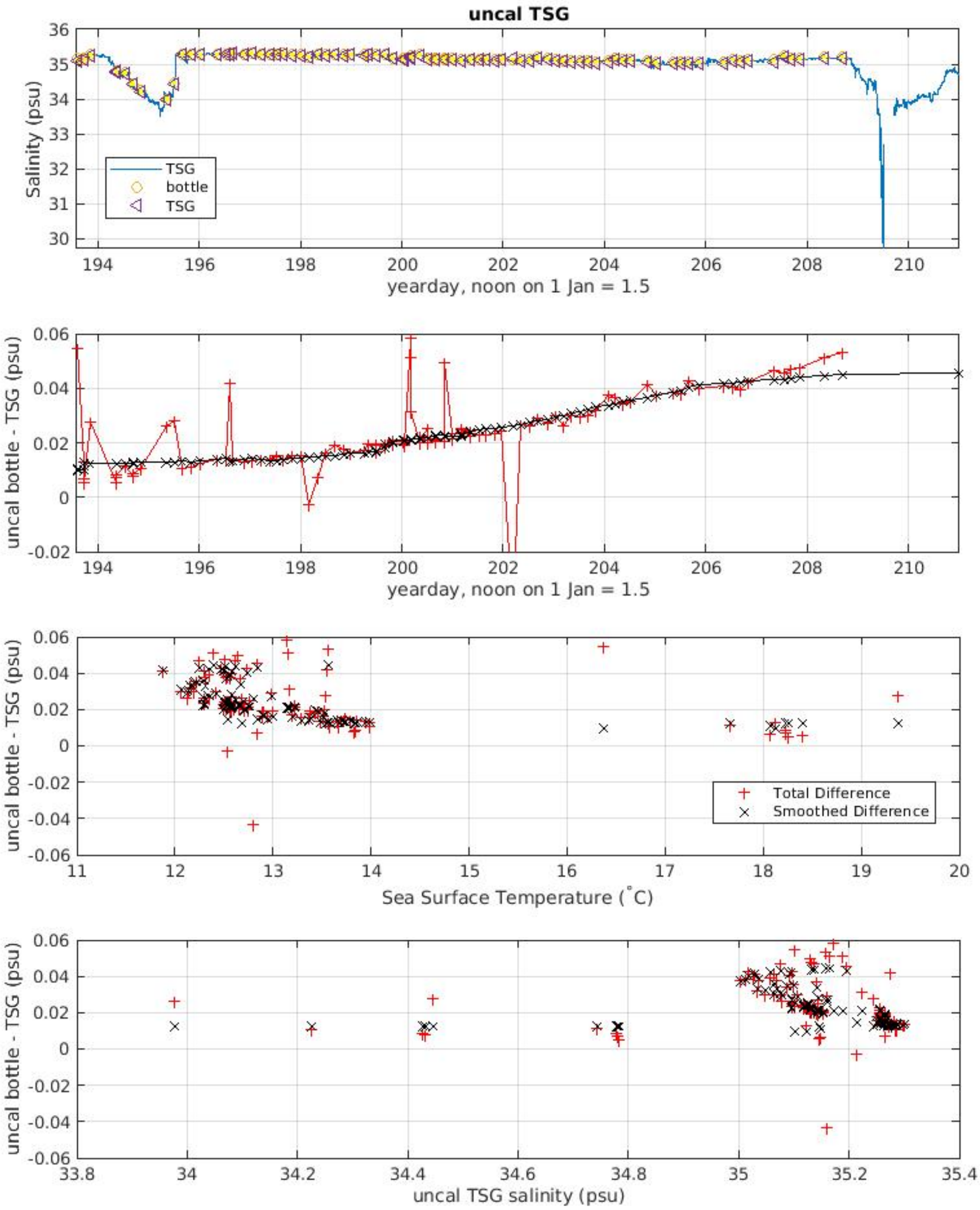


Figure 8.7 TSG and bottle salinity (top), salinity residual against time (upper middle), salinity residual against salinity (lower middle), and salinity residual against temperature (bottom).

A dramatic drop in flow rate was observed in the surfmet data on day 208 and lasted around 5 hours before the flow rate returned to normal. Temperature and salinity data during this period of low flow rate was removed. A considerable drop in TSG salinity was observed just prior to this time period. This drop in flow rate happened to occur on a day where an abundance of jellyfish were observed around the ship. It is hypothesized that this jellyfish bloom could have clogged the intake pipe, altering salinities whilst jellyfish were in the intake pipe before temporarily stopping the flow.

An option was added to *mtsg_bottle_compare.m* (comp2ctd=True), such that TSG data was also compared to near-surface CTD measurements (<10m). Similar residual comparison plots were generated for TSG and CTD salinities against yearday, sea surface temperature and salinity (Figure 8.8).

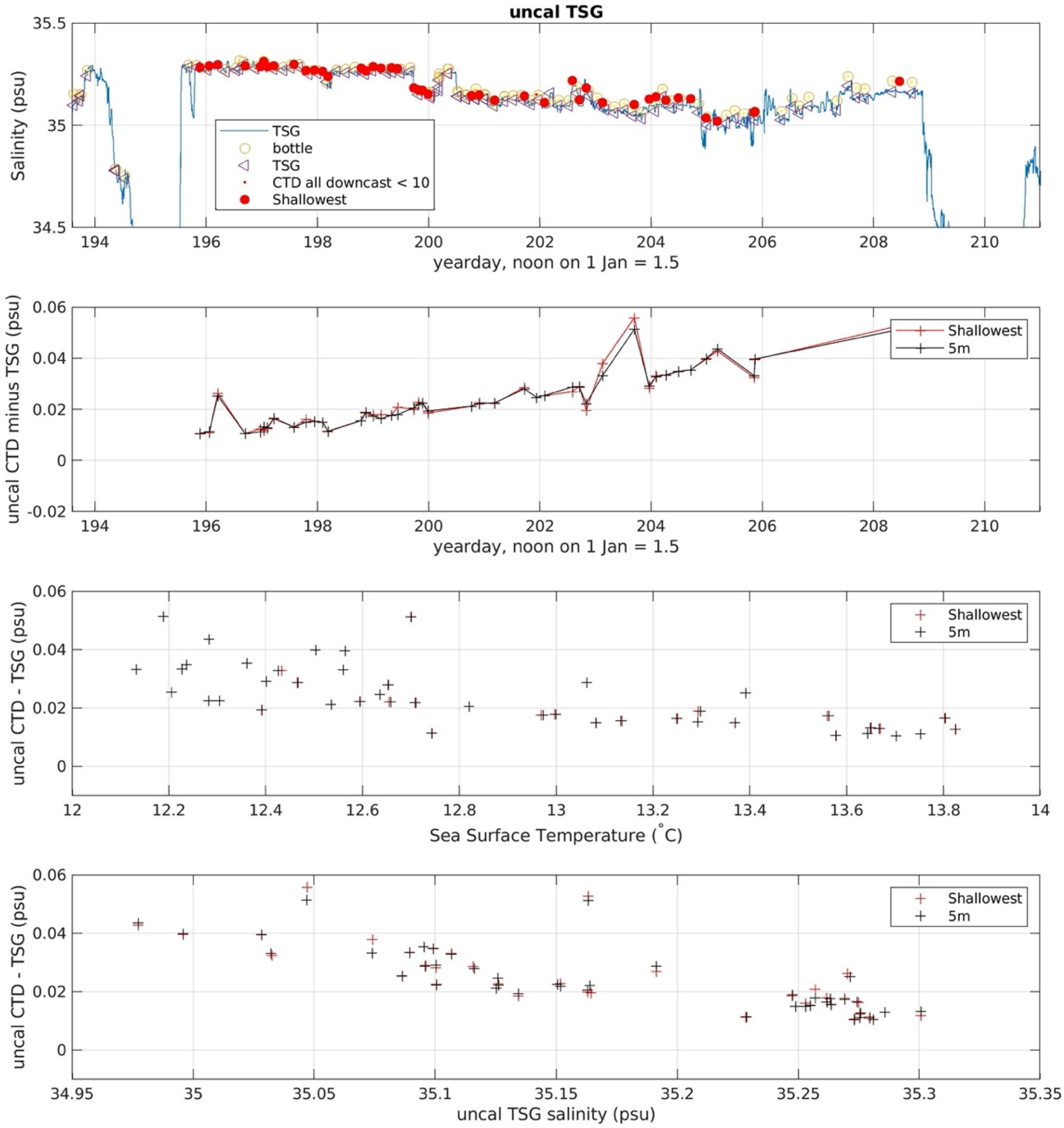


Fig. 8.8: TSG salinity and CTD salinity (top), salinity residual against time (upper middle), salinity residual against temperature (lower middle), and salinity residual against salinity (bottom).

A non-constant offset was found between bottles and TSG salinities, with larger differences over the course of the cruise. A similar variable offset was found between TSG and CTD salinity as between TSG and bottle salinities. The smoothed time-dependent difference of these offsets was used to calibrate TSG data. This correction appeared to correct for most of the residual well except for the end of the timeseries, where there were too few points after the gap to determine if this calibration was appropriate.

9 Vessel mounted Acoustic Doppler Current Profiler (vmADCP)

Yvonne Firing

The James Cook features two RDI OceanSurveyor vmADCPs mounted on the port dropkeel and operating at 75 kHz and 150 kHz respectively. Both were configured to ping in narrowband mode. The quality of the data return was generally good, with ranges of 400 m (for the os150) to 800 m (for the os75) as expected and not much manual editing required; there was only a short stretch when the ship heading into the seas degraded the returns from all acoustic instruments (presumably due to bubbles). Bottom tracking data was acquired during the first and last parts of the cruise on the transits through the Channel and the Irish Sea to and from the work site, resulting in about 740 bottom tracking points for calibration, while 80 (for the os75) to 90 (for the os150) watertrack points were obtained from the various CTD and mooring maneuvers. Unfortunately (due to a reconfiguration when not all instruments were available immediately following refit), the ADCP was configured to use the posmv as the primary heading device and seapath as the secondary, which is not desirable first because the gyro is a better primary device, and second because the posmv heading was about 4 degrees off for most of the cruise (until it was recalibrated following the end of the OSNAP section). Because both issues were noticed well into the cruise, the decision was not to change anything but to reprocess the data once the cruise was complete and a general view could be taken of the quality of the different navigation and heading streams and the best approach to take. In addition, on decimal day 208 when on passage back to port, the UHDAS acquisition computer hung around 10 pm local time, which was noticed the following morning when it was, with some difficulty, restarted. Data acquisition was initially restarted in the same "cruise" but later was restarted under JC238_part2.

Recommendations: checking the configuration of the instruments as well as the quality of the navigation streams themselves (i.e. plotting different sources of position and heading against each other) should be done as early in the cruise as possible. One hypothesis about what happened to the UHDAS computer, given that its web browser was being used to check the status of other underway data streams, is that it hung because someone tried to use the Grafana system, which apparently has a tendency to do this; possibly a sign could be made recommending that the UHDAS computer is only used for UHDAS.

9.1 Post-cruise processing

After the cruise, with help from Jules Hummon (UH Currents Group), position, heading, and ADCP data were examined, bad data excluded, and the data from the two segments combined and reprocessed using posmv for position and gyro + seapath for heading. The steps involved are summarised here:

Step 1: get info on legs

```
$ cd ~/jc238/mcruise/data/vmadcp/
$ conda activate pycodas
$ uhdas_info.py --overview atsea/JC238
```

```
===========================================================
======= start of report for atsea/JC238 =====
===========================================================

------raw-------

raw:            cnavgps    203 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
raw:               gyro    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
raw:              posmv    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
raw:            seapath    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)

adcp:  os150           .raw    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
adcp:  os150       .raw.log    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
adcp:  os150   .raw.log.bin    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
adcp:   os75           .raw    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
adcp:   os75       .raw.log    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
adcp:   os75   .raw.log.bin    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)

-----rbin-------

rbin:              cnavgps:gps    203 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin:                 gyro:hdg    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin:                posmv:gps    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin:                posmv:hdg    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin:                posmv:pmv    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin:              seapath:gps    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin:              seapath:sea    204 files  (ukjc2022_192_52385 - ukjc2022_209_50400)
rbin: ERROR         cnavgps:gps missing: ukjc2022_202_14400

-----gbin-------

gbin:      os150 (cnavgps,gyro,posmv,seapath,time)
gbin:       os75 (cnavgps,gyro,posmv,seapath,time)

------ database time ranges --------

proc:    os150nb       192.607 - 208.868 (2022/07/12 to 2022/07/28)
proc:     os75nb       192.607 - 209.639 (2022/07/12 to 2022/07/29)

...BUT these were found:
   settings.png
---------- end of report for atsea/JC238 -------------
```

 # new issue spotted: cnav is one raw and one rbin file short, on day 202

$ cd atsea/JC238/raw

$ ls -l cnavgps/ukjc2022_202*

```
  921600 Jul 21 15:59 cnavgps/ukjc2022_202_00000.gps  normal length file
  402816 Jul 21 16:52 cnavgps/ukjc2022_202_07200.gps  too early (:52)
                                      202_14400.gps  missing
  460526 Jul 21 21:59 cnavgps/ukjc2022_202_21600.gps  (starts with commas)
  586763 Jul 21 23:59 cnavgps/ukjc2022_202_28800.gps  missing 1-2 messages at a time
  587776 Jul 22 01:59 cnavgps/ukjc2022_202_36000.gps
  643456 Jul 22 03:59 cnavgps/ukjc2022_202_43200.gps
  658048 Jul 22 05:59 cnavgps/ukjc2022_202_50400.gps
  600832 Jul 22 07:59 cnavgps/ukjc2022_202_57600.gps
  629376 Jul 22 09:59 cnavgps/ukjc2022_202_64800.gps
  603264 Jul 22 11:59 cnavgps/ukjc2022_202_72000.gps
  649728 Jul 22 11:59 cnavgps/ukjc2022_202_79200.gps
```

 # check the files after the gap

$ head cnavgps/ukjc2022_202_21600.gps

 # starts with empty messages (just commas), why it's smaller

$ ls -l cnavgps/ukjc2022*

 # takes until day 206 to get back to normal size files

$ cd ../../..
$ uhdas_info.py --overview atsea/JC238_part2

```
=================================================================
======= start of report for atsea/JC238_part2 =====
=================================================================

------raw-------

raw:           cnavgps     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
raw:              gyro     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
raw:             posmv     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
raw:           seapath     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)

adcp:  os150           .raw    21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
adcp:  os150       .raw.log    21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
adcp:  os150   .raw.log.bin    21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
adcp:   os75           .raw    21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
adcp:   os75       .raw.log    21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
adcp:   os75   .raw.log.bin    21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)

-----rbin-------

rbin:             cnavgps:gps     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
rbin:                gyro:hdg     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
rbin:               posmv:gps     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
rbin:               posmv:hdg     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
rbin:               posmv:pmv     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
rbin:             seapath:gps     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)
rbin:             seapath:sea     21 files  (ukjc2022_209_55549 - ukjc2022_211_21600)

-----gbin-------

gbin:      os150 (cnavgps,gyro,posmv,seapath,time)
gbin:       os75 (cnavgps,gyro,posmv,seapath,time)

------ database time ranges --------

proc:    os150nb       209.646 - 211.292 (2022/07/29 to 2022/07/31)
proc:     os75nb       209.646 - 211.292 (2022/07/29 to 2022/07/31)
---------- end of report for atsea/JC238_part2 -------------
```

 # no problems in part2 at this level

Step 2: merge legs
$ mkdir -p spprocessing/JC238_merged
$ link_uhdaslegs.py atsea/JC238 spprocessing/JC238_merged
$ link_uhdaslegs.py atsea/JC238_part2 spprocessing/JC238_merged

Step 3: inspect data
$ cd spprocessing

 # cnav position
$ ggatime_diagnostics.py --zoomname auto JC238_merged/rbin/cnavgps/*.gps.rbin
 # a number of timestamps off by up to 1.2 s early on, then gap on day 202 (which we knew from above), after which there are a bunch of gaps of 2 or 3 s between message times (from the "blank" messages above?) through day 205, then on day 208-209 when the computer crashed time goes to 0 in the rbins file.

 # posmv position

$ ggatime_diagnostics.py --zoomname auto JC238_merged/rbin/posmv/*.gps.rbin
 # this one has no zeros but does have gaps (up to 10 s) and late messages on days 193-196, so it may be necessary to reprocess with uvship (to calculate speed for each ping then average, rather than assuming constant ensemble-length divisor).

 # seapath position
$ ggatime_diagnostics.py --zoomname auto JC238_merged/rbin/seapath/*.gps.rbin
 # lots of runs of up to 20 s gaps all through until day 210, and about 1.5% "free inertial" that is dead reckoning from last position fix based on imu -- this is way too much, there should be almost none of this

 # posmv heading
$ plot_posmv.py --cutoff 0.022 JC238_merged/rbin/posmv/*pmv.rbin
 # can see it starts working better after recalibration, though 0.033 cutoff (from config proc file) is still too high

 # check quality and agreement of posmv and seapath
$ plot_rbins.py --markersize 4 --ser1 seapath:sea --ser2 posmv:pmv JC238_merged
 # select heading, head_qual, heading, acc_heading (heading accuracy error): seapath head_qual is 0 (good). acc_heading is a little wobbly with some spikes including a big one on day 206, improving after this, so maybe this was the recalibration?
$ plot_rbins.py --markersize 4 --ser1 seapath:gps --ser2 posmv:gps JC238_merged
 # select lon, lat, quality: other than some spikes (largest on day 201 and 203), dy is mostly up to about 1 m but dx up to 2-3 m. if we wanted to replace some files from one source with files from another we'd want them to be within 1 m. in any case, when posmv is pretty good (part2) so is seapath; earlier they're both gappy/noisy. given the problems with cnav position too, posmv position all the way through is the best we're going to do.

Step 4: deal with computer freeze

 # find affected files (using od, octaldump, to see the special characters too)
$ cd JC238_merged/raw
$ tail -1 ./cnavgps/ukjc2022_208_72000.gps | od -c

```
0000000   $   G   N   G   G   A   ,   2   0   5   4   5   5   .   0   0
0000020   ,   5   5   2   6   .   7   8   2   7   5   9   ,   N   ,   0
0000040   0   5   5   2   .   5   2   1   3   7   0   ,   W   ,   2   ,
0000060   1   9   ,   0   .   7   ,   8   9   .   5   0   5   ,   M   ,
0000100   0   .   0   ,   M   ,   5   .   0   ,   0   5   2   5   *   4
0000120   5  \r  \n
0000123
```

$ tail -1 ./posmv/ukjc2022_208_72000.pmv | od -c

```
0000000   $   P   Y   R   T   M   ,   2   0   2   2
0000013
```

$ tail -1 ./gyro/ukjc2022_208_72000.hdg | od -c

```
0000000  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0
*
0003020  \0  \0  \0  \0  \0  \0  \0  \0
0003030
```

$ tail -1 ./seapath/ukjc2022_208_72000.sea | od -c

```
0000000   $   P   Y   R   T   M   ,   2   0   2   2   ,
0000014
```

$ tail -1 ./os75/ukjc2022_208_72000.raw.log | od -c

```
0000000  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0
*
0000260  \0  \0  \0  \0  \0  \0  \0  \0  \0  \0
0000272
```

 # for 3 problem nav files:

 # remove symlinks and actually copy these files here to merged

$ rm posmv/ukjc2022_208_72000.pmv
$ rm gyro/ukjc2022_208_72000.hdg
$ rm seapath/ukjc2022_208_72000.sea
$ cp -p ../../../atsea/JC238/raw/posmv/ukjc2022_208_72000.pmv posmv/
$ cp -p ../../../atsea/JC238/raw/gyro/ukjc2022_208_72000.hdg gyro/
$ cp -p ../../../atsea/JC238/raw/seapath/ukjc2022_208_72000.sea seapath/

 # Now edit these files (delete last line from each) so they end on \r \n

 # remove rbins links too so they can be remade after (necessary?)

$ rm ../rbin/posmv/ukjc2022_208_72000.pmv.rbin
$ rm ../rbin/gyro/ukjc2022_208_72000.hdg.rbin
$ rm ../rbin/seapath/ukjc2022_208_72000.sea.rbin

 # remake rbins

$ asc2bin.py -y 2022 -m pmv -o ../rbin/posmv ./posmv/ukjc2022_208_72000.pmv

```
INFO:asc2bin:./posmv/ukjc2022_208_72000.pmv
INFO:asc2bin:Ngood = 3285   Nbad = 0
Elapsed cpu time:   0.0 s
```

$ asc2bin.py -y 2022 -m hdg -o ../rbin/gyro ./gyro/ukjc2022_208_72000.hdg

```
INFO:asc2bin:./gyro/ukjc2022_208_72000.hdg
INFO:asc2bin:Ngood = 3286   Nbad = 0
Elapsed cpu time:   0.0 s
```

$ asc2bin.py -y 2022 -m sea -o ../rbin/seapath ./seapath/ukjc2022_208_72000.sea

```
INFO:asc2bin:./seapath/ukjc2022_208_72000.sea
INFO:asc2bin:Ngood = 3295   Nbad = 0
Elapsed cpu time:   0.0 s
```

#for os75:

#reduce the number of pings in problem .raw file (cut out last line)

$ cd os75
$ wc ukjc2022_208_72000.raw.log

```
  813  5691 49718 ukjc2022_208_72000.raw.log
```

$ mv ukjc2022_208_72000.raw ../../ukjc2022_208_72000.raw.orig
$ cut_raw_adcp.py os ../../ukjc2022_208_72000.raw.orig 0 812 ukjc2022_208_72000.raw

```
Extracting ping range 0 to 812
```

#edit out corresponding bad lines from .raw.log file

$ mv ukjc2022_208_72000.raw.log ../../ukjc2022_208_72000.raw.log.orig

$ head -812 ../../ukjc2022_208_72000.raw.log.orig > ukjc2022_208_72000.raw.log

#remake the .raw.log.bin file

$ rm -f ukjc2022_208_72000.raw.log.bin

$ make_rawlogbin.py ukjc2022_208_72000.raw.log

```
ukjc2022_208_72000.raw.log
wrote ukjc2022_208_72000.raw.log.bin
```

Step 5: reprocess, using posmv positions and seapath heading

$ cd ../..

$ mkdir -p proc/config

#set up config file by copying from existing (don't use uhdas_proc_gen.py because os75 changed relatively recently so that angle might be out of date)

$ cd proc/config

$ cp ../../../../atsea/JC238/proc/os75nb/config/JC238_proc.py ./

#Now edit JC238_proc.py: pos_inst = "posmv" (important!)

#make directory structure

$ cd ..

$ adcptree.py os75nb --datatype uhdas --cruisename JC238

```
found adcp templates at  /local/users/pstar/bin/miniconda3/envs/pycodas/lib/python3.9/site-packages/pycurrents-0.0.0-py3.9-linux-x86_64.
egg/pycurrents/adcp/templates
otherdemo is /local/users/pstar/bin/miniconda3/envs/pycodas/lib/python3.9/site-packages/pycurrents-0.0.0-py3.9-linux-x86_64.egg/pycurren
ts/adcp/templates/uhdas_template


** data type is uhdas
- copying additional files for data type uhdas

- config files for raw processing are in os75nb/config
copying config files using this wildcard expansion: config/JC238*
```

$ adcptree.py os150nb --datatype uhdas --cruisename JC238

#similar output (not shown)

#set up and run processing for os150

$ cd os150nb

#Now create q_py.cnt, it should look like:

```
--yearbase          2022
--cruisename        JC238 # used to identify configuration files
                          # *must* match prefix of files in config dir
--update_gbin
--configtype        python
--sonar             os150nb
--dbname            a_ukjc
--datatype          uhdas
--ens_len           300
--ping_headcorr          # applies heading correction if there is a heading
                         # correction device specified in config/{cruisename}_proc.py
--max_search_depth 1000 # if the topography says the ocean is deeper than this,
                         # do not autodetect the bottom (reduces false positives)
```

#run

$ quick_adcp.py --cntfile q_py.cnt --auto

#lots of output (not shown)

#same steps in os75 directory, with q_py.cnt like:

```
--yearbase          2022
--cruisename        JC238 # used to identify configuration files
                          # *must* match prefix of files in config dir
--update_gbin
--configtype        python
--sonar             os75nb
--dbname            a_ukjc
--datatype          uhdas
--ens_len           300
--ping_headcorr          # applies heading correction if there is a heading
                         # correction device specified in config/{cruisename}_proc.py
--max_search_depth 2000 # if the topography says the ocean is deeper than this,
                         # do not autodetect the bottom (reduces false positives)
(pycodas) %[pstar@koaekea os75nb]$ quick_adcp.py --cntfile q_py.cnt --auto
```

Step 6: inspect to figure out transducer offsets, and apply them

$ cd ../os150nb
$ catwt.py

```
getting watertrack from cal/watertrk/adcpcal.out
   **watertrack**
-----------
Number of edited points:  97 out of 102
             median     mean      std
amplitude   1.0060   1.0060   0.0102
phase       0.0020   0.0486   0.5554
-----------
```

$ catxy.py

```
getting transducer-gps offset from cal/watertrk/guess_xducerxy.out
**transducer-gps offset**
-----------
guessing ADCP (dx=starboard, dy=fwd) meters from GPS
positions from a_ukjc.gps
calculation done at 2022/09/20 12:23:47
xducer_dx = -1.867077
xducer_dy = 5.791309
signal = 1708.356559
-----------
```

$ quick_adcp.py --steps2rerun rotate:apply_edit:navsteps:calib --rotate_amplitude 1.006 --xducer_dx -2 --xducer_dy 6 --auto
$ cd ../os75nb
$ catwt.py

```
getting watertrack from cal/watertrk/adcpcal.out
   **watertrack**
-----------
Number of edited points:  81 out of  89
             median     mean      std
amplitude   1.0080   1.0086   0.0102
phase      -0.0490   0.0172   0.5046
-----------
```

$ catxy.py

```
getting transducer-gps offset from cal/watertrk/guess_xducerxy.out
**transducer-gps offset**
-----------
guessing ADCP (dx=starboard, dy=fwd) meters from GPS
positions from a_ukjc.gps
calculation done at 2022/10/21 13:01:07
xducer_dx = -1.279184
xducer_dy = 6.533261
signal = 1709.388402
-----------
```

$ quick_adcp.py --steps2rerun rotate:apply_edit:navsteps:calib --rotate_amplitude 1.008 --xducer_dx -1 --xducer_dy 6 --auto

Step 7: uvship
$ cd ..
$ plot_reflayer.py --plotfp --zrange 40:300 os150nb os75nb

$ rsync -a os75nb/ os75nb.uvship
$ cd os75nb.uvship
$ quick_adcp.py --steps2rerun navsteps:calib --refuv_source uvship --auto
$ cd ..
$ dataviewer.py -c os75nb os75nb.uvship
#this definitely cleaned up some contaminated profiles when coming on/off station with low percent good, e.g. around 196.55
$ rsync -a os150nb/ os150nb.uvship
$ cd os150nb.uvship
$ quick_adcp.py --steps2rerun navsteps:calib --refuv_source uvship --auto

Step 8: edit, check angle/amplitude, compare, iterate if necessary
$ cd os150nb.uvship
$ dataviewer.py -e
#Now edit: some profiles with low pg, some expansion of autoedited blobs based on err vel, some shallowest bin forward when underway (but neither ringing nor shallow low low pg thresholds were triggered), a couple of scattering layers
$ quick_adcp.py --steps2rerun apply_edit:navsteps:calib --auto
$ catwt.py

```
Number of edited points:  97 out of 103
              median     mean      std
amplitude   1.0000   1.0000   0.0103
phase       0.0050   0.0499   0.5453
```

$ quick_adcp.py --steps2rerun apply_edit:rotate:navsteps:calib --rotate_angle 0.02 --auto
$ catwt.py

```
Number of edited points:  95 out of 103
              median     mean      std
amplitude   1.0000   1.0004   0.0099
phase      -0.0180   0.0225   0.5424
```

$ cd ../os75nb.uvship

$ dataviewer.py -e

#Now <u>edit</u>: some seabed selector, and err vel threshold of 70 mm/s as well as some manual editing of low-amplitude profiles and expansion of autoedited blobs

$ quick_adcp.py --steps2rerun apply_edit:navsteps:calib --auto
$ catwt.py

```
Number of edited points:  86 out of  92
              median     mean      std
amplitude    1.0010   1.0007   0.0099
phase       -0.0490  -0.0167   0.5058
```

$ quick_adcp.py --steps2rerun apply_edit:rotate:navsteps:calib --rotate_angle -0.03 --rotate_amplitude 1.001 --auto
$ catwt.py

```
Number of edited points:  86 out of  92
              median     mean      std
amplitude    1.0000   0.9997   0.0099
phase       -0.0215   0.0131   0.5057
```

$ cd ..
$ dataviewer.py -c os75nb.uvship os150nb.uvship

 # More edits, iterating with quick_adcp.py with apply_edit until satisfied

Step 9: regenerate .nc files, and extract station averages
$ cd os150nb.uvship
$ adcp_nc.py adcpdb contour/os150nb_merged_uvship JC238 os150nb
$ cp contour/os150nb_merged_uvship.nc ../../../../../collected_files/
$ cd ../os75nb.uvship/
$ adcp_nc.py adcpdb contour/os75nb_merged_uvship JC238 os75nb
$ cp contour/os75nb_merged_uvship.nc ../../../../../collected_files/
$ matlab
% edit codas_to_mstar case in opt_jc238.m to look for these files rather than the default
>> for stn = 1:44; mvad_station_av(stn,'os75nb','ctd'); end

 # files produced by the last step could be used to constrain LADCP, but that processing has not been rerun at this point

10 CTD Processing and Calibration

Yvonne Firing and Marilena Oltmanns

10.1 CTD Data Processing

CTD data processing followed the same procedure as on DY146 and other cruises using Mexec, with conversion to ascii and application of alignment (oxygen tau) and cell thermal mass corrections carried out by the CTD operator on the acquisition computer. Subsequent steps, including application of oxygen hysteresis correction and (once determined) calibration functions for temperature, conductivity, and oxygen sensors, editing of bad ranges or spikes from the 24 hz data, extracting the CTD data from Niskin bottle firing times, averaging to 1 hz and computing salinity from conductivity, separating down and up casts and averaging to

2 dbar, were carried out by watchstanders running scripts on workstation koaekea after data were synced via the network drive.

Appendix C lists the CTD station times, locations, depths, and number of Niskins fired and from which samples of each type were drawn (that is, replicates are not counted in the totals here, but are indicated in Figure 10.1 as well as in Section 11). On most stations at least a few spikes were removed from the conductivity data by hand (using *mctd_rawedit.m*), while on station 19 a median despiker was run (after this cast both CTDs were cleaned). On station 3 the transmittance went bad very early in the cast and so was blanked out for the whole cast, and switched for another sensor afterwards. On station 38 around 2000 m on the upcast a small fish was caught in the CTD1 intake.

We chose CTD2, situated on the rosette vane and therefore noticeably less affected by package wake, as the primary sensor. For the 1 hz (psal) file used for microcat caldip comparison and for LADCP processing, gaps of up to 2 points were filled after averaging. For gridding 24 hz data to 2 dbar no gap filling was done but we used a method of fitting a line to all the points in the depth bin then using the midpoint value of the fit; this helps weight the depth range evenly even if the sensor spent more time at one end (e.g. due to a bottle stop). Processing and calibration choices and parameters are recorded in *opt_jc238.m* and the *setdef_cropt_cast.m* and *setdef_cropt_sam.m* scripts in the jc238 branch of the ocp_hydro_matlab git repository (see Section 5); calibration is described below.

10.2 Water samples for calibration and evaluation of Niskin quality

Water samples for calibration of CTD conductivity were drawn in 200 ml glass bottles, rinsing three times before filling to the shoulder, drying the bottle neck and throat before stoppering with new plastic stoppers and covering with clean, dry lids. A single salinity sample was drawn from every Niskin sampled. A total of 432 Niskins were fired and 401 salinity samples (Figure 10.1a) from the CTD were analysed (a few Niskins were fired on microcat calibration dip bottle stops even if no samples were drawn). Salinometer analysis is described in Section 7.

Niskins were checked before sampling by pushing in the outlet before opening the vent (the vauccum should then keep water from escaping, if the bottle is properly sealed), though this procedure was not followed for all casts throughout the cruise. Niskins observed or suspected to be leaking were flagged, with sampling skipped if the leak was obvious. Inspection of bottle salinity, oxygen, and oxygen draw temperature later (using *checkbottles_01.m* and *checkbottles_02.m* as well as *mctd_evaluate_sensors.m*) allowed additional problem Niskins to be detected. The rate of misfires and leaks was very low.

The *checkbottles_** and *mctd_evaluate_sensors* scripts are also useful for detecting and flagging bad bottle samples, and distinguishing those which deviate from the CTD profile because of strong gradients from those which are true outliers; the latter were only flagged temporarily in *mctd_evaluate_sensors.m* in order to remove them from the comparison and testing of calibration functions, but were not flagged as bad in the data files (as they represent valid analyses of water from the stated depth). Scattered oxygen samples were identified as fliers (Fig. 10.1), while stations 7 and 10-13 were flagged as questionable due to their offsets from the CTD being unusually low while all others (pre-calibration) were high. These stations were analysed on one day but it was not clear if there was a potential error to standards or blank values that might have produced the offset. Bottle oxygen values were also compared with the (fairly sparse) GLODAP (Lauvset et al., 2021, doi: doi:10.5194/essd-2021-234) data available in this area, and found to be within the envelope of the historical, secondary quality-controlled data.

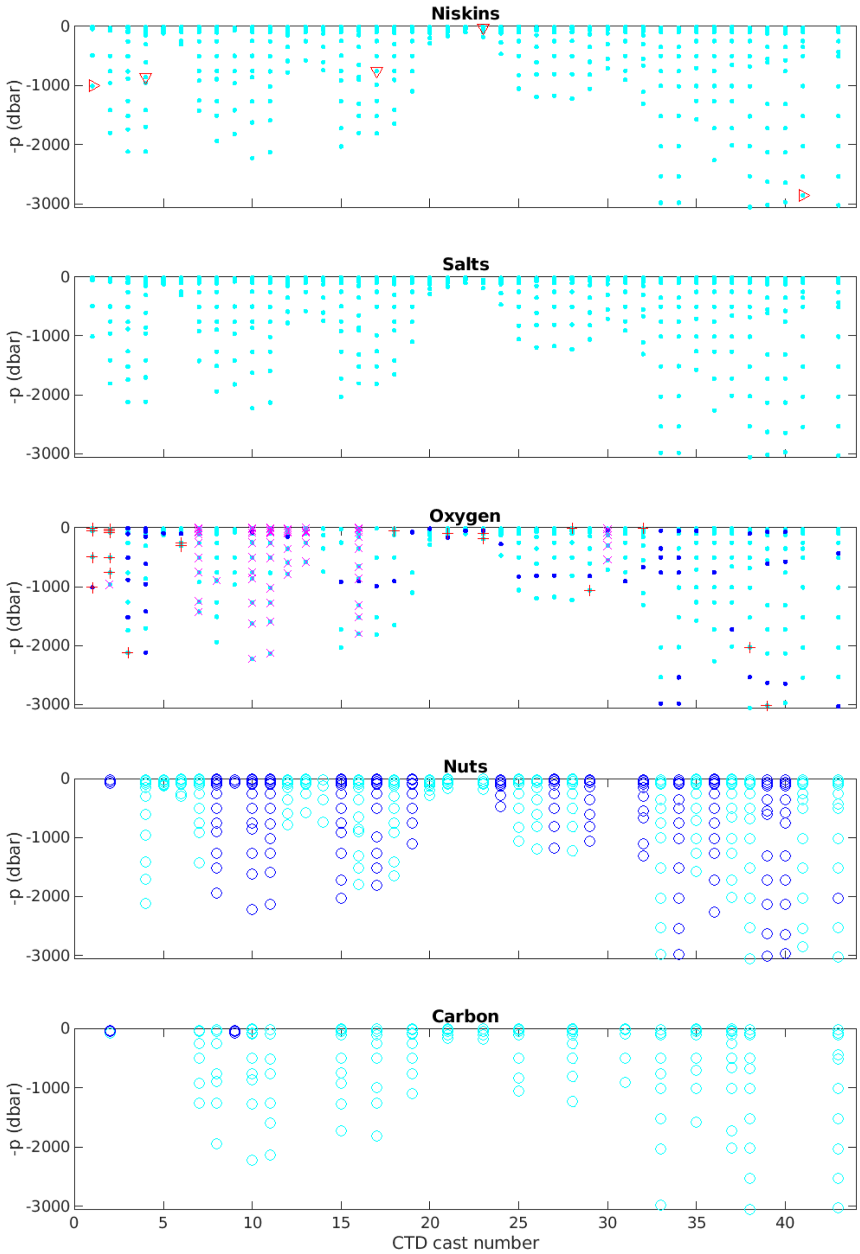


Figure 10.1: Distribution over cast and depth of Niskins fired (cyan dots, leaks right-pointing triangles and misfires down-pointing triangles); of salinity samples analysed (cyan dots); of oxygen samples analysed (cyan dots) or with replicates analysed (blue dots), with bad samples marked by red pluses and questionable samples by magenta xes; and of nutrient and carbon samples stored (cyan circles) or with replicates stored (blue circles) for analysis ashore.

10.3 CTD Temperature Quality Control

A SBE35 temperature probe mounted on one of the rosette verticals took a measurement (an average of 13 measurements) each time a Niskin was fired, allowing us to check for drift in the CTD temperature sensors. The comparisons, made using *mctd_evaluate_sensors.m*, initially showed substantial scatter, owing to strong temperature gradients and the vertical separation of the SBE35 from the CTDs. The standard deviation during each bottle stop as well as the background gradient (from the 2 dbar file) in the 5 m around the stop were used to flag points that were not suitable for comparison, bringing the total number of comparison points down to 133 but greatly reducing the scatter. Differences were inspected for dependence on station number, pressure, and temperature itself. We applied a piecewise linear pressure-dependent offset to temp1, varying from 7×10^{-4} °C at the surface to 9×10^{-4} °C at 1000 dbar and -17×10^{-4} °C at depth (3100 m). For temp2, in addition to the pressure-dependent offset varying from 1.7×10^{-4} °C at the surface to 1.6×10^{-4} °C at 1300 dbar to 0.4×10^{-4} °C at depth we applied a trend, using CTD cast number as a proxy for time, amounting to -8.8×10^{-4} °C over the 44 casts. The remaining offsets are shown in Fig. 10.2 for the primary sensor (temp2) only.

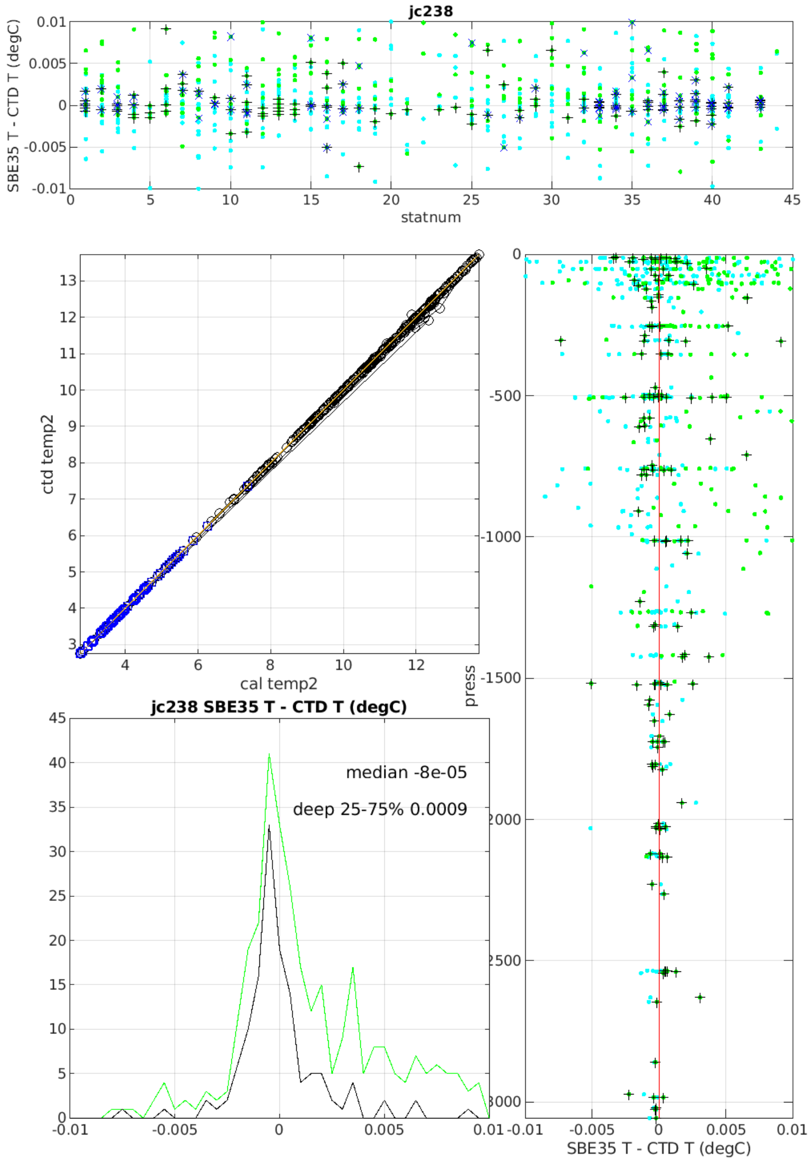


Figure 10.2: Differences between calibrated temp2 and SBE35 temperature: all points green dots and histogram, points good for calibration black pluses and histogram (differences from CTD temp1 shown by cyan dots).

10.4 CTD Conductivity Calibration

After analysis (section 7), salinity sample bottle numbers were cross referenced with sampling logsheets to match them with CTD cast and Niskin. Sample values were read in and standardised *msal_01.m*, by adjusting the standard seawater (batch P165) run at the start and end of each crate to its nominal value (with precision of 10^{-5}); these offsets were specified in *opt_jc238.m* and applied by linear interpolation between the pair of standards spanning each crate. The change over a crate was generally small, ~$2x10^{-5}$ counts.

For best accuracy, CTD conductivity is calibrated by comparing with conductivity at CTD temperature derived from analysed bottle salinity; although *mctd_evaluate_sensors* displays differences in "psu-equivalent" units for ease of interpretation, calibrations take the form of a scale factor to conductivity: cond_cal = cond(1 + factor/35). Conductivity comparisons (Fig. 10.3) were much tighter than those for temperature, reflecting lower background gradients. For both sensors the calibration factor (applied as above) depended on station number and pressure:

cond1_cal = cond1(1 + (5.5x10^{-5} stn + interp1([-10 2300 3100],[-1 -1 4]x10^{-4},press))/35),

cond2_cal = cond2(1 + (5x10^{-5} stn + interp1([-10 1300 3100],[1.5 -0.2 -0.3]x10^{-3},press))/35).

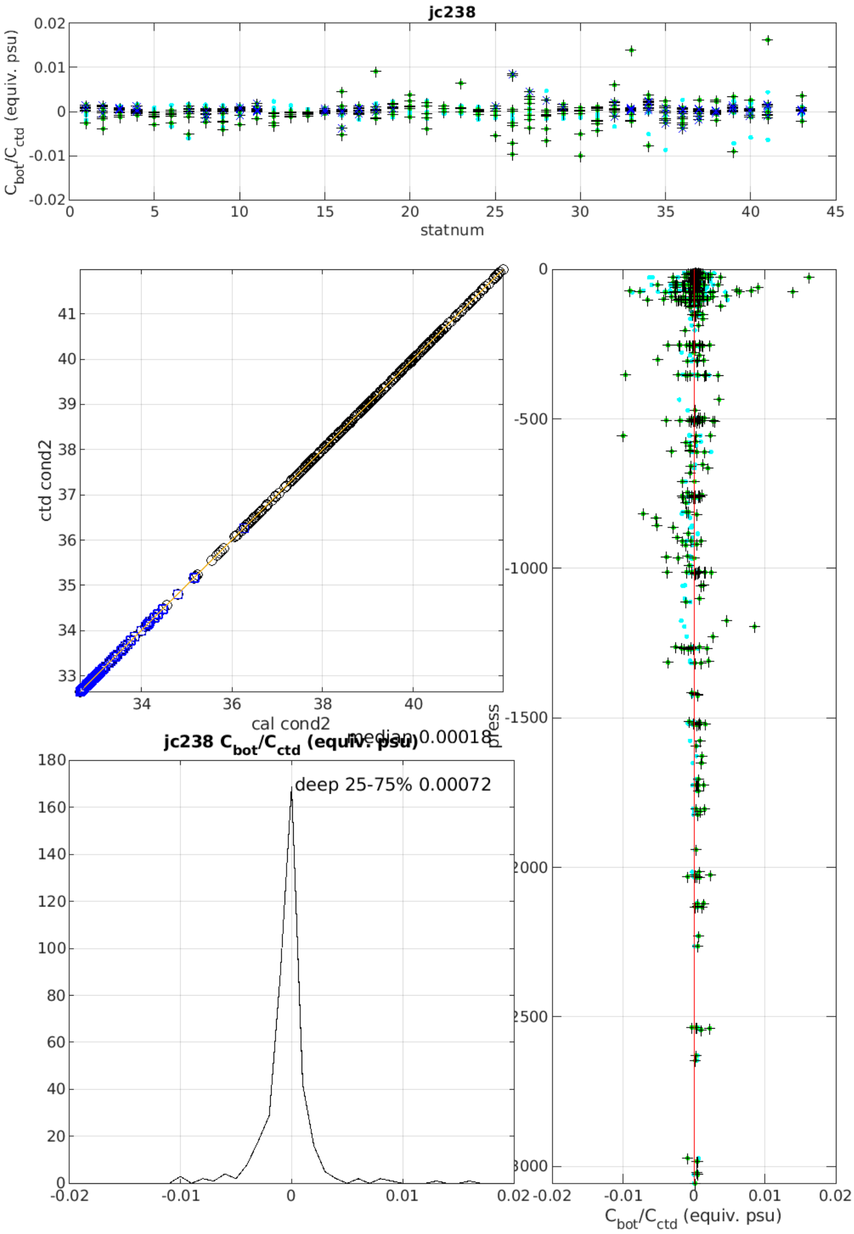


Figure 10.3: Differences between calibrated cond2 and conductivity derived from analysed bottle salinity: points good for calibration black pluses and histogram (differences from CTD cond1 shown by cyan dots).

10.5 CTD Oxygen Data Processing

In initial processing on workstation koaekea, the SBE default parameters for oxygen sensor hysteresis correction were applied. Although this cruise was a shallow one, 13 stations deeper than 2000 m were examined for residual oxygen hysteresis, using matching of down- and upcast on neutral density surfaces (calculated with script *heaveND.m*) to reduce the differences due to actual heave of property gradients between the down- and upcast. Even with this technique and with averaging, differences were very noisy above about 1000 m, but it appeared that agreement below was improved from the initial slightly greater than 1 umol/kg offset by changing the H2 parameter from 5000 to 6000 and the H3 parameter from 1450 to 1800 (CTD1) or 2000 (CTD2). All casts were therefore reprocessed using these modified coefficients.

10.6 CTD Oxygen Calibration

Bottle oxygen data were supplied in a spreadsheet by analysts and concentrations read in using *moxy_01.m*, which also converted from umol/L to umol/kg using density from oxygen draw temperature and CTD salinity. The functions generally used to calibrate oxygen sensors are various combinations of scale factors and offsets with linear, quadratic, and/or exponential dependences on pressure, temperature, time, and oxygen concentration itself. However, due to the limited depth and oxygen range on this cruise we aimed to find simple functions that reduced the scatter between CTD and bottle values. Comparison was first made in terms of the ratio between CTD and bottle oxygen concentration, leading to scale factors of $1.025+1.2\times10^{-4}$(stn)+interp1([-10 400 3100],[-0.9 -0.25 2.7]$\times10^{-2}$,press) for oxygen2 and interp1([-10 600 3100],[1.04 1.04 1.06],press)+interp1(1 32 36 40 44],[-2 0 2 -2 1],stn) for oxygen2. The zig-zagging scale factor for oxygen1 was applied because it appeared, based on oxygen1-oxygen2 comparison, to be partially real sensor drift (rather than an offset in the bottles). However, there was also some component of station-dependent offset between bottles and both CTD sensors, even once bottle oxygen from stations 7 and 9-13 was flagged, with another run of low comparisons associated with a few anomalously fresh stations late in the cruise (37-40).

Figure 10.4 shows the results for primary sensor oxygen2. To reduce the potential bias associated with uncorrected (or incorrectly corrected) oxygen hysteresis, oxygen calibrations were also tested against the comparison between bottle values and neutral density-matched CTD downcast data. Figure 10.5 shows this comparison for oxygen2.

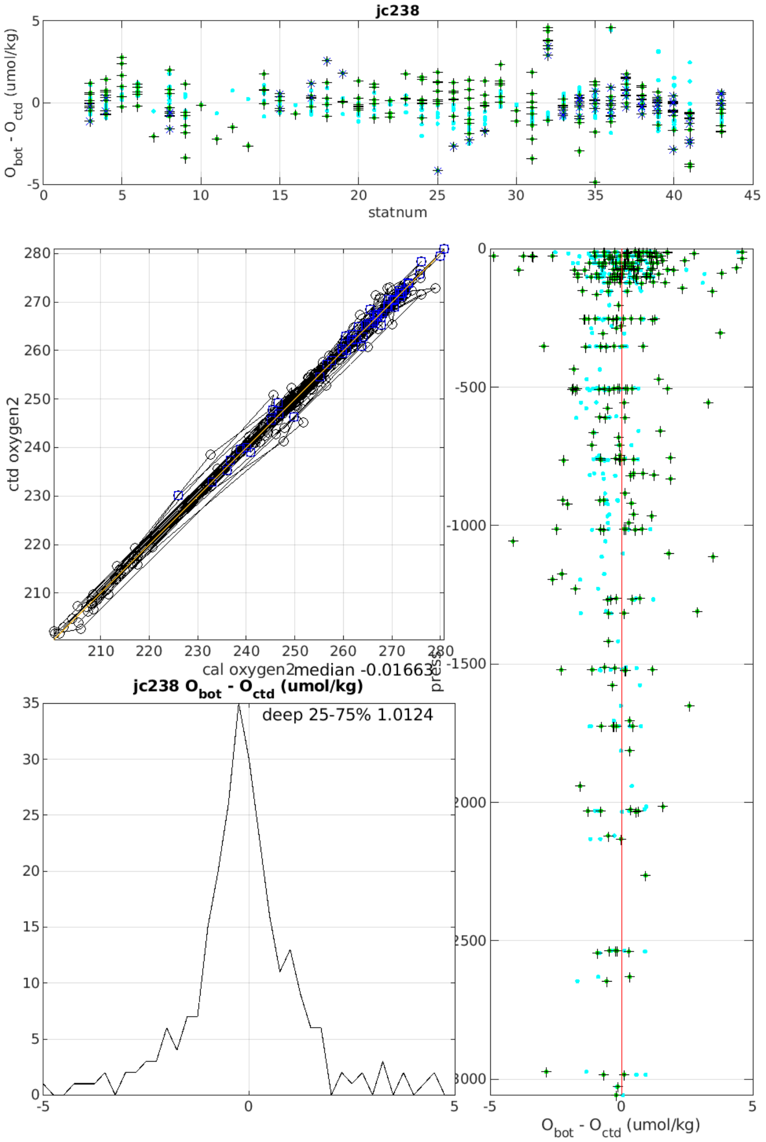


Figure 10.4: Differences between calibrated oxygen2 and bottle oxygen: points good for calibration black pluses and histogram (differences from CTD oxygen1 shown by cyan dots).

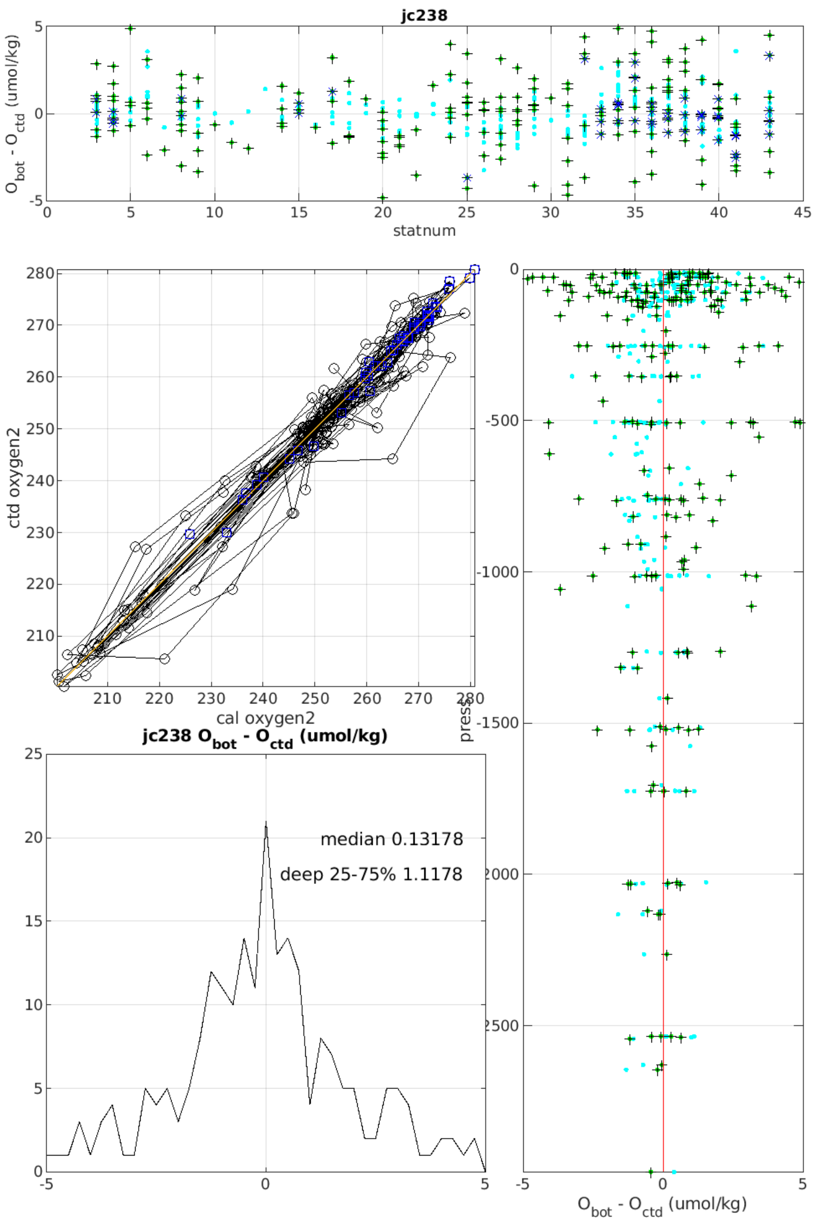


Figure 10.5: Differences between bottle oxygen and calibrated oxygen2 from downcast points with the same neutral density as that measured on the upcast when each Niskins was fired: points good for calibration black pluses and histogram (differences from CTD oxygen1 shown by cyan dots).

11 Lowered ADCP Processing

Adeola Michael Dahunsi

11.1 Configuration, deployment, and processing

Similar to the approach in previous cruises, the CTD rosette was equipped with two 300-kHz Teledyne RDI Workhorse Monitor LADCPs. One, the downlooker (Master, SN:23444), was installed in downward looking orientation while the other, the uplooker (Slave, SN: 12369), was installed in an upward looking configuration. The LADCPs collected data in beam coordinates with 25 x 8 m bins later converted to earth coordinates during processing. The deployment of the LADCP was usually done by the NMF CTD technicians. Checks for faults in the LADCP were done before every cast with pre-deployment and deployment scripts to set ping, bin, and transformation parameters, and to start the LADCP heads pinging. To reduce interference between the two LADCPs, the Slave LADCP is set to ping in response to the Master LADCP.

Post CTD recovery, both LADCPs were connected to a laptop in the deck lab for charging, data downloading and initial quality checking, carried out by the NMF technicians. The files were saved with names of the form XXXDL000.000 and XXXUL000.000 for master and slave respectively, where XXX is the CTD cast number, and copied from the networked Sensors and Moorings drive directory to the data processing workstation in "**local/users/pstar/cruise/data/ladcp/ix/raw"** for processing.

11.2 Data processing

The data processing for each cast station was done using the Lamont-Doherty Earth Observatory LDEO-IX v13 Matlab package developed at Lamont-Doherty Earth Observatory (LDEO) by Martin Visbeck and maintained by Andreas Thurnherr.. The software is based on an inverse method for calculating velocity profiles from the LADCP data using different constraints such as:
(1) ship navigation and position data from the GPS
(2) bottom tracking (BT) velocities

The change in the profiles as a result of adding the different constraints is checked by adding them one at a time in succession. This is first done for the two LADCPs, DL and UL, separately before combining them as DLUL for the different constraints below:
(1) Ship navigation (DLUL_GPS)
(2) Ship navigation and bottom tracking (DLUL_GPS_BT)

In order to automate the running of the processing under different constraints, a wrapper version for the LDEO IX scripts (process_cast.m and set_cast_params.m) was written to accept input arguments determining which constraints would be used, and saved as process cast_cfgstr.m and set_cast_params_cfgstr.m, respectively. Therefore, the MATLAB processing steps for each cast (XXX) is by running the following lines of code:

```
>> stn=XXX
>> cfgstr.orient = DLUL;
>> cfgstr.constraints = GPS;
>> process cast cfgstr(stn, cfgstr);
>> cfgstr.constraints = GPS, BT;
>> process cast cfgstr(stn, cfgstr);
```

11.2 Processing warnings for the LADCP casts

Generally, the processing of the LADCP casts files showed few processing warnings or some usual LDEO software errors such as report of an up-looking instrument detected in the down-looking file when processing the up-looker files separately. The cast 42 was not processed due to instrument not reaching sufficient depth (~100m) before being recovered and redeployed without restarting the LADCP files. Out of 42 casts processed, the LDEO software produced errors for 15 casts listed below:
Cast 1 - Found 117 (2.6% of total) velocity measurements > 2.5 m/s
Cast 4 - Found 245 (3.1% of total) velocity measurements > 2.5 m/s
Cast 10 - Cast duration differs in downlooker/uplooker data

Cast 11 - Found 254 (4.3% of total) velocity measurements > 2.5 m/s
Cast 14 - Found 162 (5.0% of total) velocity measurements > 2.5 m/s
Cast 16 - Found 121 (2.0% of total) velocity measurements > 2.5 m/s
Cast 17: Found 172 (3.4% of total) velocity measurements > 2.5 m/s
Cast 18 - Found 120 (2.3% of total) velocity measurements > 2.5 m/s
Cast 21 - Removed 20 pressure spikes during: 2 scans
Cast 25 - Found 213 (5.0% of total) velocity measurements > 2.5 m/s
Cast 38 - Found 139 (1.4% of total) velocity measurements > 2.5 m/s
Cast 40 - Found 239 (3.3% of total) velocity measurements > 2.5 m/s
Cast 41 - Found 233 (3.3% of total) velocity measurements > 2.5 m/s
Cast 43 - Found 459 (5.3% of total) velocity measurements > 2.5 m/s

Figures 11.1 and 11.2 give the mean and standard deviation of the velocities under different constraints. Both the uplooker and downlooker files were used for the processing of all casts for further analysis.

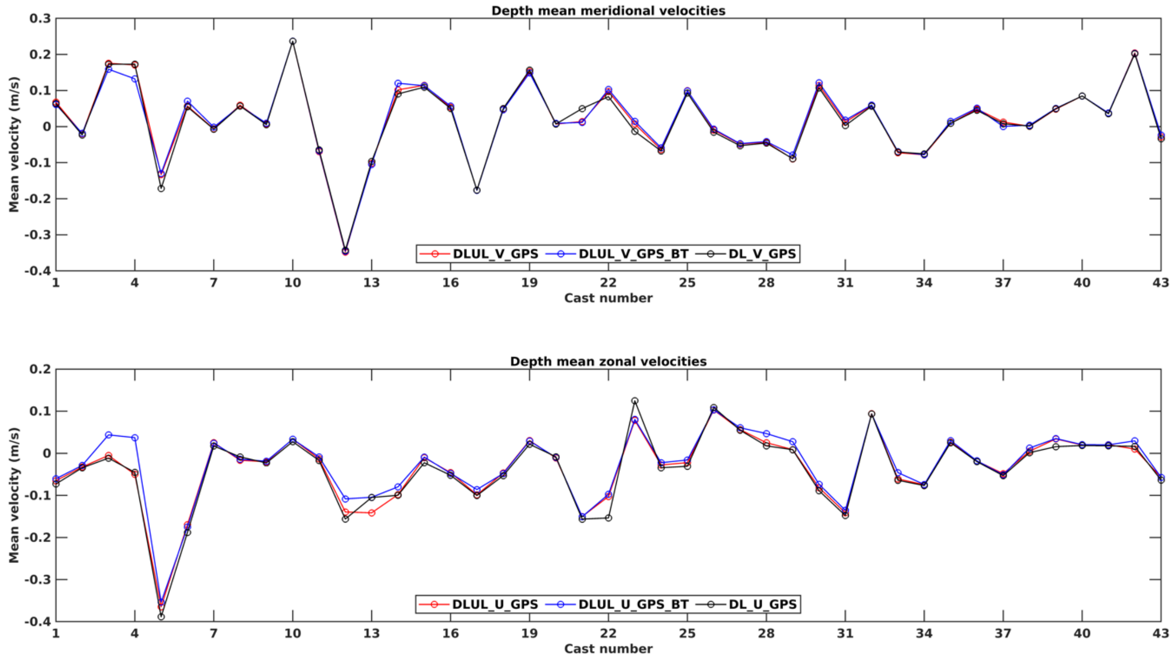


Figure 11.1: Depth mean of meridional (upper frame) and zonal (lower frame) velocities due to including different constraints.

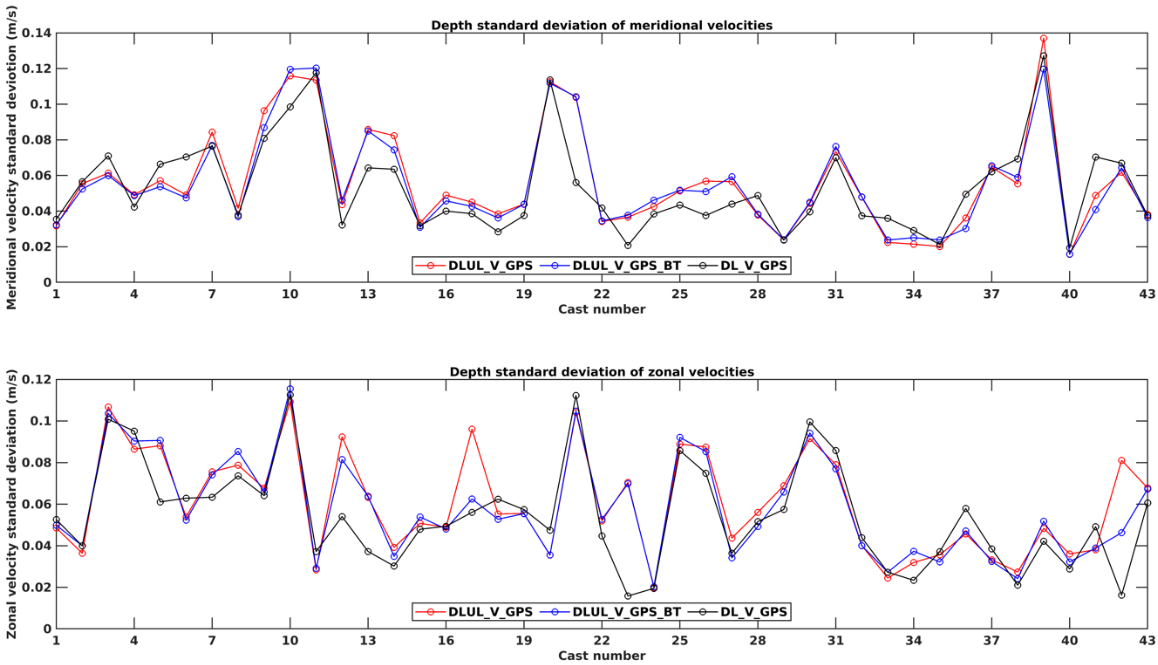


Figure 11.2: Standard deviation of meridional (upper frame) and zonal (lower frame) velocities due to including different constraints.

12 CTD section (preliminary results)

Milo Bischof and Adeola Dahunsi

Temperature-Salinity diagrams were plotted to aid watermass identification along the transect. CTD measurements of potential temperature and practical salinity were initially converted to conservative temperature and absolute salinity using the Matlab Gibbs Seawater toolbox. The section was then separated into three subsections, the Rockall Trough (east of 13° W), the shallower Hatton-Rockall Bank (13-20° W), and the Iceland Basin (west of 20° W). Temperature-salinity diagrams for each subsection are shown in Figure 12.1, with scatterpoints shaded to show depth. Figure 12.2 shows the same temperature-salinity diagrams, but coloured according to oxygen concentration as measured by the CTD.

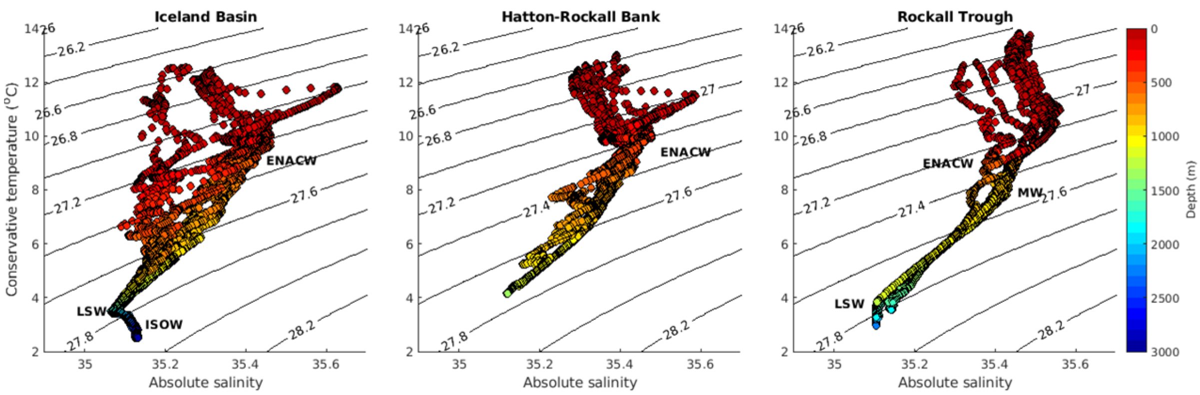


Figure 12.1: Temperature-salinity diagrams for the Rockall Trough (left), Hatton-Rockall Bank (middle) and Iceland Basin (right), coloured by depth.

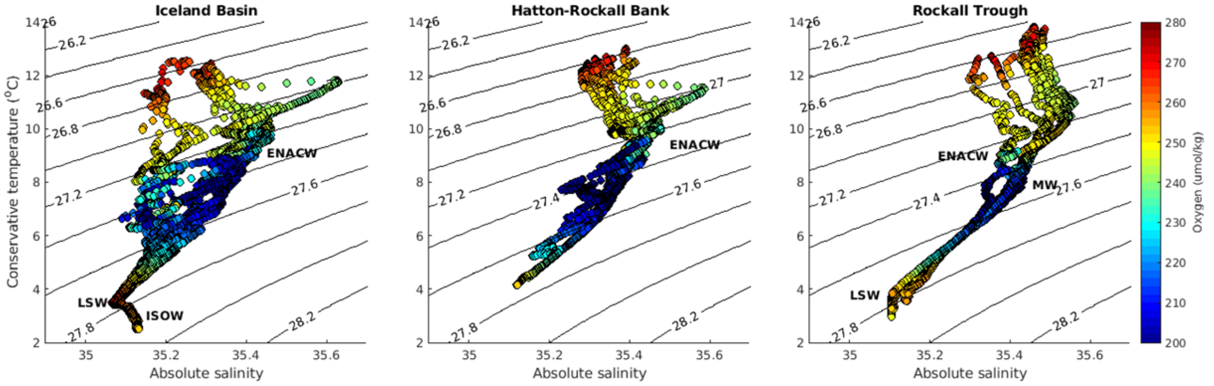


Figure 12.2: As in Figure 12.1 but coloured by oxygen concentration.

The main water masses found in the Rockall Trough subsection were Eastern North Atlantic Central Water (ENACW) with a potential density of 27.2-27.5 kg/m^3, and Labrador Sea Water (LSW) with a potential density of 27.7-27.85 kg/m^3 and a salinity minimum. Some profiles show indications of a mid-depth salinity maximum at a potential density of approximately 27.6 kg/m^3, potentially indicating the presence of Mediterranean Water (MW). Subarctic Intermediate Water (SAIW), another water mass typically found in the region at a neutral density of approximately 27.65 kg/m^3 and temperatures higher than 4.5 °C, could not be identified conclusively from our data.

The Iceland Basin section shows a presence of ENACW and LSW, as well as Iceland Scotland Overflow Water (ISOW) with a potential density of 27.85 kg/m^3 and higher salinity than LSW. ISOW is only found at the deepest stations of the subsection at depths below 2000 m (Figure 12.3).

The Hatton-Rockall Bank subsection is shallower compared to the other two subsections, with a maximum depth of approximately 1200 m. Consequently, no LSW or ISOW is found on this subsection. Similarly to the other subsections, ENACW is located at a depth of approximately 500-800 m.

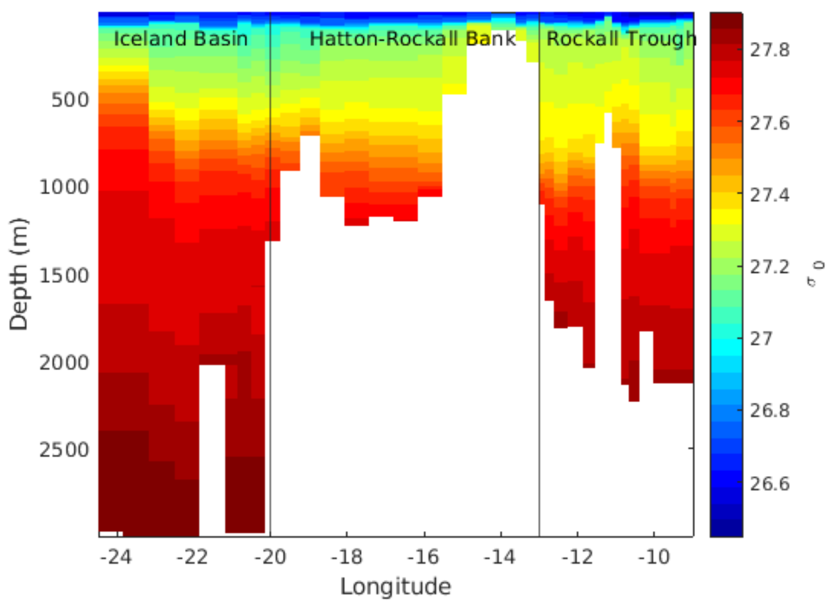


Figure 12.3: Potential density sections.

The main differences between water masses in the Rockall Trough and Iceland Basin is the presence of ISOW in the deeper stations of the Iceland Basin. While the salinity minimum associated with LSW is found at similar potential densities in both subsections, LSW in the Iceland Basin seems to have higher oxygen concentrations than in the Rockall Trough (Figure 12.4). While the Rockall Trough profiles follow a roughly similar path in temperature-salinity space, there seems to be a larger spread in the profiles of the Iceland Basin at depths shallower than 1000 m. Profiles can be separated into those that are stratified mostly by temperature, and those that are stratified by both temperature and salinity. Upon closer investigation, the temperature stratified profiles belong to the last CTDs of the section, which were taken after a storm had passed through. It is possible that this event contributed to a decay of salinity stratification.

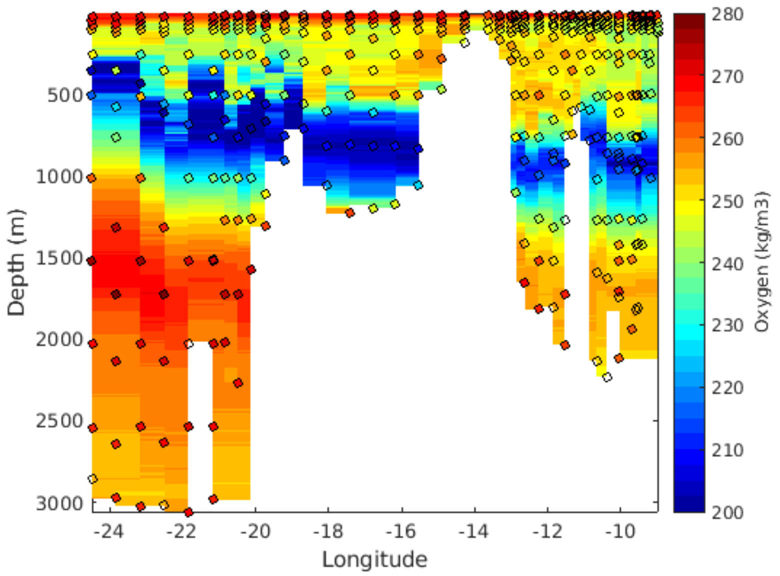


Figure 12.4: Dissolved oxygen concentration from the CTD (uncalibrated) overlain with lab analysed bottle oxygen (dots).

The velocity section for both meridional (Figure 12.5) and zonal velocities (Figure 12.6) were produced by concatenating all the LADCP sections for the entire cruise and plotted against depth and distance reference to the first cast station. Out of the 44 cast sections, 36 was used for the velocity section and other analysis.

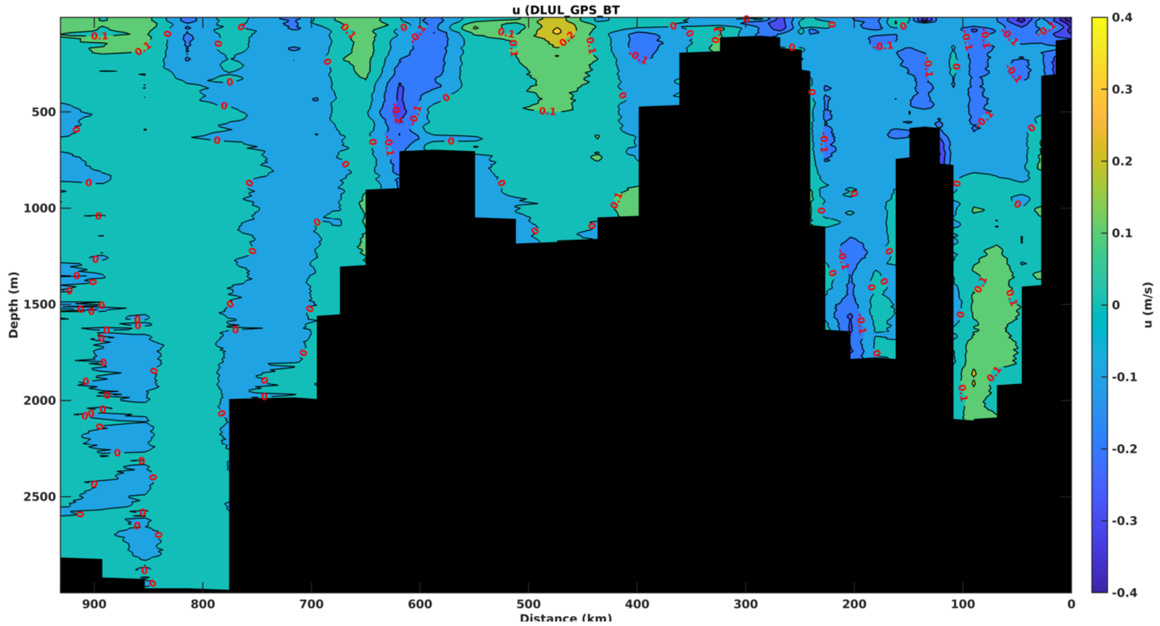


Figure 12.5: Zonal velocity section for the cruise LADCP casts

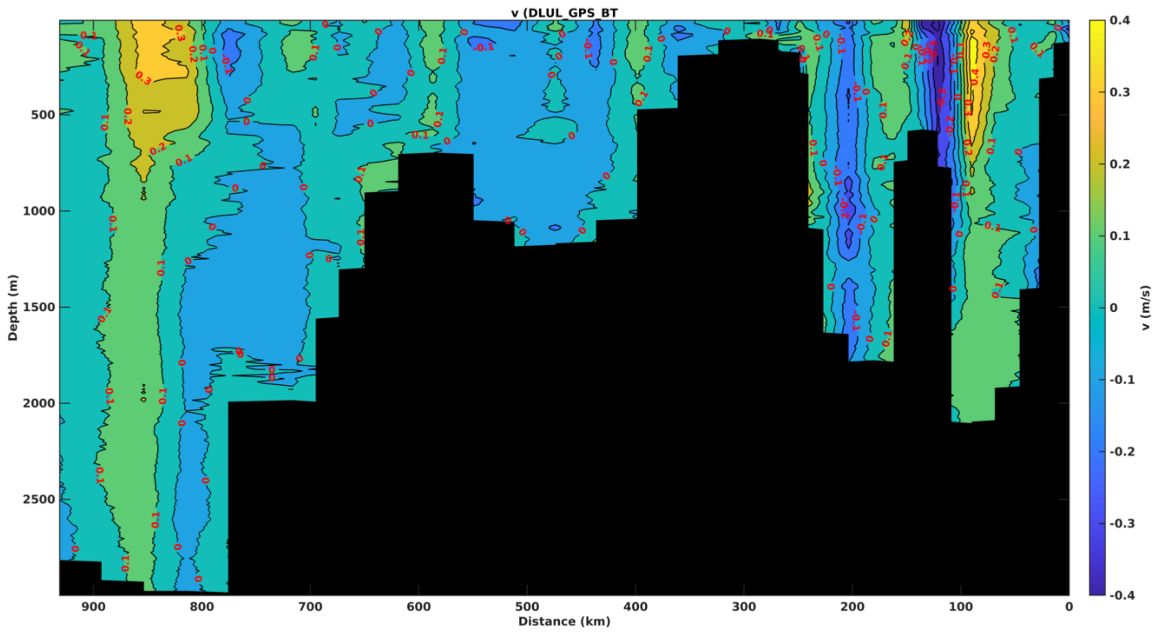


Figure 12.6: Meridional velocity section for the cruise LADCP casts

The geostrophic velocity was calculated by first using the functions *gsw_geo_strf_dyn_height* for calculating the dynamic height anomaly as the integral of specific volume anomaly from the pressure **p** of the CTD bottle to the reference pressure p_ref (defined as zero). The required input parameters were taken from the variable named **mgrid** from the MATLAB file "**/local/users/pstar/cruise/data/ctd/grid_jc238_osnape.mat**," generated by *msec_grid.m*. These inputs are Absolute Salinity (mgrid.SA), Conservative Temperature (mgrid.CT), sea pressure (mgrid.press) and the reference pressure (p_ref=0). Then the result from the calculation with *gsw_geo_strf_dyn_height* in addition to longitude (mgrid.lon), latitude (mgrid.lat) and sea pressure (mgrid.press) are used as input to *gsw_geostrophic_velocity* to calculate the geostrophic velocity. The geostrophic velocity section shown in Figure 12.7 has been referenced to the deepest point for each section.

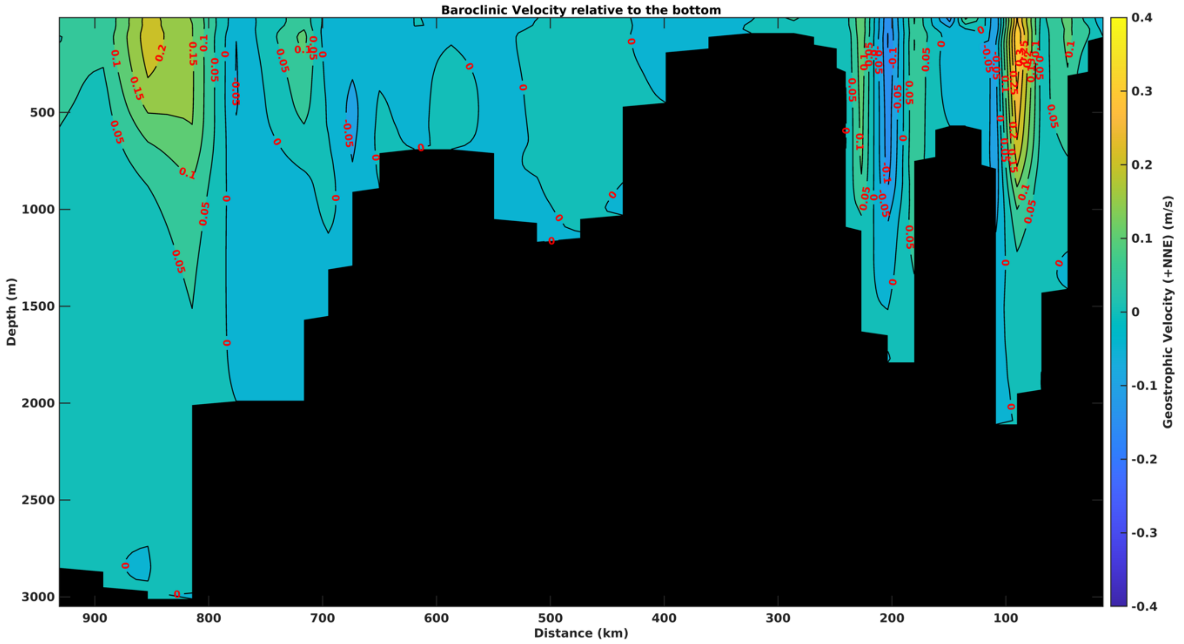


Figure 12.7: Baroclinic geostrophic velocity relative to the deepest common level between each station pair, positive to the left (south) of the track.

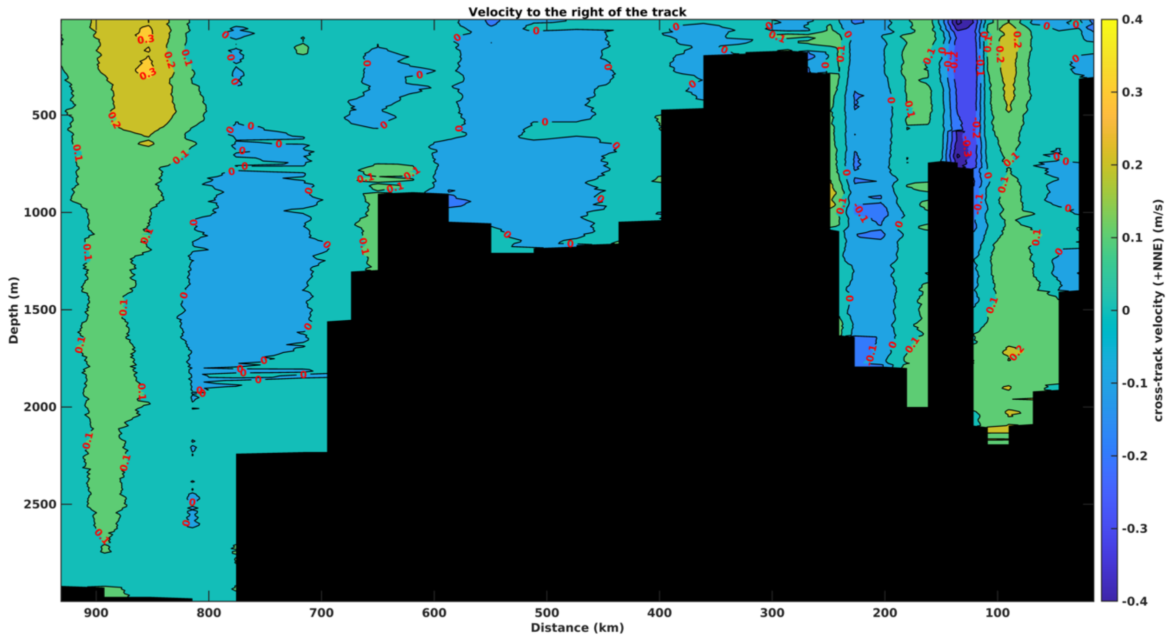


Figure 12.8: Rotated velocity section for the cruise LADCP casts (positive to the left of the track)

The result presented in Figure 12.8 was calculated rotating the meridional zonal velocity through angle estimated with the fuction *sw_dist* which takes the longitude and latitude of the various cast points as input. The result gives the velocity to the right of the ship track while the geostrophic velocity gives the velocity to the left of the track.

13 Dissolved Oxygen Sampling and Analysis

Sarah Beith, Nele Thomsen, Milo Bischof

13.1 Introduction

508 seawater samples were collected from 42 CTD casts at stations along the eastern section of the Ellett Line and analysed via Winkler photometric auto-titration. Sampling and analysis were carried out around the clock throughout cruise JC238 to determine concentrations of dissolved O2. Methodologies were performed as per those documented in the GO-SHIP protocol (Langdon, 2010), based on the standard methodologies of Carpenter, 1965 adapted for large scale hydrographic studies (e.g. Culberson, 1991; Dickson, 1995).

13.2 Methodology

Sampling: seawater samples were drawn from Niskin bottles via a short length of silicon tubing, ensuring air bubbles did not enter the individually calibrated sampling bottles. Excess seawater (two to three times the bottle volume) was flushed through the sample bottles to clean them and assist air bubble removal. Samples were fixed immediately via addition of 1ml of 3M $MnCl_2$ followed by 1ml of (8M NaOH + 4M NaI). The sample temperature during fixing was recorded using a digital thermometer (±0.1°C) in a separate sample bottle. Reagents were dispensed below the sample surface so as not to introduce air bubbles and to ensure all reacting species were contained within the sample. Ground glass lid stoppers were put on tightly, again ensuring no air bubbles were trapped within the sample. Samples were shaken vigorously for 30 s and transferred to a dark cool storage space in the lab. After half an hour, samples were re-shaken for another 30 s and allowed to settle and equilibrate with lab temperature for at least 1.5 hours before analysis. If analysis could not be done within 4 hours of sampling the samples were stored submerged in seawater to prevent gas exchange.

Quality control: prior to each analytical session the Na2S203 titrant (~0.1 M) was standardised using a commercial KIO3 standard, OSIL 0.01N (1.667 mM) standard or an in-house 3.007 mM KIO3 standard. In addition, to draw further comparisons between less expensive in-house standards and more costly commercial standards, titrant standardisations were carried out using a second in-house 1.669 mM KIO3 standard alongside commercial JT Baker Dilut-It 1.666 mM KIO3 standard at the beginning of the sampling programme. To account for matrix effects, seawater blanks were analysed periodically throughout the cruise or whenever a significant change occurred e.g. a fresh titrant solution was in use; blank concentrations were subtracted from titration calculations (Carpenter, 1965).

Analysis: 1 ml of 75 % H_2SO_4 was added to samples followed by a Teflon coated magnetic stirrer, and the sample was then titrated against Na2S2O3 to the endpoint.

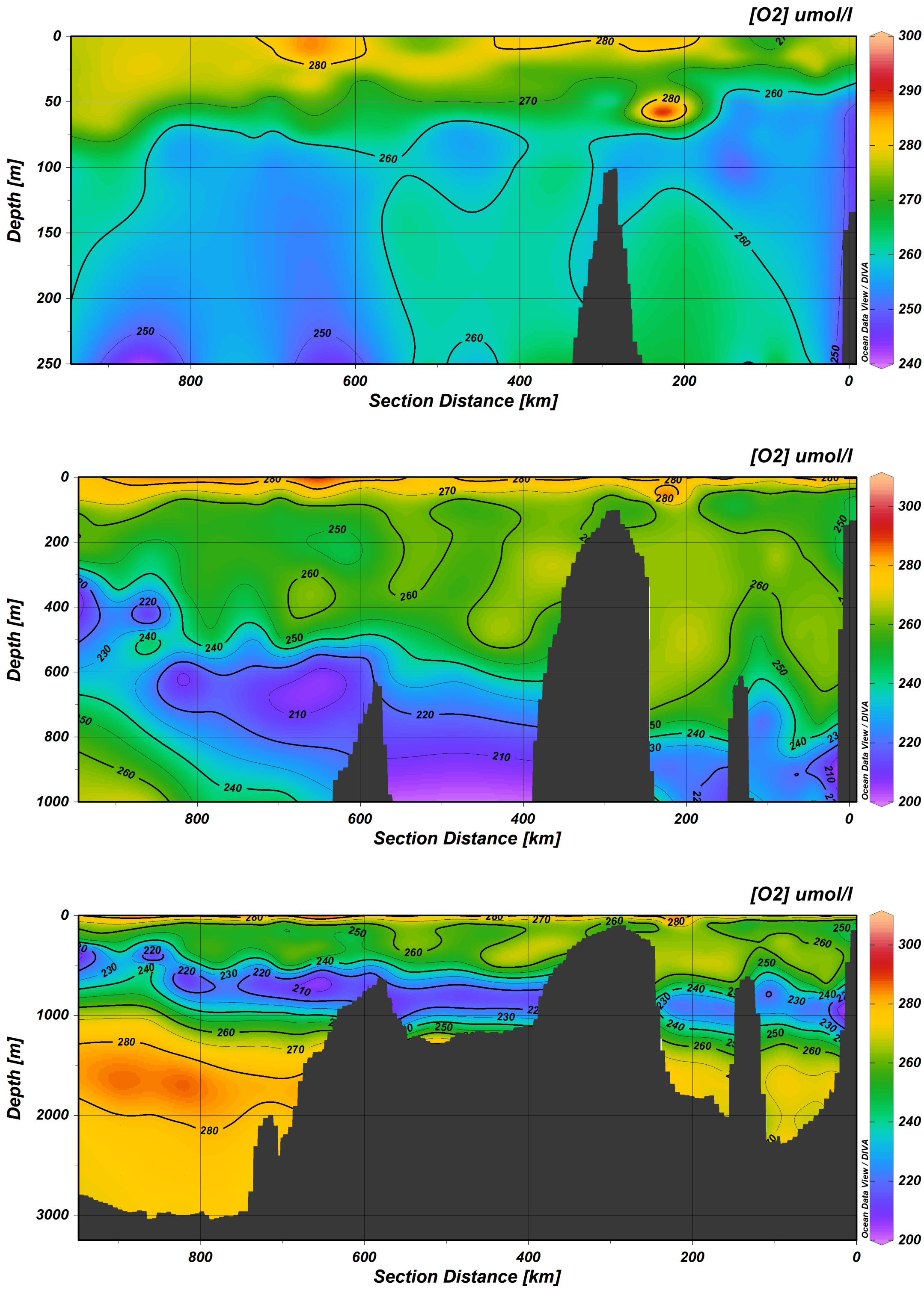


Figure 13.1. Dissolved Oxygen profiles measured during JC238 from the Icelandic Basin (left) to Scotland (right) (Ocean Data View, R. Schlitzer, 2011). The top panel shows dissolved oxygen concentration in the upper layer highlighting phytoplankton blooms. Middle panel shows oxygen concentration in the upper 1000m including the oxygen minimum zone and lower panel the full depth profile.

References

Carpenter, J.H. 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. *Limnol.and Oceanogr.* 10:141-143.
Culbertson, C.H. 1991. Dissolved Oxgen. WHPO Publication 91-1.
Dickson, A.D. 1995. Determination of dissolved oxygen in sea water by Winkler titration. WOCE Operations Manual, Part 3.1.3 Operations & Methods, WHP Office Report WHPO 91 – 1.
Langdon. C. 2010. Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique. The GO-SHIP Repeat hydrography manual: A collection of expert reports and guidelines. IOCCP report No.14.

14 Dissolved Inorganic Carbon, nutrients and pH Sampling

Sarah Beith, Nele Thomsen, Milo Bischof

14.1 Introduction

Six hundred and eighty two seawater samples were collected around the clock from 42 CTD casts at stations along the eastern section of the Ellett Line: 141 samples for Dissolved Inorganic Carbon (DIC) and Total Alkalinity (TA), and 541 samples for nutrients. DIC/TA samples will be analysed at the University of St. Andrews, Scotland, UK; nutrient samples will be analysed at SAMS (Scottish Association for Marine Science), Scotland, UK. Sampling and storage procedures for DIC/TA and Nutrients were carried out as per Dickson *et al*., 2007 and Becker *et al*., 2019 respectively.

14.2 Dissolved Inorganic Carbon Methodology

Sampling: within 10 minutes of sampling for Dissolved Oxygen, seawater samples were drawn from Niskin bottles via a short length of silicon tubing, ensuring bubbles did not enter the 250 cm^3 glass sample bottles. Excess seawater (at least one bottle volume) was flushed through the pre-labelled sample bottles to clean them and assist bubble removal. Ground glass lid stoppers were put on tightly, again ensuring no bubbles were trapped within the sample. To allow for water expansion, 2.5 cm^3 seawater was removed using a pipette.

Storage: To preserve the samples until analysis, 50 µl ~7 % $HgCl_2$ was added by dispensing from a pipette below the sample surface in order not to introduce bubbles. A small amount of Apiezon® L grease was applied to the ground glass stoppers which were then replaced in the bottles and turned to ensure a good seal. PVC tape was bound tightly around each bottle and stopper, and the secured sample bottles were placed upright in cushioned crates to be stored at room temperature in the dark until analysi

14.3 Nutrients Methodology

Sampling: seawater samples were drawn from Niskin bottles via a short length of silicon tubing and a PALL filter (AcroPak 500 Capsule with Supor Membrane 0.8/0.45 µm) immediately after sampling for dissolved gases. New, 5 % HCl–cleaned, pre-labelled 50 cm^3 Falcon PP tubes were rinsed twice with a few cm^3 of sample before being filled up to the 45 cm^3 mark and capped.

Storage: samples were frozen upright in a -20 °C freezer before being transferred into labelled polythene bags and returned to the freezer.

References

Becker, S., Aoyama, M., Woodward, E.M.S., Bakker, K., Coverly, S., Mahaffey, C., and Tanhua, T. 2019. GO-SHIP Repeat Hydrography Nutrient Manual: The precise and accurate determination of dissolved inorganic nutrients in seawater, using Continuous Flow Analysis methods.

Dickson, A.G., Sabine, C.L., and Christian, J.R. 2007. Guide to Best Practices for Ocean O_2 Measurements. PICES Special Publication 3. IOCCP Report No. 8.

15 Argo Float Deployment

Ben Moat

Two BGC NAVIS floats and one Provor were deployed during the expedition (Table 15.1).

Float number	date	Time (UTC)	Latitude	Longitude	Water Depth (m) and CTD profile
SBS-NAVIS F1102	16th July 2024	21:14	57° 18.3N	10° 24.0W	2200 CTD cast 10
SBS-NAVIS F1101	24th July 2024	23:49	57° 57.7N	23° 10.3W	2989 CTD cast 43
NKE-PROVOR P44043-21UK004	2th July 2024	23:55	57° 57.2N	23° 10.2W	2989 CTD cast 43

Table 15.1 Argo Float deployment

16 Moorings

Estelle Dumont, Lewis Drysdale, Sam Tiefolo Diabate, Rob McLachlan

We successfully completed the refurbishments of 7 moorings that were deployed in 2020: RTEB1, RTWB1, RTWB2, RH-ADCP, IB5, IB4 and IB3. We also installed a new mooring (lander): RTEBL1 at 57° 05.901’ N, 9° 33.159’ W.

16.1 Deck Setup

The NMF double barrel winch was setup on the middle of the deck to be used for all mooring recovery and deployment operations. A North Sea five Tonne winch was setup on the starboard aft section of the working deck and used with the ship’s aft gantry and a hanging block for anchor deployments.

16.2 Recoveries

Moorings were released with an Ixsea deck box setup in the main lab. For most recoveries and trilaterations the drop keel was used. Once the mooring was on the surface and alongside the vessel the moorings were recovered on the starboard side of the vessel using a recovery line from the double barrel winch, paid out aft around the back off the vessel and led up the starboard waist.

A Seacatch 5 tonne hook was used to attach the recovery line on board to the recovery line on the mooring. In a few instances it was not possible to hook into the recovery line of the mooring as weather/entanglement meant the mooring had to be hooked in another place.

16.3 Deployments

All moorings were wound onto wire drums using the double barrel winch. Every link in the mooring was wrapped in thick plastic groundsheet to ensure that no damage to the outer sleeve would happen. When the mooring was being deployed this wrap was removed to enable the mooring to be connected together fully.

Mooring deployments were all started a sufficient distance away from the target mooring site so as to leave enough time to deploy the mooring and tow it at 0.5 knots the last few hundred meters. The anchors were lifted off deck ~50 m from the target site using the 5T winch described above. All anchors were connected up using a Seacatch quick release which enabled a quick, safe and reliable method of letting go of the anchor once the ship was in the target position.

16.3.1 Trilateration

Mooring trilateration (true range multilateration) for each mooring establishes an accurate seabed location for the mooring using multiple range measurements from the ship's transponder to the acoustic release transducer above the mooring anchor package. This is important for safe ship positioning during mooring recovery operations or, in the event of a release failure, drag wire recovery. After each deployment the ship repositioned to ~0.8 nm from the anchor drop. An IXSEA deck unit (TT 801) was used to ARM and range to a single release.

A minimum of three ranges are required. Accurate recording of ranges and times of range are critical to obtaining a precise location.

Steps to triangulating the anchor position:

1. The ship's position (minimum 5 decimal places) and depth calculated at the time of each range using the function:

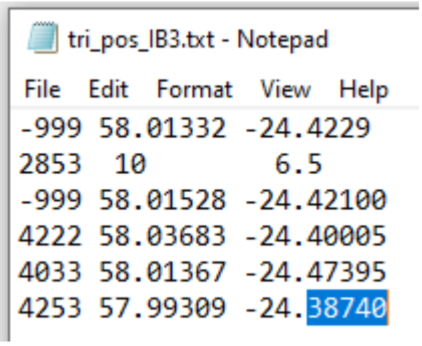
/local/users/pstar/programs/m_moorproc_toolbox/exec/gitrepo/mfiles/triangulation_with_tgt/get_position_and_depth_jc238.m

2. A text file containing depths, positions, and ranges must be created in: /local/users/pstar/programs/m_moorproc_toolbox/exec/gitrepo/mfiles/triangulation_with_tgt/{SAMS_moorings, NOC_moorings}

3. The file follows the order:
    a. The first row contains the target position
    b. The second row is uncorrected water depth at anchor drop, the release height above bottom and the transducer depth
    c. The third row indicates the position at the anchor drop

   d. Row 4 to 6 indicates the range of the acoustic release, the latitude and the longitude for each trilateration position. See Figure 16.1 for an example.

4. Run **Anchor4.m** in Matlab:
   a. This script will open a GUI window asking for the name of the file to be loaded and the program will generate and save a figure with the results of the trilateration which produces a triangulation estimate based on the three ranges and positions.


tri_pos_IB3.txt - Notepad

File Edit Format View Help

```
-999 58.01332 -24.4229
2853  10        6.5
-999 58.01528 -24.42100
4222 58.03683 -24.40005
4033 58.01367 -24.47395
4253 57.99309 -24.38740
```

Figure 16.1. Screenshot of text file for IB3 trilateration from DY2020.

16.4 Mooring Instrumentation

Summary statistics for all moored instruments are found in Appendix L.

16.4.1 SBE37

16.4.1.1 Recoveries

Fifty-three SBE37s Microcats SMP were recovered from the moorings. All were still operational and collecting data at the time of recovery after being deployed for 21 months. The instruments deployed in the top 100m showed quite significant biofouling however none near the cell intake and exhaust. No damage was observed except for a bent guard on the microcat attached on the RHADCP buoy (S/N 9113).

Clock drift was mostly within 1 minute of UTC time, with the oldest instruments (serial numbers in the 3000s) showing a larger offset of up to 4.2 minutes.
The microCAT CTDs were all cal-dipped post-deployment (see cal-dip summaries in Section 19 and results tables in Appendices D and E).
Raw data were converted to cnv in SBEDataProcessing (DatCnv module) for SBE37's v≥3.0, and in SeaTerm using the "Convert" tool for SBE37s v≤3.0.

16.4.1.2 Data return

Data return from OSNAP microCATs was excellent. MicroCAT serial number 14367 deployed at 1500 m on IB4 presented questionable conductivity values from approximately day 600 until end of deployment. microCAT-ODO serial numbers 15298 and 15476 deployed at 47 and 498 m respectively on IB4 logged poor bad conductivity data and oxygen data (in the case of 15298). All other microCAT instruments deployed as part of the OSNAP array returned data for the full deployment. Data will be corrected for drift and/or offsets using information from calibration dips done on this cruise and DY120.

16.4.1.3 Deployments

Fifty-four SBE37s Microcats SMP were deployed across the moorings. They were all cal-dipped and prior to deployment (see cal-dip result table in the Appendix). Instruments showing a conductivity offset >0.02 mS/cm were not deployed, and generally we tried to select those with an offset <0.015 mS/cm wherever possible.
They were fitted with new batteries (SAFT 3.6V Lithium AA cells), their clocks were synchronised with GPS time and set to sample every 1800s (as in 2020). Endurance estimates from SeaBird's DeploymentEndurance software were over 1200 days for all.

16.4.2 SBE37-ODO

16.4.2.1 Recoveries

Five SBE37-ODOs were recovered on EB1:

- S/N 14987, paired with V2 SeaFET S/N 004, deployed at ~53m
- S/N 21318, paired with V1 SeaFET S/N 117, deployed at ~54m
- S/N 21560, deployed at ~500m
- S/N 21320, deployed at ~750m
- S/N 21319, deployed at ~950m

Two were recovered form IB4:

- S/N 15298, deployed at ~50m
- S/N 15476, deployed at ~500m

All standalone ODOs were still recording at recovery, as well as the one paired with V2 SeaFET. The last ODO, S/N 21318, paired with the V1 SeaFET, had run out of battery (see SeapHOx section).
Additionally, S/N 21318 was found to have intermittent communication issues post-recovery (both when connected to the SeaFET and on its own via SeaTerm V2). The same problem happened during DY120 with S/N 21317, which had to be sent back to SeaBird for repairs. Some communication issues were also noted with S/N 15298, although not as severe.
All ODOs were cal-dipped post-recovery (see cal-dip result table in Section 19).

Notable instrument issues:

- S/N 15298: bad conductivity data (values >50mS/cm for most of the deployment)
- S/N 15476: bad conductivity data (values <30 mS/cm for most of the deployment)

The conductivity sensor issue for both instruments was known prior to deployment (see DY120 cruise report), and SBE37s were placed next to those ODOs on the mooring line to obtain real salinity data at those depths.

- S/N 21319 data gaps occurred frequently between day 300 and 500 after deployment; bad oxygen data (>500 µmol/kg) after the 04/07/2022.

16.4.2.2 Deployments

SBE37-ODOs deployed on EB1 and IB4 were cal-diped prior to deployment (for pressure, temperature and conductivity). All produced acceptable results except S/N 21317 which showed a conductivity offset of 0.04 mS/cm. Similar offsets (or worse) had been observed for other ODOs during DY120. The oxygen readings seemed however acceptable (in line with the uncalibrated CTD oxygen data), and it was deployed with an SBE37 (S/N 9140) next to it which will provide more reliable conductivity data.
The SBE63 sensor (oxygen optode) requires a longer flushing time than the conductivity sensor for the readings to stabilise. SBE37-ODOs have the option of using Adaptive Sampling, described in the instrument manual as:
"If enabled (AdaptivePumpControl=Y), the Microcat calculates the pump time before each sample for best oxygen accuracy, as a function of the temperature and pressure of the previous

sample (temperature and pressure influence the oxygen sensor time constant). Pump time increases with increasing pressure and decreasing temperature. The pump continues to run while sampling."

This option was activated for all SBE37-ODOs deployed stand-alone. As the pumping time is significantly higher than for a standard Microcat the energy usage is therefore increased. Endurances and pumping times were estimated (using the minimum expected temperature at each depth) before setting the sampling intervals for deployments in 2018 and 2020. Since all the ODOs recovered were still sampling the same settings and endurance calculation methods were used again.

New batteries were fitted prior to deployment (SAFT 3.6V Lithium AA cells), and the clocks synchronised to GPS time.

Summary of endurance estimates and sampling intervals:

Mooring	**S/N**	**Expected depth (m)**	**Expected minimum temp (°C)**	**Expected max pumping time (sec)**	**Sampling interval (sec)**	**Estimated endurance (days)**
EB1	21317	500	9.1	69	3600	923
EB1	15254	750	8.0	76	3600	858
EB1	24104	950	4.5	92	4500	890
IB4	12906	50	9.1	65	3600	973
IB4	12908	350	8.2	71	3600	907
IB4	12962	500	8.2	73	3600	891
IB4	13000	700	5.4	85	4500	949

16.4.3 DeepSeapHOx

The DeepSeapHOx is a SeaFEt pH sensor combined with a SBE37-ODO (as described in the previous section). The two instruments are powered internally by their own internal battery pack, connected together via a Y-cable, with the SeaFET controlling the sampling and data recording.

16.4.3.1 Recoveries

Two Deep SeapHOxes were deployed next to each other on EB1 in 2020 at around 50m depth:

- V1 SeaFET 117 + SBE37-ODO 21318:

  The setup parameters used in 2020 were the same as in 2018, which were later found to be unsuitable (sampling rate too high to reach reaching the two-years endurance; see DY120 cruise report). As expected, the instruments had run out of battery again this time. The SeaFET last recording was made on 22/05/2022 (battery readings at recovery: main 8.4V, isolated 4.5V). The SBE37-ODO's battery was also exhausted (battery pack voltage measured at recovery 0.1V), but it is uncertain exactly when this happened. Although the SeaFET was recording until May 2022, there are significant gaps in the sensors data (from both the ODO and the SeaFET) from mid-February 2021, until the final readings in mid-November 2021.

  The ODO was found to have an intermittent communication issue post-recovery (see previous section), which may have been present during deployment and could explain the gaps in the data. However, further tests were carried out post-recovery on the SeaFET paired with another ODO (S/N 21319), and no sensors data was output either (pairing parameters, connectors, Y-cable and communication cable were all checked and no issues detected). This suggests there could be a technical issue with the SeaFET itself, in addition to the original ODO. Further investigation will be done after the cruise.

  The clock offset was negligible (-26s).

Due to the technical issues the SeaFET could not be cal-dipped post-recovery. This will be attempted back at SAMS if the data output problem can be solved. The instrument will then be sent back to SeaBird for assessment, calibration, and upgrade to the V2 firmware.

- V2 SeaFET 004 + SBE37-ODO 14987:
  Both instruments were still recording at the time of recovery, with no particular issues noted. The V2 SeaFET definitely seems more predictable and reliable than the V1.
  The clock offset was negligible (-16s).
  A CTD cast was conducted next to the mooring before recovery, and discrete water samples taken for dissolved oxygen, DIC/TA and nutrients, which will be used to calibrate the sensors.

The raw data from both instruments seem in good agreement at the start of the deployment until spring 2021 (Figure 16.1), when the data interruptions appear for S/N117. The sensors offsets between them appear stable for that period, except for the conductivity which seems to indicate a drift of one or both sensors. The SeapHOx datasets will be post-processed and calibrated after the cruise.

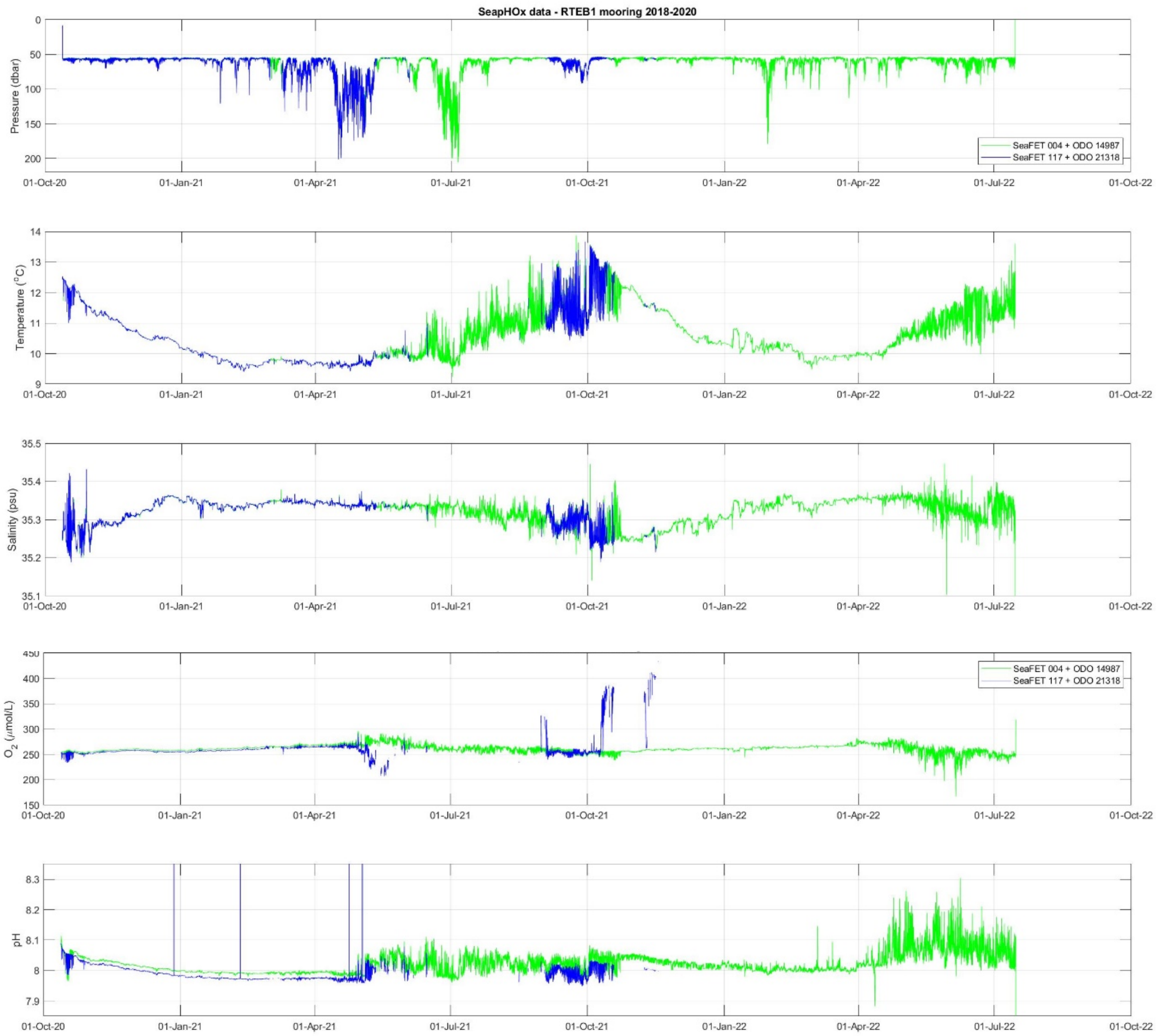


Figure 16.1: comparison of Deep SeapHOx raw data (mooring RTEB1, 50m)

16.4.3.2 Deployments

One Deep SeapHOx, comprising of SeaFET S/N 2002 (V2) and SBE37-ODO S/N 14149, was deployed on EB1.
The ODO was cal-diped separately (for pressure, temperature and conductivity) and produced good results.
Both instruments were fitted with new batteries (Duracell Industrial D-cells – nominal capacity 15,476mAh – and SAFT AA Lithium AA cells), and their clocks synchronised to GPS time.
The ODO baud rate was set to 9600 in SBE SeaTerm V2, before being connected to the SeaFET and the two paired together in the UCI software using the command 'Resync'.
The SeapHOx was then placed in seawater for 3.5 days before deployment, to allow for the SeaFET sensor to recondition after the battery installation.
Since the recovered V2 SeaFET and associated ODO were found to be still operational, the same sampling parameters as in DY120 were used again (3600s sampling interval, 65s pump duration; see full setup log in Appendix V).
Just before deployment the instrument was accidentally placed in a tub of fresh water (tap water) on deck. It was removed after 5 to 10 minutes and put back in the seawater bath until deployment. The SeaFET pH sensor is sensitive and should not be exposed to pure fresh water.
The SeaFET manual reads:

> *Do not put the sensing elements in fresh water: it may cause data to be unstable and damage to the sensor.*
>
> *Do not use high-purity water such as Milli-Q on the sensor. The manufacturer recommends clean tap water over DI water.*

As the incident happened within minutes of deployment we did not have time to check the sensor or turn around one of the recovered SeaFETs; and decided to go ahead with deploying S/N 2002 with the risk of a potentially damaged sensor and unstable data.

16.4.4 Nortek Aquadopp

16.4.4.1 Recoveries

22 Nortek Aquadopps were recovered across the moorings. After recovery the data were downloaded and the clock offsets checked (no significant drift found, maximum +193s). One instrument (S/N 11030 on EB1) was flooded (water ingress at o-ring) and the data could not be retrieved.

16.4.4.2 Deployments

22 Nortek Aquadopps were deployed. Their clocks were synchronised with GPS time, and new batteries fitted prior to deployment (alkaline dual packs, nominal capacity 100Wh). A functional check was performed. They were set to sample every 3600s, with an averaging period of 60s (same setup as the ones recovered; full setup parameters are available in Appendix V).

16.4.5 RDI 300KHz ADCP

16.4.5.1 Recoveries

Six RDI WorkHorse ADCPs 300KHz were recovered from IB3, IB4 and IB5. All were still operational, and no significant issues noted.

16.4.5.2 Deployments

Six ADCPs were deployed on IB3, IB4 and IB5. Before deployment new batteries were installed, clocks synchronised to GPS time, and functional tests performed. The setup parameters were:

- Ensemble interval = 1 hour
- Water pings = 42
- Ping interval = auto (00:01:25.7)
- Number of depth cells = 28
- Depth cell size = 4m

The full setup information is available in Appendix V.

16.4.6 Nortek Signature 55

An upward looking Nortek Signature 55 ADCP was deployed on DY120 in 1000 m of water on the Rockall-Hatton Bank. The Signature55 is a long-range profiler that uses dual frequency, 55kHz and 75kHz, for both long, coarse resolution profiles and shorter, fine resolution. We only use the 55kHz coarse profile to get full water column data recovery over a two-year deployment period.

16.4.6.1 Recovery and data download

The instrument head, connected via subconn cable to an external battery pack, was released from its syntactic buoy frame and plugged in to mains power supply via the 24V DC power converter and LAN plug socket on the ADCP. Once connection was established and the ADCP was using mains power, the battery was then removed and serviced.

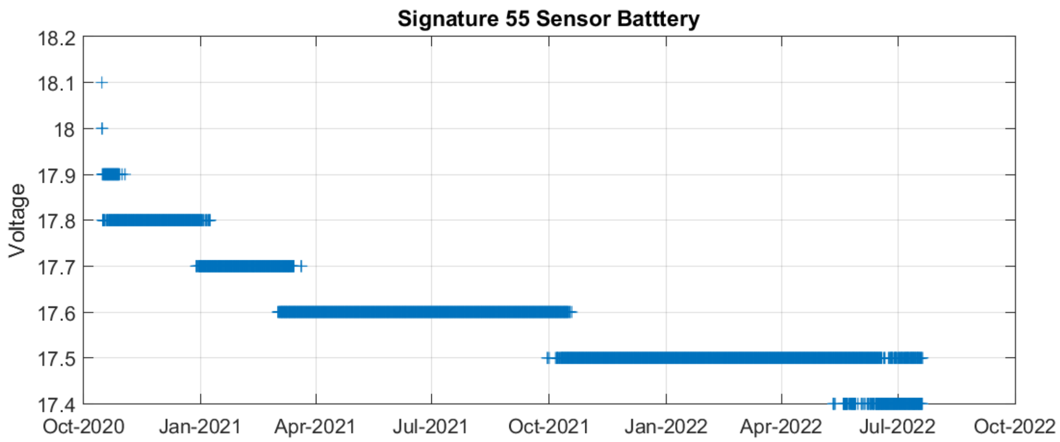


Figure 16.2. Battery voltage during deployment October 2020- July 2022

Date download was done **Recorder Data Retrieval** tab in Nortek Signature Deployment software. Data return was

16.4.6.1.1 Files downloaded

S200044A008_RHADCP_2020_avgd.AD2CP [25 MB]
S200044A008_RHADCP_2020.AD2CP [225 MB]

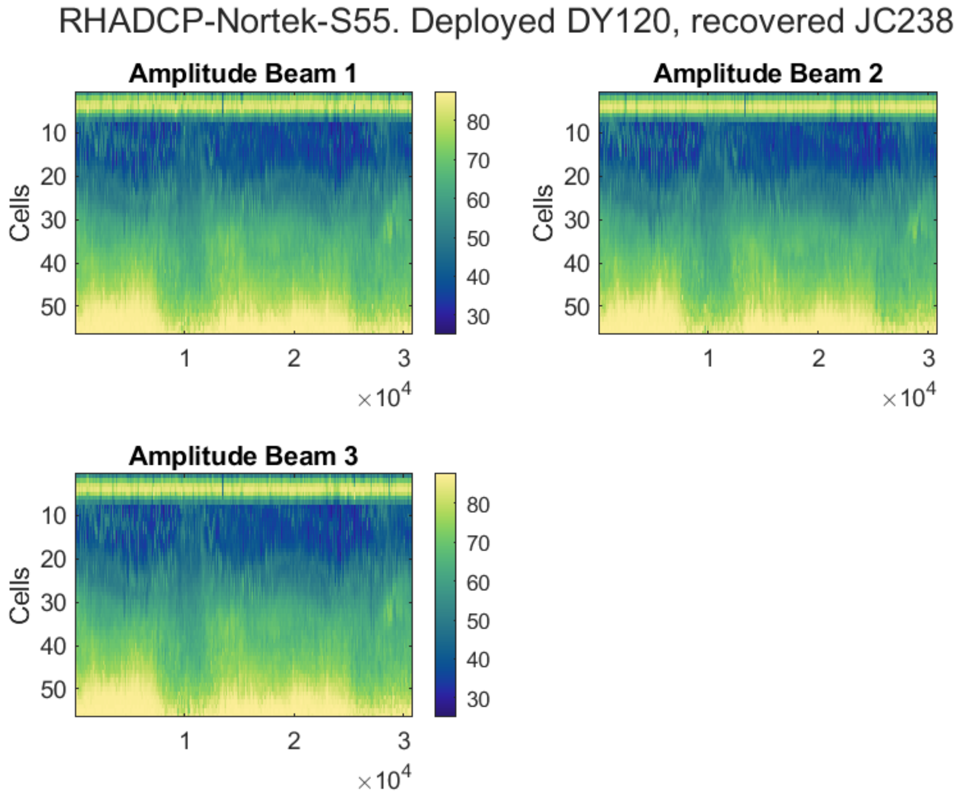


Figure 16.3. Beam amplitude of S55 deployed on RHADCP.

16.4.6.2 Redeployment

The S55 was redeployed with memory cleared and replacement battery pack. The S55's firmware was updated, in accordance with the Nortek guidance. The current firmware update for this Signature 55 is *Signature55_SECV6056_BBPV2214_12.ad2*

16.4.6.3 Functionality check

Pre-deployment checks followed those outlined in the Signature55 Operations Manual by using the help section accessed through the instrument software – Nortek Signature Deployment. While connected to mains power and using communication via ethernet cable, the instrument was loaded with test parameters from file AD2CP_55kHz_900001_test_RHADCP.deploy. This file was generated according to the instructions in the software, using a sampling frequency of 6 s. Parameters observed during the functionality check are summarised in Figure 16.4. Compass calibration was not attempted due to the abundance of metals on the ship.

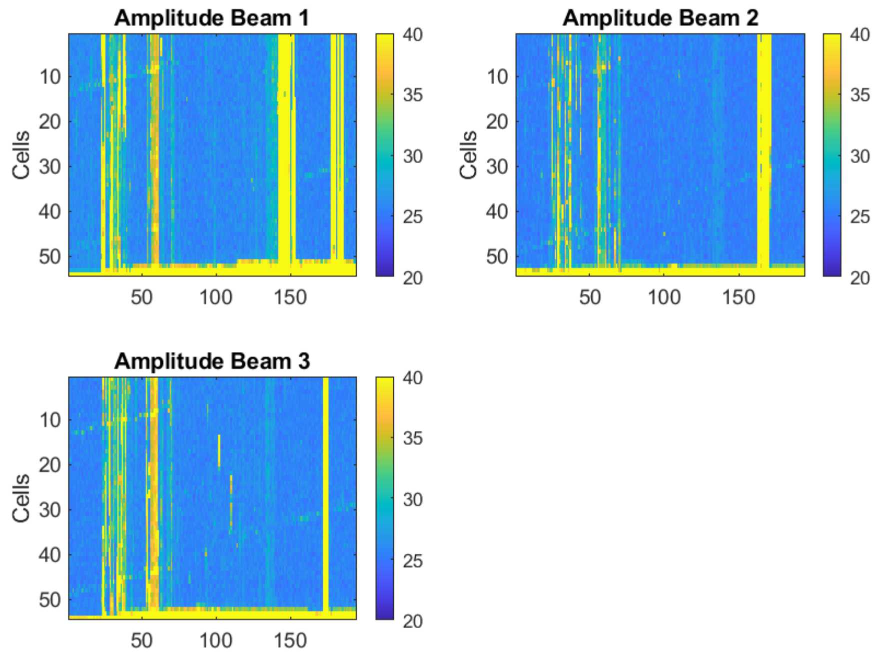


Figure 16.4. Amplitude test results from functionality test on Nortek S55 S.N. J20268-002

A new deployment file (AD2CP_55kHz_900001_RHAD2_JC238.deploy) was created. Sampling was set to commence immediately by selecting **Online > Start Data Collection**, and select the .deploy file. A blue LED light (which blinks every time a ping is sent by the instrument) was observed at deployment start and 30 mins thereafter.

Configuration	Summary
Name	Coarse profile
Performance	
Configured length (days)	790
Estimated max length (days)	976.3
Battery capacity (Wh)	3600
Power usage (Wh)	2912.9
Recorder capacity (MB)	15258.8
Memory usage (MB)	304.7
Data sampling	
Power level (dB)	-2
Long range mode	ON
Multiplexing	ON
Number of pings	10
Slanted beams	
Horizontal prec. (cm/s)	2.09
Vertical prec. (cm/s)	0.54
Velocity range (m/s)	1
Vertical beams	
Vertical prec. (cm/s)	n/a
Velocity range (m/s)	n/a

Measurement range	
Desired range (m)	1022
Configured range (m)	1122
Estimated range (m)	1022.3
Blanking distance (m)	2
Cell size (m)	20
Number of cells	56
Number of beams	3
Altimeter	OFF
Ice drift	OFF
Pulse distance	n/a
Altimeter start (m)	n/a
Altimeter end (m)	n/a
Sampling rate	
Measurement interval	00:30:00
Configured average interval	00:01:00
Actual average interval	00:01:00
Sampling rate (Hz)	n/a
#Samples	n/a
Burst duration (s)	n/a

Figure 16.5. Configuration parameters for JC238 deployment of RHADCP, Nortek S55 sn J20268-002

16.5 Mooring Data Processing

16.5.1 MicroCAT processing

Processing of moored SBE 37 microCAT and microCAT-ODO. The steps for processing data are outlined in detail in Osnap-Class Mooring Processing Toolbox user guide *(/programs/m_moorproc_toolbox/Documents/Processing_documents/*). The main steps are:

16.5.1.1 Shipboard calibrations

Cruise CTD files (pre and post deployment)

a) Create the directory for the cruise data: *osnap/cruise_data/$cruise*
b) Copy the cruise data from the archive directory of the cruise data.
    a. Look at the previous year cruise to copy the same type of ctd files (*_1hz.nc, *.ros and *_align_ctm.cnv) for each caldip cast.
    b. The number of the caldip casts can be found in the cruise report or in *osnap\data\moor\proc_calib*cruise*\cal_dip (cast*info.dat).*

16.5.1.2 Microcat caldip data

a) Create a cast???info.dat file in *osnap/data/moor/proc_calib/$cruise/cal_dip/* for each caldip that summarizes information about each caldip CTD cast (location, time) and the serial numbers and the deployment periods of the lowered MicroCAT. The deployment period number is used later (part 6b) to create a metadata file of the mooring deployed during the deployment period.

b) Create the directories that will host the raw MicroCAT data files for each CTD cast, *osnap/data/moor/raw/$cruise/microcat_cal_dip/cast???/* (where ??? is the cast number), and move in this directory the raw data file (.hex, .cnv, .xml, .xmlcon, etc..)
c) The script *osnap/exec/$cruise/stage1/microcat/mc_call_caldip.m* loads:
    a. the raw microcat data located in *osnap/data/moor/raw/$cruise/microcat_cal_dip/$castnber/*
    b. the shipboard CTD data (if new calibrated ctd files are available after the cruise, the *_raw.nc and *_psal.nc have to be replaced) files for the $castnber (in *osnap/data/$cruise/)*
    c. The caldip metadata file castnnninfo.dat file located in *osnap/data/moor/proc_calib/$cruise/cal_dip/.*
d) mc_call_caldip.m writes to a directory *~/osnap/data/moor/proc_calib/cal_dip/$cruise/microcat/$castnber/* which is created manually. Plots are generated for all microcat data for one CTD cast with the shipboard CTD data. Note that the raw microcat files have to be named as serialnumber_cal_dip_data.cnv.
e) The script *osnap/exec/$cruise/stage1/microcat/mc_caldip_check_$cruise.m* provides a quick quantitative comparison of Microcat cal-dip data with the SBE911 data from the CTD. Data obtained at the deepest bottle stops are used. For each instrument differences of conductivity, temperature and pressure between the instrument and the CTD sensor were calculated. The mean and standard deviation of the differences for each instrument are then presented in a table in *~/osnap/data/moor/proc_calib/cal_dip/$cruise/microcat/$castnber$/microcat_check$castnber$.log*

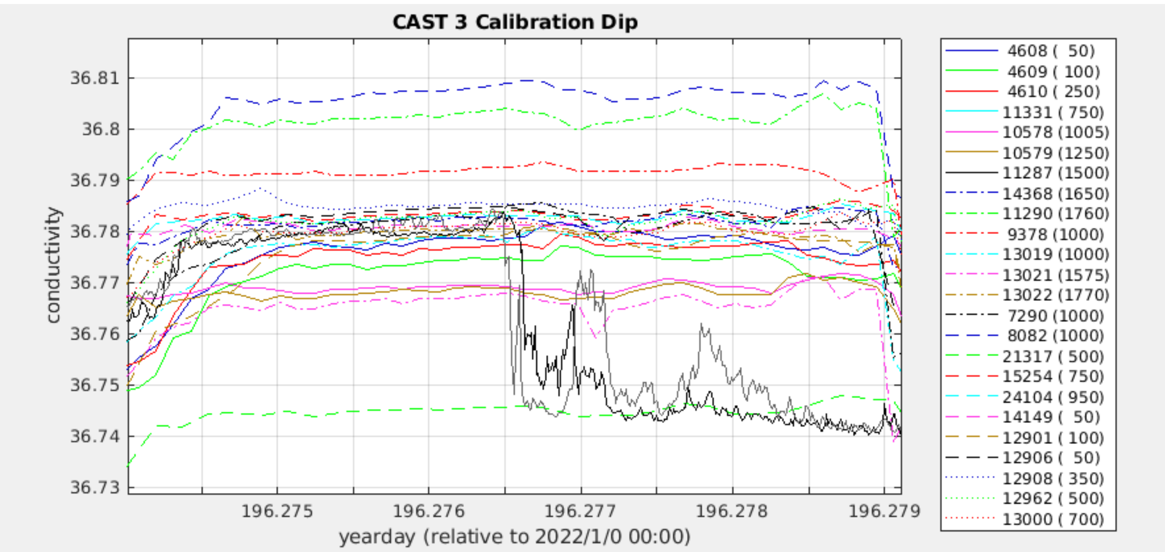


Figure 16.6. Conductivity data from calibration dip

16.5.1.3 Microcat deployment data

a) Create a data processing control file $moorname$info.dat for each mooring in the directory osnap/data/moor/proc/$moorname$. The $moorname$info.dat file contains metadata for mooring position (lon, lat, waterdepth and mean magnetic deviation during the deployment), deployment period, nominal depths and serial numbers of each instrument. *see previous cruise folder for an example.

b) Copy the raw SBE37 files (with .cnv files) in the directory osnap/data/moor/raw/$cruise/microcat/. If the raw .cnv files are not named as $serialnumber_data.cnv, rename them.

c) Edit (paths to the data, mooring name, year of the first measurement) and run the script *osnap/exec/$cruise/stage1/microcat/mc_call_2_$cruise.m* : convert the raw data to RDB formatted file .raw for an entire mooring. The processed data are stored in *osnap/data/moor/proc/$moor/microcat/*

d) Check that the deployment time and recovery time are accurate in the corresponding *$osnap/data/moor/proc/$moor/moor_info.dat* file, then edit and run *osnap/exec/$cruise/ stage2/microcat/microcat_raw2use_003_with_ODO.m* . This script generates *.use* files (launching and recovery period removed) in *osnap/data/moor/proc/$moor/microcat/* . The script also creates data overview sheet including basic statistics, and produces summary plots, including 2-day low-pass plots

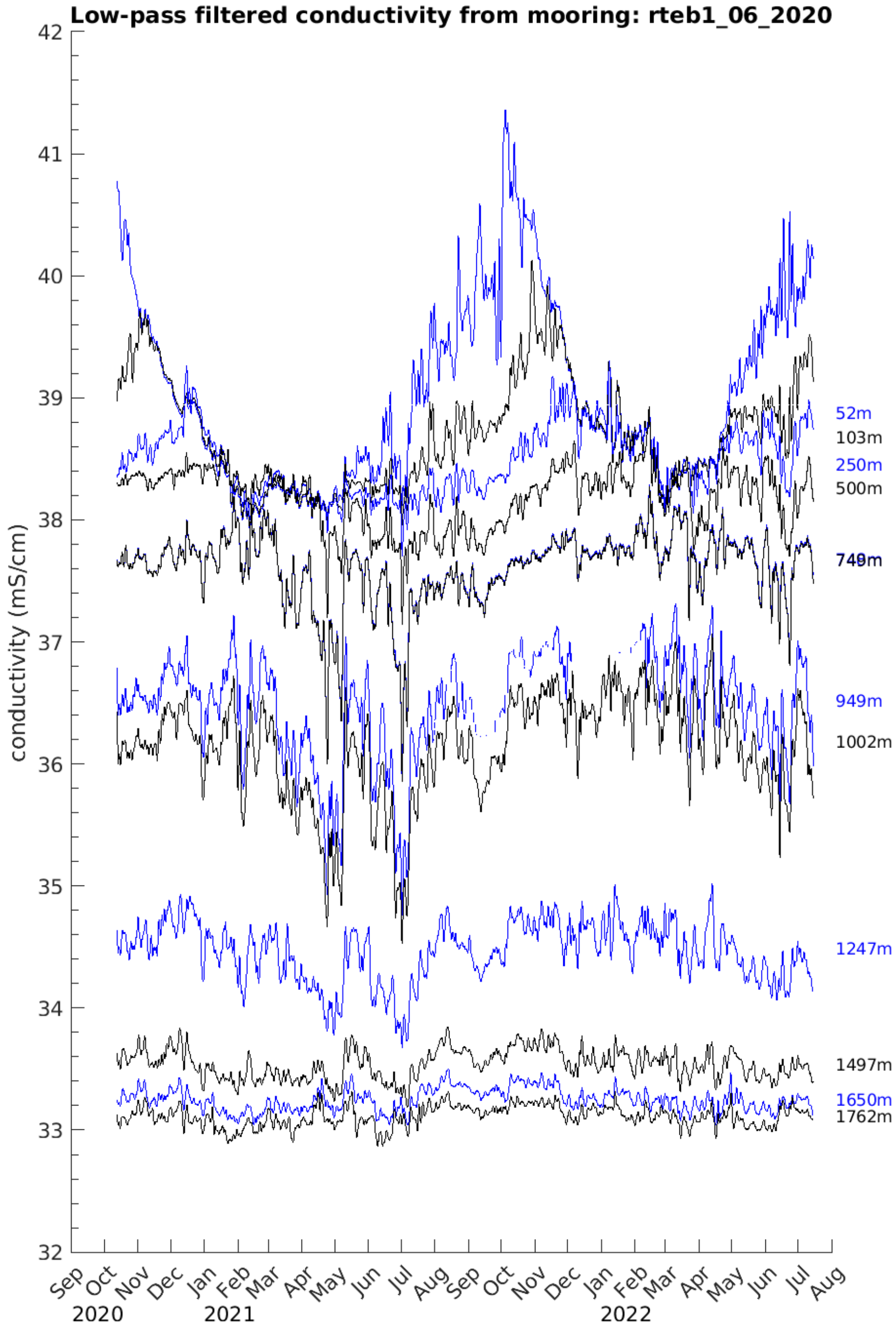


Figure 16.7. Conductivity overlay from EB1.

16.5.2 DeepSeapHOx Data Processing

SeapHOx data were downloaded and transferred to the network drive, then copied onto the processing computer in the directory *osnap/data/moor/raw/jc238/seaphox*. The data output from the instrument was to .CSV and .CTD file format. Processing steps:

1. A text file containing the serial number of the instrument and each data filename was created (rteb1_06_2020_filenames.txt) .
2. Run *process_seaphox.m*, which calls *seaphox2rodb.m*

3. Run seaphox_raw2use.m

16.5.3 Moored current-meter data processing (ADCP & single-point)

Lewis Drysdale, Sam T. Diabaté

All OSNAP moorings possess hydroacoustic instruments measuring oceanic currents. They are of two kinds, namely 1) Acoustic Doppler Current Profilers (ADCPs), which measure currents over a depth range ; and 2) single-point current-meters, which more simply measure the currents at their deployment depth. The single-point current-meter deployed on the OSNAP mooring recovered during this cruise are all Nortek Aquadopp, while the ADCPs are all Teledyne-RI, at the exception of the Nortek S55 ADCP installed at the RHADCP mooring, covered in section 16.4.6.

The processing of ADCP and Aquadopp data is the subject of the present section. After each recovery, data was downloaded by the NMF technicians and transferred to the ship intranet[1]. Processing was performed to succinctly check instrument operation and data quality. The processing scripts include editing, initial quality control, filtering, gridding, and eventually visualization. Data processing is made up of four stages – in addition to initial download – summarized in Figure 16.8, where the top (bottom) row features the workflow for single-point current-meters (ADCPs).

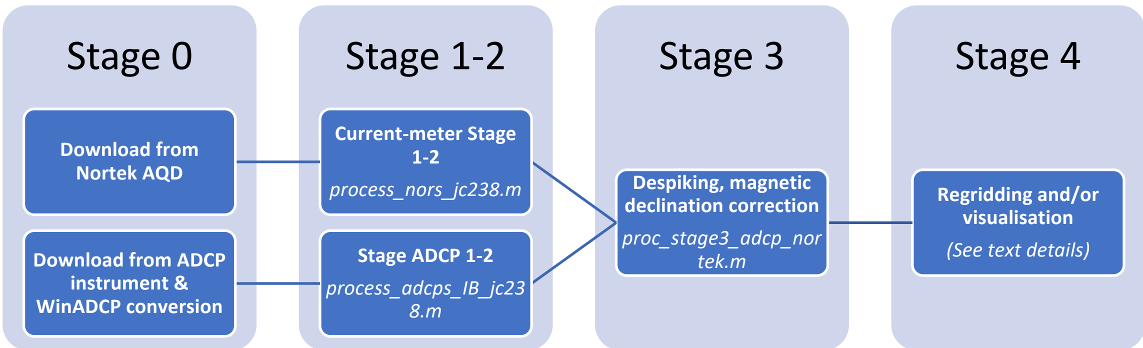


Figure 16.8 Current meter/profiler workflow.

16.5.3.1 Single-point current-meter stage 1 and 2 processing

A precise processing guide is given in the OSNAP-CLASS mooring processing toolbox guide, section **Processing of moored current meter and ADCP data**. Here we present a summary of the processing completed during jc238.

Filenames and directory trees were arranged following the general functioning of the OSNAP-CLASS processing toolbox. For each moored instrument, the three Aquadopps data files ($Num_data.dat, $Num_data.aqd, and $Num_data.hdr ; where $Num stands for the instrument serial number) were copied to the moored raw data folder on *pstar*[2], together with one informative text file for each mooring. The later text files, named

In these footnotes and the following, ***pstar*** = smb://koaekea.local/pstar and ***cook*** = smb://cookfs.cook.local.
--
[1] In the folders /Nortek/ and /adcp/ within ***cook***/JC238/Sensors_and_Moorings/Moorings/Recovery/$MooringName/
[2] In ***pstar***/osnap/data/moor/raw/jc238/nortek/

$Mooring_$DeplNum_$DeplYear_filenames.txt contained the list of all Aquadopps per moorings and the name of the associated .dat files (see Fig. 16.9). **The bottom-most current-meter (serial no. 11030) installed at 1768m on the RTEB1 mooring line was flooded, and its data could not be downloaded by the NMF technicians.** Its entry in rteb1_06_2020_filenames.txt was hence removed and no processing was performed for this instrument.

```
rteb1_06_2020_filenames.txt
1  11021 11021_data.dat
2  11023 11023_data.dat
3  11026 11026_data.dat
4  11028 11028_data.dat
5  11029 11029_data.dat
```

Figure 16.9. Content of the informative text file (here for rteb1). This file needs to be placed in the same folder as the *.dat, *.aqd, and *.hdr data files.

Lookup paths necessary to run the processing scripts can be set up in Matlab by running the function *startupjc238.m*[3]. Here, the function *startupjc238_Sam_PstarMountedOnMac.m*[4] was used instead, as it allowed Sam Diabaté to work from his local Matlab install, with *pstar* mounted as an external device (/Volumes/pstar/…). In addition to setting the look-up paths, this also change the working directory to the /stage1/ folder within the broader repertory of the OSNAP-CLASS processing toolbox[5].

The script *process_nors_jc238.m* was run, which performs stage 1 and stage 2 of the processing. It removes launching and recovery periods, converts data to .raw and generates an informative sheet containing mooring position, instrument serial numbers, etc. For each single-point current-meter, *process_nors_jc238.m* also produces plots of the u,v and w velocities against time, which can be used for diagnostics.

16.5.3.2 ADCP stage 1 and 2 processing

ADCP data files (*.000) were converted to .mat files by Lewis Drysdale and Sam Diabaté using WinADCP, and subsequently copied to the processing computer pstar[6]. The naming was set-up to match instructions ($serialnumber_data.mat). The script *process_adcps_IB_jc238.m* was run, performing stage 1 and stage 2 of the processing. Similar to *process_nors_jc238.m* for the Nortek Aquadopps, it removes launching and recovery periods and converts data to .raw. For each ADCP bin, process_adcps_IB_jc238.m also produces plots of the u,v and w velocities against time, which can be used for diagnostics.

The input depth during instrument setup was 1970m for 13872 on the IB4 mooring, which is incorrect. The approximate depth was in fact around 94 meters. This was corrected for when

[3] In ***pstar***/osnap
[4] Ibid
[5] In ***pstar***/programs/m_moorproc_toolbox/exec/gitrepo
[6] In ***pstar***/osnap/data/moor/raw/jc238/adcp/

running *process_adcps_IB_jc238.m* by indicating 'no' when asked whether a pressure sensor was mounted on the ADCP, and indicating 94 meters for the nominal depth when asked. A more precise nominal depth should be sought.

16.5.3.3 Stage 3 processing of single-point current-meter and ADCP data

Rockall Trough moorings do not feature ADCP, while Icelandic Basin moorings do. In both cases, processing stage 3 can only be done if processing stages 1 and 2 have been completed on the Nortek Aquadopp data first. For the Icelandic Basin moorings, the ADCP stage 1 and 2 must be completed in addition. In that case, the ADCP nominal depths, instrument numbers and serial numbers must be manually indicated in the informative sheet generated during the stage 1 single-point current meter processing. This text file is found in the mooring processed data folder[7]. Stage 3 was done by running *proc_stage3_adcp_nortek.m* which performs the following:

1. Removal of the data with 'percentage good' below 75% (ADCP only).
2. Correction for magnetic declination.
3. Correction for sound speed deviations from 1500 m/s.
4. De-spiking was done using the default spike/mean ratio of 10, and no additional manual de-spiking was performed.
5. Low-pass filtering of the de-spiked data using a fourty-hour Butterworth filter, and interpolation onto 12-hour timesteps.

While the two last steps are automatically performed by *proc_stage3_adcp_nortek.m*, some information must be indicated by the operator to perform magnetic declination and sound speed corrections. Prior to the execution of *proc_stage3_adcp_nortek.m* and for each mooring, the magnetic declination at the median deployment date was indicated in the information sheet[8]. These values, obtained from the NOAA Magnetic Field Calculators[9] are: RTEB1= 4.25W, RTWB2= 5.58W, RTWB1= 5.76W, IB5= 8.84W, IB4= 11.21W, and IB3= 11.73W. During the execution of *proc_stage3_adcp_nortek.m*, a fixed salinity value of 35.1 was indicated in the Matlab prompt when asked. This information, together with the temperature recorded by the instruments, allows *proc_stage3_adcp_nortek.m* to compute density and eventually sound velocity.

16.5.3.4 Stage 4: Regridding and/or visualisation of ADCP and single-point current-meter data

Aquadopp data was re-gridded on a regular 20dbar interval using interpolation. This action was performed by running *velocity_grid_nor_osnap_jc238.m*[10]. This script also produced a .mat file which was used to create stick plots of the currents at the Rockall Trough moorings (See Figs. 16.10, 16.11, and 16.12).

The ADCP data was not merged with the single-point data. Contour plots were nonetheless generated showing horizontal velocities obtained from both upward and downward looking ADCPs (See Figs. 16.13, 16.14, and 16.15). This was done using *plot_ADCP_data_IB.m*[11].

[7] ***pstar***/osnap/data/moor/proc/$Mooring_$DeplNum_$DeplYear/$Mooring_$DeplNum_$DeplYearinfo.dat
[8] ***pstar***/osnap/data/moor/proc/$Mooring_$DeplNum_$DeplYear/$Mooring_$DeplNum_$DeplYearinfo.dat
[9] https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml
[10] ***pstar***/programs/m_moorproc_toolbox/exec/gitrepo/stage3/gridding/CM/velocity_grid_nor_osnap_jc238.m
[11] ***pstar***/programs/m_moorproc_toolbox/exec/gitrepo/delayed_processing_script/adcp/

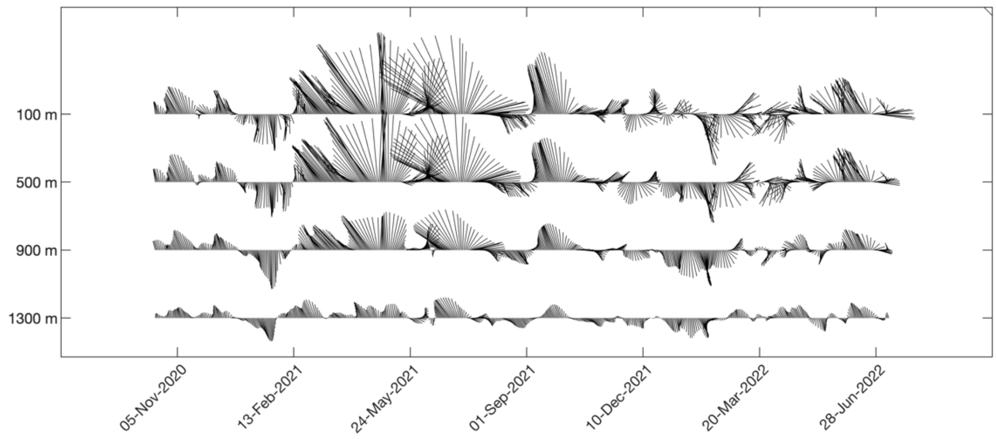


Fig. 16.10. Stick plots of current velocities at RTEB1. 10-day low-pass filtering additional to the other processing steps mentioned in the text.

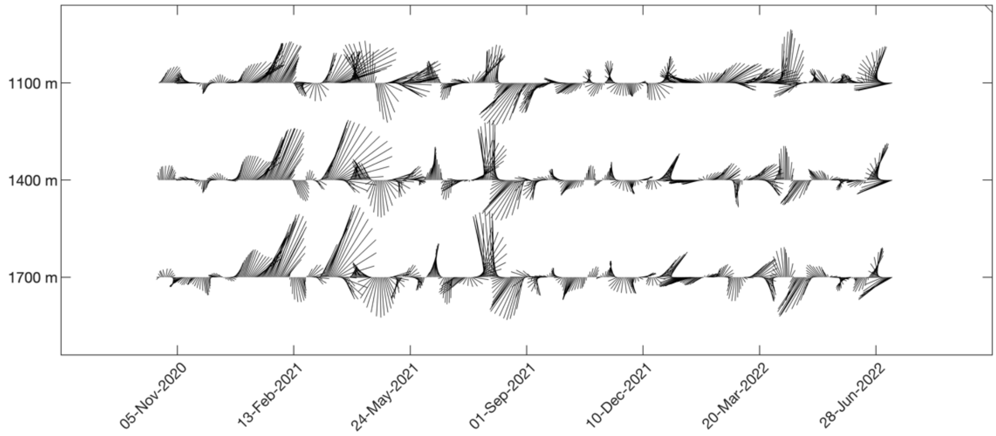


Fig. 16.11. Stick plots of current velocities at RTWB2. 10-day low-pass filtering applied in addition to the other processing mentioned in the text.

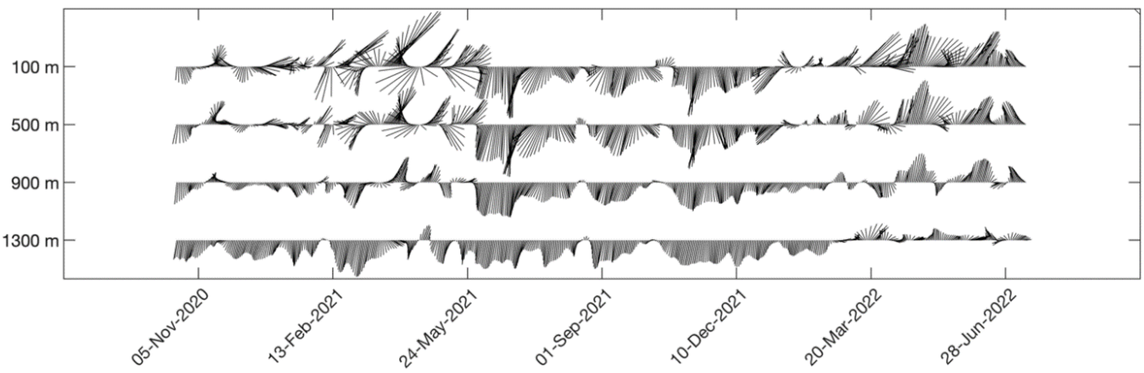


Fig. 16.12. Stick plots of current velocities at RTWB1. 10-day low-pass filtering applied in addition to the other processing mentioned in the text.

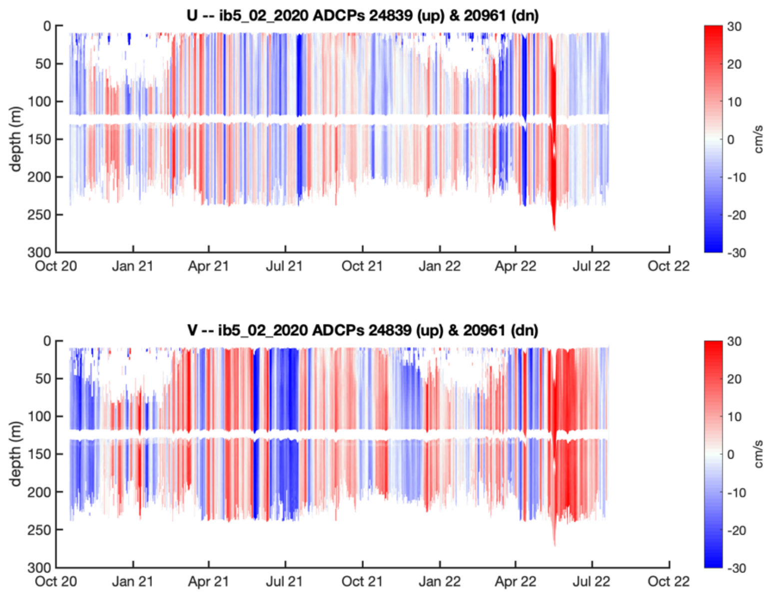


Figure 16.13. ADCP obtained horizontal velocities at IB5.

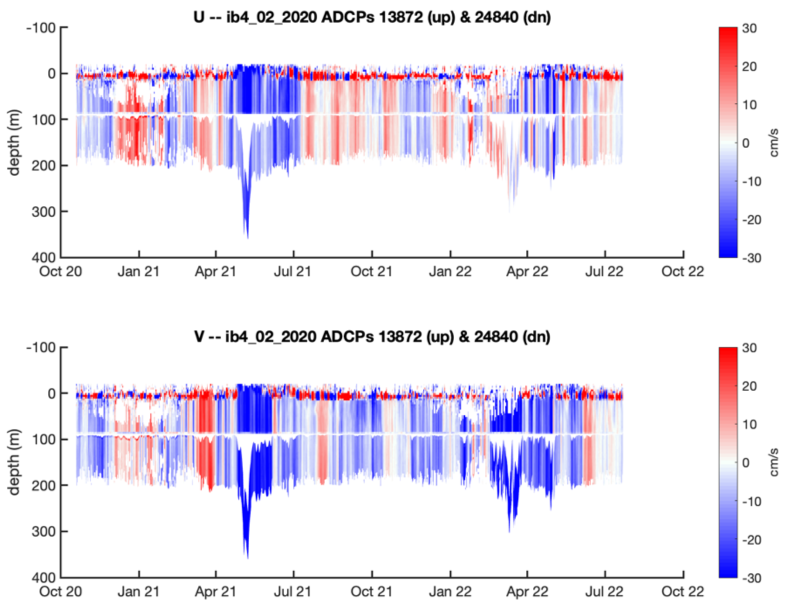


Figure 16.14. ADCP obtained horizontal velocities at IB4. The water line is visible, top bins need to be removed. Also, pressure sensor of the upward looking ADCP need to be looked at.

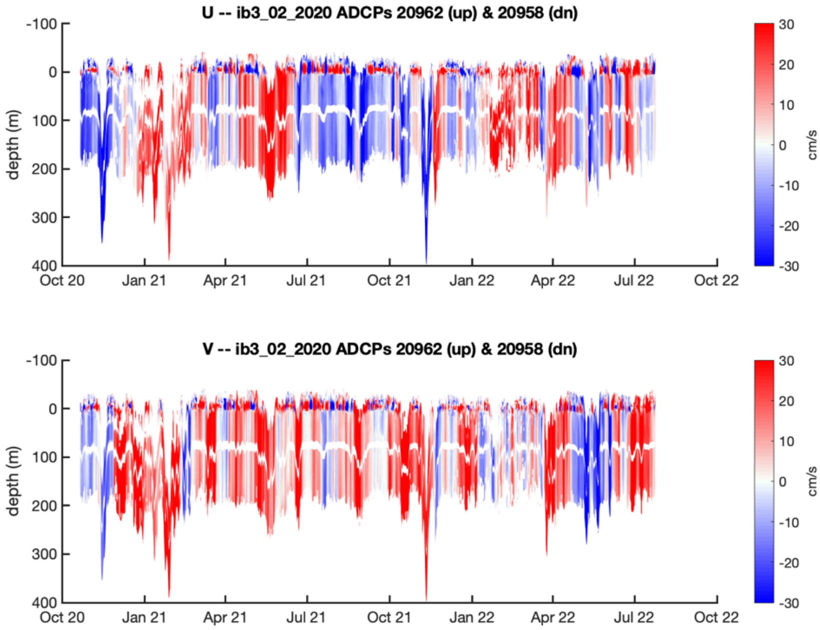


Figure 16.15. ADCP obtained horizontal velocities at IB3.

17 Lander (Fetch-AZA)

Lewis Drysdale, Estelle Dumont, Kristin Burmeister

17.1 Rockall Trough Eastern Boundary Lander (RTEBL1) - Fetch AZA

Before disembarking from Southampton dock, the AZA was connected to its seabed frame using an overhead crane to lower the AZA on to the frame. Command and communication for arming the release screw was via the iWand and using Subsea Array Manager software. The whole package was then secured for transit.

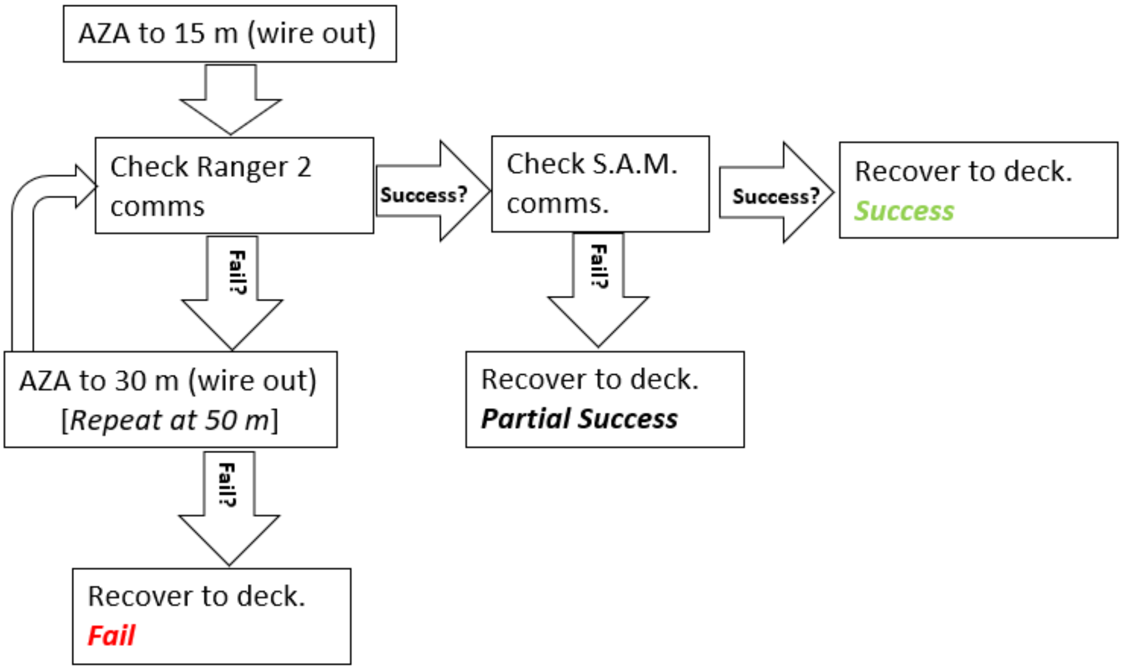
17.2 Acoustic communications test

An acoustic communications test was carried out on 15/07/22 after a CTD station at 57.0907°N , -9.5498°W. The aim of the test was to attempt to establish communication with the AZA using the ships integrated USBL system – Sonardyne Ranger 2 and to attempt to communicate with the AZA using the Subsea Array Manager software (via the Ranger 2 USBL system).

The package was lifted on the auxiliary rope winch on the CTD gantry (starboard) using three lifting strops connected to the lifting shackles on the frame (see picture). The rope winch did not have a depth counter, so the depths were estimated by the winch driver.

The AZA test followed the flow chart pictured below. Communication was established after three depth attempts, 1st at 15 m (rope out), 2nd at 30 m (rope out) and last, where communication was successful, at 50 m (rope out). The USBL system recorded a depth of 70

m. Communication was established via both the Ranger 2 system and the SAM software and the test was deemed a success.



17.3 Deployment

The target position of RTEB1L is 57.10000°N, 9.55000°W, which is 785m east of RTEB1 at a nominal depth of 1790 m.

17.3.1 Deployment Narrative

0915: The on/off magnet was removed from the unit. A red LED was observed and the internal pressure gauge was checked.

0937: A comms test via the iWand allowed successful communication with the unit. Using the SAM software, the preconfigured job was sent to the Fetch-AZA via the iWand (see Fig. 17.1 for logging configuration). Get AZA status command sent, status unknown response. Set to Launch/Recovery mode, HP closed, LP valve open.

1150: Assemble lifting bridle to acoustic release. The custom-made deployment bridle was made up of three lengths of braided rope with spliced loops at each end. Each end of rope was spliced on to a master link attached to the topside shackle of an IXSEA acoustic release. The tail end of each rope length was passed through a shackle on each leg of the lander frame and looped on to the release hook.

1222: Connect via iWand. Get AZA status, HP valve closed, LP valve open. Enter seabed mode, HP valve closed, LP valve open. We clicked the “Start AZA logging” button and were prompted to the “Advanced” button menu set the “Max deployment depth” and “Run single AZA operation” (took 24 min)

1246: The fetch AZA and lander were lifted over the starboard side rail using the CTD gantry and winch and lowered to approximately 70 m depth. Communication via Sonardyne Ranger 2 USBL system work as soon as lander was in water.

1250: Release command sent to IXSEA release: Return - Release OK.

1251: Tracked descent using Sonardyne Ranger 2 USBL (see Fig. 17.2)

1312: Lander at seabed. 57.098354°N, 009.552655°W, pressure sensor of beacon reported a depth of 1790m (see Appendix N). The distance between the final position of the mooring RTEB1 and the lander RTEBL1 is 722m. The final position of the lander is 243m SW of the target position. Successful communication between the lander and the USBL system was established with the ship being at 57°05.877'N, 009°33.102'W.

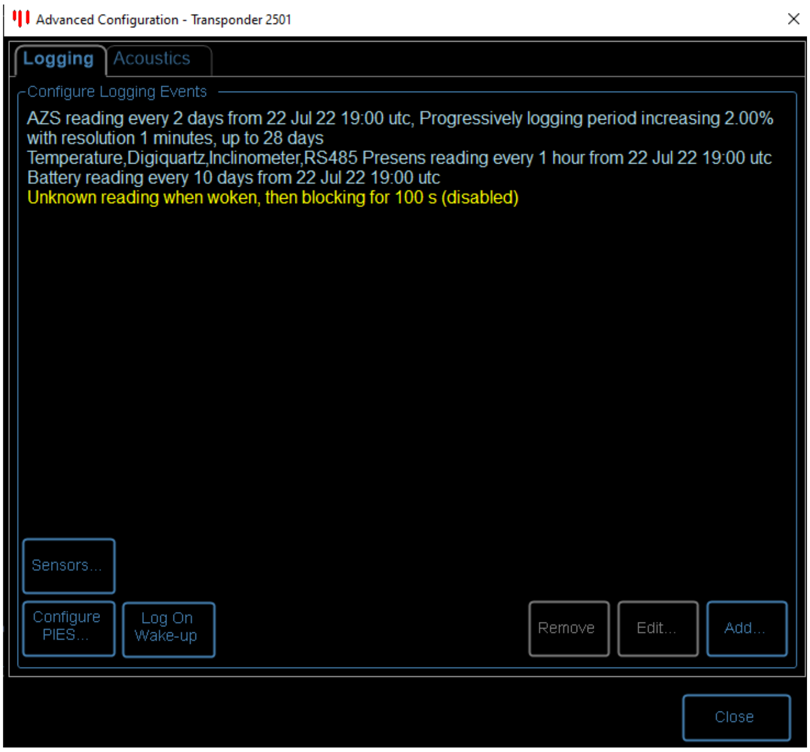


Figure 17.1. S.A.M. configuration screenshot for job: EBL1_deploy as set before deployment of RTEBL1.

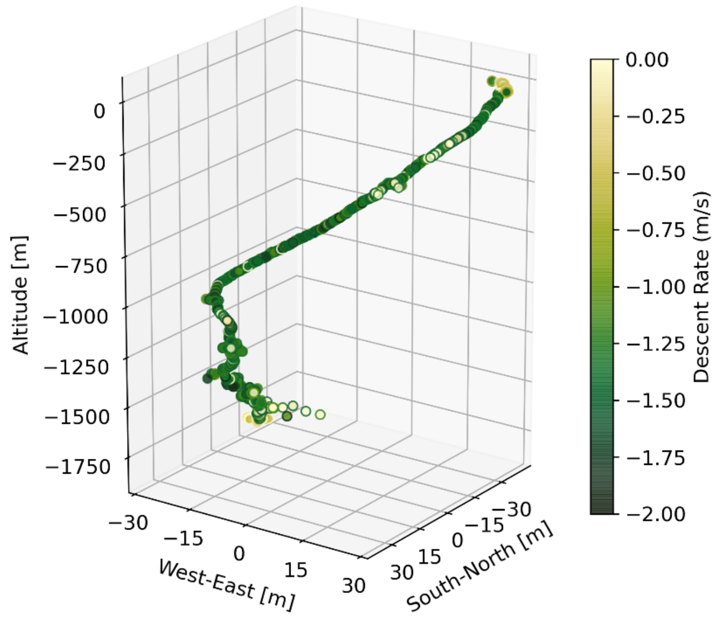


Figure 17.2. Fetch-AZA lander (RTEBL1) trajectory and descent rate as measured by the ships Ranger 2 USBL. Distance between ship and final lander position is 73m. The recorded depth (Dz) was corrected for sound speed ($Dz*c_2/c_1$, with c_1=1466.14 m/s used by USBL [outdated] and c_2=1495.13 m/s as corrected sound speed

18 USBL

Juan Ward and Daniel Phillips

The information in this section has been taken from the NMF Scientific Ship Systems Cruise Report where full details can be found.

Attribute	*Value*
Number of deployments	2
Datetime of last CASIUS	08/02/2022
Starboard Head 1DRMS	Out of calibration since refit 2022
Port Head 1DRMS	63.2 % of beacon positions within 0.40 % Depth At 4560 m depth, 63.2 % of positions are within 18.1 m, 86.5 % are within 26.0 m, 98.2 % are within 43.0 m.

Deployment information:

Deployment name	*Head used*	*Beacon(s) used*	*Datetime Start*	*Datetime End*	*SVP Used (Filename)*
BPR Test Dip	Port	AZA-Fetch (Compatt6)	15/07/2022 13:55	15/07/2022 14:36	FILE2_SVP_19022021*

Deployment name	*Head used*	*Beacon(s) used*	*Datetime Start*	*Datetime End*	*SVP Used (Filename)*
BPR Deployment	Port	AZA-Fetch (Compatt6)	16/07/2022 12:07	16/07/2022 13:22	FILE2_SVP_19022021*

* The sound velocity profile (SVP) was not updated in Ranger2. The calculated uncertainty in seabed position arising from this error is <1.5m horizontally and <34m vertically. See the Appendix for this calculation.

The Sonardyne Subsea Array Manager (SAM) software was installed on the ship's Ranger2 PC. Instructions in "User Manual for the Subsea Array Manager software UM-8313-001" were followed to connect it to the ship's USBL HPT. Communication with the HPT was disabled in Ranger2, and NSH communication was configured in SAM. Testing the HPT from SAM caused a "NoDongle!" error. Sonardyne support advised that our HPT needed acoustic modem functionality enabled. Manual commands were input via Ranger2, following Sonardyne's instructions, to get the HPT parameters and input the upgrade command. The Sonardyne license dongle was then updated using the Sonardyne security tool to enable the required functions for the period of the deployment.

The SAMS team requested the ability to track the BPR to the seabed and then interface with the instrument to check the inclination and sensors. Following Sonardyne's advice, the BPR was added to Ranger2 as a Compatt6, with the BPR's address and turn-around-time applied.

On 15th July, the BPR was deployed to 50m to test communications with the ship's HPT. Ranger2 was able to track the BPR, and it was possible to hand over to the SAM software to interrogate the BPR and change its operating mode.

On the 16th July, the BPR was deployed and dropped using a mooring release transducer. It was tracked in Ranger2 and interrogated with the SAM software once on the seabed. All communications indicated that the BPR was fine and operating as expected. Depth and position data for the deployment was acquired by RVDAS and plotted with a 5-second delay. This data was downloaded by the SAMS team and is included in the RVDAS data directory.

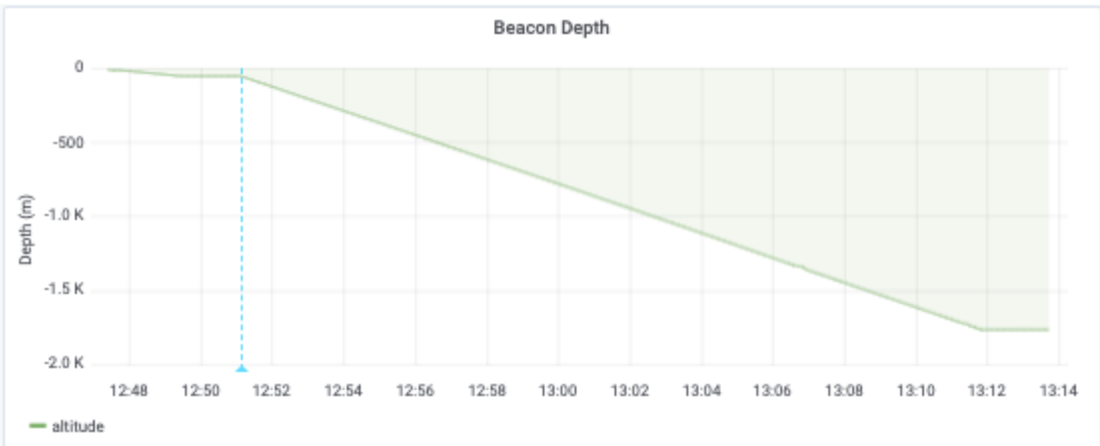


Figure 1 Plot of BPR depth vs time on 17/07/2022.

19 Calibration Dips

Estelle Dumont

All SBE37s and SBE37-ODOs were deployed on the CTD frame for direct comparison to CTD values for five minutes at several depths. For full cal-dips the CTD was stopped for five minutes at every bottle stops; for others (e.g. for shallow rated instruments having to go on a separate, shallow cast, or for the ODOs) only at the bottom and at the depths the instruments were recovered from and/or going to be deployed at.

The comparisons provide calibration points for the mooring instrumentation either pre or post-deployment calibrations, instrument functioning and as a rapid assessment of whether to redeploy and instrument or return ashore for servicing and laboratory calibration. These calibration dips are a critical factor in tracing the instrument accuracy and stability back to a stable reference standard in the field. Final calibrations are obtained post final CTD calibration.

These calibration casts are summarised below. For details on the cal-dip data processing see Section 16.5.1. For individual instruments cal-dip results see tables in Appendices D and E.

Caldip No	**0**		**1**		**2**		**2b**	
CTD cast	**1 (test)**		**3 (EEL N)**		**4 (EEL N)**		**19 (EEL D)**	
Depth (m)	**1000**		**2090**		**2090**		**1087**	
Caldip stops (m)	**1000, 500**		**all from 2090 to 75**		**all**		**1087, 50**	
Start datetime	**Thu 14 Jul 21:00**		**Fri 15 Jul 05:00**		**Fri 15 Jul 16:40**		**Mon 18 Jul 10:30**	
	S/N	**Deployed JC238**	**S/N**	**Deployed JC238**	**S/N**	**Deployed JC238**	**S/N**	Recovered JC238
Slot 1	9140	EB1	*ODO-14149*	EB1	3207	IB5	9141	EB1
Slot 2			*ODO-15254*	EB1	3212	IB5		
Slot 3			*ODO-21317*	EB1	3213	IB5		
Slot 4			*ODO-24104*	EB1	3219	IB5		
Slot 5			*ODO-12901*		3231	WB2		
Slot 6			*ODO-12906*	IB4	3232			
Slot 7			*ODO-12908*	IB4	3244	WB2		
Slot 8			*ODO-12962*	IB4	3248	IB4		
Slot 9			*ODO-13000*	IB4	3253	IB4		
Slot 10			SAMS-4608	EB1	3254	WB1		
Slot 11			SAMS-4609	EB1	3256	WB1		
Slot 12			SAMS-4610	EB1	3257	WB1		
Slot 13			7290	WB2	3264	IB5		
Slot 14			8082		3276	WB1		
Slot 15			9378	RHADCP	6115	IB5		
Slot 16			10578	EB1	6123	IB5		
Slot 17			10579	EB1	8077			
Slot 18			11287		8078			
Slot 19			11290		8079			
Slot 20			11331		11321	WB1		
Slot 21			13019	EB1	11324	WB1		
Slot 22			13021	EB1	11325	WB1		
Slot 23			13022	EB1	11336	WB1		
Slot 24			14368	EB1	11340	WB1		

Caldip No	3			4	
CTD cast	33 (IB4)			37 (OSNAP 22)	
Depth (m)	2935			1987	
Caldip stops (m)	all			1987, 1000, 650, 500, 100, 50	
Start datetime	Fri 22 Jul 08:00			Sat 23 Jul 06:20	
	S/N	Recovered JC238	Deployed JC238	S/N	Recovered JC238
Slot 1	3221		IB4	*ODO-14987*	EB1
Slot 2	3222		IB4	*ODO-21318*	EB1
Slot 3	3224		IB4	*ODO-21319*	EB1
Slot 4	11287			*ODO-21320*	EB1
Slot 5	11331			*ODO-21560*	EB1
Slot 6	9390	EB1	IB4	*ODO-15298*	IB4
Slot 7	9396	EB1	IB4	*ODO-15476*	IB4
Slot 8	11322	EB1	IB3		
Slot 9	11327	EB1	IB3		
Slot 10	11330	EB1	IB4		
Slot 11	11334	EB1	IB4		
Slot 12	11335	EB1	IB4		
Slot 13	11338	EB1	IB3		
Slot 14	10575	WB2			
Slot 15	11341	WB2	IB3		
Slot 16	13020	WB2			
Slot 17	10576	WB1	IB3		
Slot 18	11137	WB1	IB3		
Slot 19	11139	WB1	IB3		
Slot 20	11342	WB1	IB3		
Slot 21	11343	WB1			
Slot 22	14364	WB1	IB3		
Slot 23	9375	IB5			
Slot 24	14365	IB5	IB4		

Caldip No	5			6		7	
CTD cast	38 (OSNAP24)			43 (OSNAP26)		44 (DARWIN A)	
Depth (m)	3007			2978		1041	
Caldip stops (m)	all			all		1041	
Start datetime	Sat 23 Jul 11:40			Sun 24-Jul 20:45		Wed 27-Jul 11:00	
	S/N	Recovered JC238	Deployed JC238	S/N	Recovered JC238	S/N	Recovered JC238
Slot 1	7923	WB1		3481	IB3	8081	DM
Slot 2	7924	WB1		8443	IB3		
Slot 3	11465	WB1		9373	IB3		
Slot 4	9113	RHADCP		9374	IB3		
Slot 5	10560	IB5	IB3	10559	IB3		
Slot 6	11110	IB5	IB3	11323	IB3		
Slot 7	11288	IB5		11326	IB3		

Slot 8	11289	IB5		11328	IB3		
Slot 9	11320	IB5		11329	IB3		
Slot 10	3218	IB4		11332	IB3		
Slot 11	9372	IB4		11337	IB3		
Slot 12	9377	IB4		14367	IB3		
Slot 13	9391	IB4					
Slot 14	10562	IB4					
Slot 15	10577	IB4					
Slot 16	11109	IB4					
Slot 17	11111	IB4					
Slot 18	11140	IB4	IB3				
Slot 19	11333	IB4					
Slot 20	14353	IB4					
Slot 21	14354	IB4					
Slot 22							
Slot 23							
Slot 24							

Appendix A: SERIAL NUMBERS OF CTD UNDERWATER SENSORS AND HARDWARE

Instrument / Sensor	Manufacturer/ Model	Serial Number	Channel	Casts Used
Primary CTD deck unit	SBE 11plus	11P-19817-0495	n/a	All casts
CTD Underwater Unit	SBE 9plus	09P-39607-0803	n/a	All casts
Stainless steel 24-way frame	NOCS	CTD8	n/a	All casts
Primary Temperature Sensor (frame)	SBE 3P	03P-2729	F0	All casts
Primary Conductivity Sensor (vane)	SBE 4C	04C-2858	F1	All casts
Digiquartz Pressure sensor	Paroscientific	93896	F2	All casts
Secondary Temperature Sensor (frame)	SBE 3P	03P-4814	F3	All casts
Secondary Conductivity Sensor (vane)	SBE 4C	04C-3054	F4	All casts
Primary Pump (frame)	SBE 5T	05T-7516	n/a	All casts
Secondary Pump (vane)	SBE 5T	05T-7517	n/a	All casts
24-way Carousel	SBE 32	32-19817-0243	n/a	All casts
DOST	SBE35	35-34173-0037		All casts
Primary Dissolved Oxygen Sensor (frame)	SBE 43	43-2575	V0	All casts
Secondary Dissolved Oxygen Sensor (vane)	SBE 43	43-2818	V1	All casts
Fluorometer	CTG Aquatracka MKIII	88-2615-126	V2	All casts
Altimeter	Valeport VA500	81632	V3	All casts
PAR Up-looking DWIRR	Biospherical	70510	V4	All casts
pH-combined Sensor	AMT	346	V5	All casts
Transmissometer	WET Labs C-star	CST-1718TR	V6	1 - 3
Transmissometer	WET Labs C-star	CST-2150DR	V6	4 - 44
Light Scattering Sensor	WET Labs BBRTD	759R	V7	All casts
10L Water Samplers	OTE	Set E	n/a	Odd numbers only Leaking bottle #1 replaced with #2 prior to cast 42
Upward-looking LADCP	TRDI/WHM300kHz	4275	n/a	All casts
Downward-looking LADCP	TRDI/WHM300kHz	12369	n/a	All casts
LADCP Battery Pack	NOCS	WH010T	n/a	All casts

APPENDIX B: SEA-BIRD 9*PLUS* CONFIGURATION FILE

Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 0
Voltage words suppressed : 0
Computer interface : RS-232C
Deck unit : SBE11plus Firmware Version >= 5.0
Scans to average : 1
NMEA position data added : Yes
NMEA depth data added : No
NMEA time added : No
NMEA device connected to : PC
Surface PAR voltage added : No
Scan time added : Yes

1) Frequency 0, Temperature
Serial number : 03P-2729
Calibrated on : 28 April 2021
G : 4.35500409e-003
H : 6.41383712e-004
I : 2.30182565e-005
J : 2.18587894e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency 1, Conductivity
Serial number : 04C-2858
Calibrated on : 13 August 2020
G : -1.02345407e+001
H : 1.43849461e+000
I : 5.45418632e-004
J : 3.74711409e-005
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC
Serial number : 93896
Calibrated on : 12 November 2020
C1 : -8.331332e+004
C2 : -3.281962e-001
C3 : 2.216060e-002
D1 : 2.906000e-002
D2 : 0.000000e+000
T1 : 3.005232e+001

T2 : -3.843669e-004
T3 : 4.436390e-006
T4 : 0.000000e+000
T5 : 0.000000e+000
Slope : 1.00005000
Offset : -2.68480
AD590M : 1.289250e-002
AD590B : -8.106440e+000

4) Frequency 3, Temperature, 2
Serial number : 03P-4814
Calibrated on : 28 April 2021
G : 4.30087112e-003
H : 6.24277868e-004
I : 1.83296789e-005
J : 1.23535239e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency 4, Conductivity, 2
Serial number : 04C-3054
Calibrated on : 28 April 2021
G : -9.80228664e+000
H : 1.42049812e+000
I : 2.65690865e-004
J : 6.44135237e-005
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

6) A/D voltage 0, Oxygen, SBE 43
Serial number : 43-2575
Calibrated on : 28 April 2021
Equation : Sea-Bird
Soc : 4.33300e-001
Offset : -4.60300e-001
A : -4.69600e-003
B : 2.02790e-004
C : -2.46080e-006
E : 3.60000e-002
Tau20 : 1.22000e+000
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

7) A/D voltage 1, Oxygen, SBE 43, 2

Serial number : 43-2818
Calibrated on : 17 May 2022
Equation : Sea-Bird
Soc : 4.68200e-001
Offset : -4.98700e-001
A : -4.57880e-003
B : 2.37850e-004
C : -3.67760e-006
E : 3.60000e-002
Tau20 : 1.64000e+000
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

8) A/D voltage 2, Fluorometer, Chelsea Aqua 3
Serial number : 88-2615-126
Calibrated on : 17 November 2020
VB : 0.260123
V1 : 1.975280
Vacetone : 0.783490
Scale factor : 1.000000
Slope : 1.000000
Offset : 0.000000

9) A/D voltage 3, Altimeter
Serial number : 81632
Calibrated on : 9 June 2022
Scale factor : 15.000
Offset : 0.000

10) A/D voltage 4, PAR/Irradiance, Biospherical/Licor
Serial number : 70510
Calibrated on : 13 August 2021
M : 1.00000000
B : 0.00000000
Calibration constant : 16666670000.00000000
Conversion units : umol photons/m^2/sec
Multiplier : 1.00000000
Offset : -0.06110141

11) A/D voltage 5, pH
Serial number : 346
Calibrated on : 7 February 2022
pH slope : 5.7970
pH offset : 2.4305

12) A/D voltage 6, Transmissometer, WET Labs C-Star
Serial number : CST-2150DR

Calibrated on : 17 Sept 2021
M : 21.4869
B : -0.1311
Path length : 0.250

13) A/D voltage 7, OBS, WET Labs, ECO-BB
Serial number : 759R
Calibrated on : 10 December 2019
ScaleFactor : 0.003806
Dark output : 0.040600

APPENDIX C: SUMMARY OF CTD STATION NUMBERS, DATES, POSITIONS, DEPTH

Summary of CTD stations: station designation, CTD cast number, start, bottom, and end times, latitude and longitude, water depth (from CTD pressure+altimeter) and depth reached by CTD, number of Niskins fired and number sampled for salts, oxygen, nutrients, and carbon.

Station	CTD cast	yy/mm/dd	latitude	longitude	water depth	max depth	Niskins	salts	oxygen	nuts	carbon	notes
					m	m						
		22/07/14 2111										
	1	22/07/14 2150	56 46.231 N	009 10.321 W	1088	1001	4	12	0	0	0	Test
		22/07/14 2231										
		22/07/15 0118										
EB1	2	22/07/15 0202	57 05.268 N	009 32.800 W	1790	1781	8	9	1	3	3	pre
		22/07/15 0257										
		22/07/15 0457										
EEL N	3	22/07/15 0549	57 13.939 N	010 02.848 W	2100	2091	12	12	10	0	0	caldip
		22/07/15 0740										
		22/07/15 1643										
EEL N	4	22/07/15 1729	57 13.866 N	010 02.891 W	2101	2091	12	12	11	11	0	
		22/07/15 1927										
		22/07/15 2316										
EEL R	5	22/07/15 2323	56 59.965 N	008 59.806 W	133	123	6	6	6	6	0	
		22/07/15 2341										
		22/07/16 0045										
EEL Q	6	22/07/16 0056	57 03.070 N	009 13.067 W	314	304	7	7	5	7	0	
		22/07/16 0121										
		22/07/16 0221										
EEL P	7	22/07/16 0257	57 06.071 N	009 25.075 W	1417	1408	11	10	12	10	6	
		22/07/16 0347										
		22/07/16 0507										
EEL O	8	22/07/16 0548	57 08.990 N	009 41.986 W	1925	1915	12	12	11	12	7	
		22/07/16 0654										
		22/07/16 1352										
EB1	9	22/07/16 1435	57 06.691 N	009 34.716 W	1809	1799	8	12	6	3	3	post
		22/07/16 1524										
		22/07/16 1857										
EEL M	10	22/07/16 1943	57 18.100 N	010 22.900 W	2208	2198	12	12	10	12	9	
		22/07/16 2101										
		22/07/16 2241										
EEL L	11	22/07/16 2331	57 22.022 N	010 39.986 W	2112	2101	12	12	12	12	7	
		22/07/17 0041										
		22/07/17 0213										
EEL K	12	22/07/17 0238	57 23.952 N	010 52.044 W	783	773	8	8	7	8	0	
		22/07/17 0317										
		22/07/17 0425										
EEL J	13	22/07/17 0444	57 26.882 N	011 05.166 W	584	573	7	7	6	7	0	
		22/07/17 0517										
		22/07/17 1849										
EEL I	14	22/07/17 1913	57 28.092 N	011 19.108 W	749	739	7	7	4	4	0	
		22/07/17 1947										
		22/07/17 2048										
EEL H	15	22/07/17 2134	57 28.956 N	011 31.924 W	2016	2006	12	12	5	12	9	
		22/07/17 2232										
		22/07/17 2356										
EEL G	16	22/07/18 0036	57 29.554 N	011 50.953 W	1789	1779	12	12	12	12	0	
		22/07/18 0138										
		22/07/18 0324										
EEL F	17	22/07/18 0403	57 30.475 N	012 14.760 W	1800	1789	12	11	5	11	8	
		22/07/18 0504										
		22/07/18 0747										
EEL E	18	22/07/18 0831	57 31.980 N	012 37.980 W	1640	1630	11	11	5	11	0	
		22/07/18 0927										
		22/07/18 1033										
EEL D	19	22/07/18 1110	57 32.524 N	012 51.968 W	1099	1088	9	8	3	8	8	
		22/07/18 1153										
		22/07/18 1729										
EEL C	20	22/07/18 1744	57 32.946 N	012 59.968 W	295	285	7	7	7	7	0	
		22/07/18 1807										
		22/07/18 1935										
EEL B	21	22/07/18 1944	57 34.032 N	013 19.962 W	177	165	6	6	5	6	5	
		22/07/18 2002										
		22/07/18 2114										
EEL A	22	22/07/18 2124	57 35.003 N	013 37.889 W	114	104	3	3	3	0	0	
		22/07/18 2132										
		22/07/18 2343										
RAG 160	23	22/07/18 2352	57 35.549 N	014 16.019 W	196	185	6	4	3	5	4	
		22/07/19 0012										
		22/07/19 1822										
RAG 159	24	22/07/19 1840	57 36.241 N	014 53.934 W	477	466	7	7	7	7	0	
		22/07/19 1905										
		22/07/19 2146										
RAG 158	25	22/07/19 2225	57 36.845 N	015 31.825 W	1055	1045	8	7	8	8	7	
		22/07/19 2307										
		22/07/20 0428										
RAG 156	26	22/07/20 0457	57 38.083 N	016 47.675 W	1191	1181	8	8	8	8	0	
		22/07/20 0536										
		22/07/20 1715										
RAG 157	27	22/07/20 1743	57 37.404 N	016 09.978 W	1171	1161	8	8	8	8	0	
		22/07/20 1818										
		22/07/20 2228										
RAG 155	28	22/07/20 2302	57 38.800 N	017 25.918 W	1223	1213	8	8	7	8	8	
		22/07/20 2346										
		22/07/21 0200										
RAG 154	29	22/07/21 0227	57 39.394 N	018 03.845 W	1058	1047	8	8	7	8	0	
		22/07/21 0306										

Station	CTD cast	yy/mm/dd	latitude	longitude	water depth	max depth	Niskins	salts	oxygen	nuts	carbon	notes
					m	m						
		22/07/21 1356										
OSNAP 17	30	22/07/21 1421	57 39.949 N	018 41.864 W	712	702	7	7	7	0	0	
		22/07/21 1449										
		22/07/21 1658										
OSNAP 18	31	22/07/21 1722	57 43.729 N	019 13.645 W	910	899	8	8	8	0	5	
		22/07/21 1757										
		22/07/21 1955										
OSNAP 19	32	22/07/21 2031	57 47.488 N	019 44.752 W	1304	1293	10	10	9	10	0	
		22/07/21 2119										
		22/07/22 0301										
IB4	33	22/07/22 0410	57 58.838 N	021 09.832 W	2946	2935	12	12	7	12	9	pre
		22/07/22 0605										
		22/07/22 1643										
IB4	34	22/07/22 1741	57 58.903 N	021 09.768 W	2945	2935	12	12	12	12	0	post
		22/07/22 1857										
		22/07/22 2306										
OSNAP 20	35	22/07/22 2344	57 50.141 N	020 08.502 W	1567	1556	11	11	11	11	8	
		22/07/23 0038										
		22/07/23 0205										
OSNAP 21	36	22/07/23 0250	57 52.679 N	020 29.812 W	2242	2232	12	12	12	12	0	
		22/07/23 0359										
		22/07/23 0625										
OSNAP 22	37	22/07/23 0709	57 54.913 N	020 51.211 W	1997	1987	12	12	12	12	10	
		22/07/23 0831										
		22/07/23 1142										
OSNAP 24	38	22/07/23 1248	57 57.450 N	021 51.451 W	3018	3007	12	12	11	12	10	
		22/07/23 1441										
		22/07/23 1705										
OSNAP 25	39	22/07/23 1811	57 57.463 N	022 30.815 W	2982	2972	12	12	11	12	0	
		22/07/23 1929										
		22/07/23 2340										
OSNAP 27	40	22/07/24 0039	57 57.524 N	023 50.124 W	2935	2925	12	12	12	12	0	
		22/07/24 0210										
		22/07/24 0436										
OSNAP 28	41	22/07/24 0540	57 57.656 N	024 29.264 W	2826	2814	12	11	11	12	0	
		22/07/24 0707										
		22/07/24 2023										
OSNAP 26	42	22/07/24 2031	57 57.629 N	023 10.396 W	2989	100	0	0	0	0	0	aborted
		22/07/24 2036										
		22/07/24 2047										
OSNAP 26	43	22/07/24 2152	57 57.626 N	023 10.394 W	2989	2978	12	12	11	12	10	
		22/07/24 2339										
		22/07/27 1107										
Darwin M.	44	22/07/27 1140	59 51.205 N	007 03.361 W	1042	1032	5	0	0	0	0	
		22/07/27 1208										

APPENDIX D: MICROCAT CTDS. DEPLOYED, RECOVERED, CALIBRATION DIPS

good = temperature offset <0.01°C, conductivity offset < 0.015 mS/cm, pressure offset variable

SN	Owner	Caldip ref	Caldip CTD cast	Caldip result	Recovered JC238	Recovered depth	Deployed JC238	Deployed depth (nominal)
9140	SAMS	0	1	good	-	-	EB1	500
4608	SAMS	1	3	good	-	-	EB1	50
4609	SAMS	1	3	good	-	-	EB1	100
4610	SAMS	1	3	good	-	-	EB1	250
7290	NMF	1	3	good	-	-	WB2	1000
8082	NMF	1	3	cond diff ~0.02 mS/cm	-	-	-	-
9378	NMF	1	3	good	-	-	RHADCP	1000
10578	NMF	1	3	good	-	-	EB1	1005
10579	NMF	1	3	good	-	-	EB1	1250
11290	NMF	1	3	cond diff 0.015-0.02 mS/cm	-	-	-	-
13019	NMF	1	3	good	-	-	EB1	750
13021	NMF	1	3	good	-	-	EB1	1500
13022	NMF	1	3	good	-	-	EB1	1760
14368	NMF	1	3	good	-	-	EB1	1650
3207	NMF	2	4	good	-	-	IB5	500
3212	NMF	2	4	good	-	-	IB5	50
3213	NMF	2	4	good	-	-	IB5	105
3219	NMF	2	4	good	-	-	IB5	200
3231	NMF	2	4	good, seems better at depth	-	-	WB2	1770
3232	NMF	2	4	cond diff >=0.02 mS/cm	-	-	-	-
3244	NMF	2	4	good	-	-	WB2	1575
3248	NMF	2	4	good	-	-	IB4	500
3253	NMF	2	4	cond diff ~0.015 mS/cm	-	-	IB4	350
3254	NMF	2	4	good	-	-	WB1	1000
3256	NMF	2	4	good	-	-	WB1	1250
3257	NMF	2	4	good	-	-	WB1	1500
3264	NMF	2	4	good	-	-	IB5	700
3276	NMF	2	4	good	-	-	WB1	1575
6115	NMF	2	4	good	-	-	IB5	350
6123	NMF	2	4	good	-	-	IB5	920
8077	NMF	2	4	cond diff ~0.02 mS/cm	-	-	-	-
8078	NMF	2	4	cond diff ~0.02 mS/cm	-	-	-	-
8079	NMF	2	4	cond diff ~0.02 mS/cm	-	-	-	-
11321	NMF	2	4	good	-	-	WB1	50
11324	NMF	2	4	good	-	-	WB1	100
11325	NMF	2	4	good	-	-	WB1	250
11336	NMF	2	4	good	-	-	WB1	500
11340	NMF	2	4	good	-	-	WB1	750
9141	SAMS	2b	19	cond diff ~0.02 mS/cm	EB1	52	-	-

SN	Owner	Caldip ref	Caldip CTD cast	Caldip result	Recovered JC238	Recovered depth	Deployed JC238	Deployed depth (nominal)
3221	NMF	3	33	good	-	-	IB4	50
3222	NMF	3	33	good	-	-	IB4	2300
3224	NMF	3	33	good	-	-	IB4	200
9375	NMF	3	33	good	IB5	874	IB4	900
9390	NMF	3	33	good	EB1	1650	IB4	1200
9396	NMF	3	33	good	EB1	250	IB4	1500
10575	NMF	3	33	cond diff 0.015-0.02 mS/cm	WB2	1005	-	-
10576	NMF	3	33	good	WB1	1499	IB3	2300
11137	NMF	3	33	good	WB1	1000	IB3	1900
11139	NMF	3	33	good	WB1	1248	IB3	1500
11287	NMF	1, 3	33	data issue at both caldips	-	-	-	-
11322	NMF	3	33	good	EB1	103	IB3	900
11327	NMF	3	33	good	EB1	748	IB3	1200
11330	NMF	3	33	good	EB1	1002	IB4	100
11331	NMF	1, 3	33	data issue at both caldips	-	-	-	-
11334	NMF	3	33	good	EB1	1247	IB4	700
11335	NMF	3	33	good	EB1	1497	IB4	1900
11338	NMF	3	33	good	EB1	1762	IB3	2800
11341	NMF	3	33	good	WB2	1576	IB3	100
11342	NMF	3	33	good	WB1	106	IB3	200
11343	NMF	3	33	cond diff ~0.02 mS/cm	WB1	49	-	-
13020	NMF	3	33	cond diff ~0.13 mS/cm	WB2	1771	-	-
14364	NMF	3	33	good	WB1	247	IB3	50
14365	NMF	3	33	good	IB5	480	IB4	2800
9113	SAMS	5	38	cond diff ~3 mS/cm	RHADCP	1070	-	-
11465	NMF	5	38	good	WB1	1573	-	-
7923	SAMS	5	38	cond diff >0.02 mS/cm	WB1	499	-	-
7924	SAMS	5	38	cond diff 0.015-0.02 mS/cm	WB1	750	-	-
9391	NMF	5	38	good	IB4	47	-	-
14353	NMF	5	38	good	IB4	103	-	-
11109	NMF	5	38	good	IB4	498	DM	950
11111	NMF	5	38	good	IB4	698	-	-
9372	NMF	5	38	cond diff 0.015-0.02 mS/cm	IB4	901	-	-
14354	NMF	5	38	cond diff >0.02 mS/cm	IB4	199	-	-
11333	NMF	5	38	data issue	IB4	348	-	-
3218	NMF	5	38	good	IB4	1199	-	-
11140	NMF	5	38	good	IB4	1502	IB3	700
10562	NMF	5	38	good	IB4	1902	-	-
10577	NMF	5	38	good	IB4	2302	DM	1025
9377	NMF	5	38	good	IB4	2802	-	-
10560	NMF	5	38	good	IB5	33	IB3	350
11289	NMF	5	38	cond diff >0.02 mS/cm	IB5	89	-	-
11320	NMF	5	38	good	IB5	685	-	-
11288	NMF	5	38	cond diff 0.015-0.02 mS/cm	IB5	184	-	-

SN	Owner	Caldip ref	Caldip CTD cast	Caldip result	Recovered JC238	Recovered depth	Deployed JC238	Deployed depth (nominal)
11110	NMF	5	38	good	IB5	329	IB3	500
10559	NMF	6	43	good	IB3	47	-	-
11332	NMF	6	43	cond diff ~0.02 mS/cm	IB3	103	-	-
11337	NMF	6	43	good	IB3	199	-	-
11323	NMF	6	43	cond diff 0.015-0.02 mS/cm	IB3	348	-	-
9374	NMF	6	43	good	IB3	498	-	-
3481	NMF	6	43	data issue	IB3	698	-	-
11329	NMF	6	43	cond diff >0.02 mS/cm	IB3	901	-	-
9373	NMF	6	43	good	IB3	1199	-	-
14367	NMF	6	43	cond diff >10 mS/cm	IB3	1502	-	-
11328	NMF	6	43	good	IB3	1902	-	-
11326	NMF	6	43	cond diff ~0.02 mS/cm	IB3	2302	-	-
8443	NMF	6	43	good	IB3	2802	-	-
8081	NMF	7	44	tbc	DM	1025	-	-

APPENDIX E: MICROCAT ODOS. DEPLOYED, RECOVERED, CALIBRATION DIPS

good = temperature offset <0.01°C, conductivity offset < 0.015 mS/cm, pressure offset variable

SN	Owner	Caldip ref	Caldip CTD cast	Caldip result	Recovered JC238	Recovered depth	Deployed JC238	Deployed depth (nominal)	Comments
21317	SAMS	1	2	oxy good, cond bad			EB1	500	cond not good (0.04 mS/cm) but next to SBE37, oxy ok
15254	SAMS	1	2	good	-	-	EB1	750	
24104	SAMS	1	2	good	-	-	EB1	950	
14149	NMF	1	2	good	-	-	EB1 (SeapHOx)	50	
12901	NMF	1	2	good	-	-	-	-	
12906	NMF	1	2	good	-	-	IB4	50	
12908	NMF	1	2	good	-	-	IB4	350	
12962	NMF	1	2	good	-	-	IB4	500	
13000	NMF	1	2	good	-	-	IB4	700	
14987	SAMS	4	37	cond diff ~0.02 mS/cm	EB1 (SeapHOx)	53	-	-	
21318	SAMS	4	37	data issue	EB1 (SeapHOx)	54	-	-	comms issues, pump running continuously after caldip, data issues during caldip
21560	SAMS	4	37	good	EB1	500	-	-	
21320	SAMS	4	37	good	EB1	749	-	-	
21319	SAMS	4	37	good	EB1	949	-	-	
15298	SAMS	4	37	cond diff >5 mS/cm	IB4	47	-	-	comms issues after cast
15476	SAMS	4	37	cond diff >30 mS/cm	IB4	499	-	-	

APPENDIX F: MICROCAT ODOS. DEPLOYED, RECOVERED.

SN	Owner	Recovered JC238	Recovered depth	Deployed JC238	Deployed depth (nominal)
117	SAMS	EB1	50	-	-
004	NMF	EB1	50	-	-
2002	NMF	-	-	EB1	50

APPENDIX G: NORTEK CURRENT METERS. DEPLOYED, RECOVERED.

SN	Owner	Recovered JC238	Recovered depth (nominal)	Deployed JC238	Deployed depth (nominal)	Comments
11034	NMF	-	-	EB1	100	
8364	NMF	-	-	EB1	250	
6242	NMF	-	-	EB1	500	
9822	NMF	-	-	EB1	1000	
9853	NMF	-	-	EB1	1350	
6273	NMF	-	-	EB1	1770	
6276	NMF	-	-	WB2	1000	
6534	NMF	-	-	WB2	1350	
6723	NMF	-	-	WB2	1770	
8120	NMF	-	-	WB1	100	
9881	NMF	-	-	WB1	500	
9213	NMF	-	-	WB1	1000	
11997	NMF	-	-	WB1	1350	
9874	NMF	-	-	WB1	1600	
11990	NMF	-	-	IB5	500	
11992	NMF	-	-	IB5	925	
11979	NMF	-	-	IB4	2300	
12047	NMF	-	-	IB4	2800	
11021	NMF	EB1	100	IB4	1500	
11023	NMF	EB1	250	-	-	
11026	NMF	EB1	500	IB3	1500	
11028	NMF	EB1	1000	IB3	2300	
11029	NMF	EB1	1350	IB3	2800	
11030	NMF	EB1	1770	-	-	water ingress in bulkhead, data not recovered
8080	NMF	WB2	1000	-	-	
11042	NMF	WB2	1350	-	-	
11046	NMF	WB2	1770	-	-	
11047	NMF	WB1	100	-	-	
11048	NMF	WB1	500	-	-	
11055	NMF	WB1	1000	-	-	
13018	NMF	WB1	1350	-	-	
9861	NMF	WB1	1570	-	-	
11069	NMF	IB5	500	-	-	
11063	NMF	IB5	880	-	-	
11064	NMF	IB4	1500	-	-	
11067	NMF	IB4	2300	-	-	
11058	NMF	IB4	2800	-	-	
13130	NMF	IB3	1500	-	-	
11051	NMF	IB3	2300	-	-	

SN	Owner	Recovered JC238	Recovered depth (nominal)	Deployed JC238	Deployed depth (nominal)	Comments
13142	NMF	IB3	2800	-	-	

APPENDIX H: WORKHORSE 300 KHZ ADCPS. DEPLOYED, RECOVERED.

SN	Owner	Recovered JC238	Recovered depth (nominal)	Deployed JC238	Deployed depth (nominal)
20957	NMF	-	-	IB5 - U	100
20959	NMF	-	-	IB5 - D	100
20960	NMF	-	-	IB4 - U	100
24589	NMF	-	-	IB4 - D	100
24588	NMF	-	-	IB3 - U	100
24587	NMF	-	-	IB3 - D	100
24170	NMF	-	-	DM - D	1000
24839	NMF	IB5 - U	100	-	-
20961	NMF	IB5 - D	100	-	-
13872	NMF	IB4 - U	100	-	-
24840	NMF	IB4 - D	100	-	-
20962	NMF	IB3 - U	100	-	-
20958	NMF	IB3 - D	100	-	-
22790	NMF	DM - D	1000	-	-

APPENDIX I: IRIDIUM BEACONS. DEPLOYED, RECOVERED.

SN	IMEI	Owner	Recovered JC238	Deployed JC238
B11-055	300234060570000	NMF	EB1 (mid)	EB1 (top)
B11-042	300234060477980	NMF	EB1 (top)	EB1 (mid)
B11-041	300234060475980	NMF	WB2	WB2
B11-052	300234060573000	NMF	WB1 (top)	WB1 (top)
B11-048	300234060474980	NMF	WB1 (mid)	WB1 (mid)
B11-049	300234060571000	NMF	RHADCP	RHADCP
B11-054	300234060475730	NMF	IB5	IB5
B11-046	300234060475990	NMF	IB4	IB4
B11-050	300234060572000	NMF	IB3	IB3
B11-045	300234060476980	NMF	DM	-
B11-043	300234063561040	NMF	-	DM

APPENDIX J: LIGHT BEACONS. DEPLOYED, RECOVERED.

SN	Owner	Recovered JC238	Deployed JC238
B11-039	NMF	-	EB1 (top)
B11-033	NMF	EB1 (mid)	EB1 (mid)
B11-035	NMF	WB2	WB2
B11-034	NMF	WB1 (top)	WB1 (top)
B11-038	NMF	WB1 (mid)	WB1 (mid)
B11-040	NMF	RHADCP	RHADCP
B11-026	NMF	IB5	IB5
B11-029	NMF	IB4	IB4
B11-030	NMF	IB3	IB3

SN	Owner	Recovered JC238	Deployed JC238
B11-027	NMF	DM	DM
B11-028	NMF	EB1 (top)	-

APPENDIX K: ACOUSTIC RELEASES. DEPLOYED, RECOVERED.

SN	Owner	Deployed JC238
1761	NMF	EB1
2000	NMF	EB1
2307	NMF	WB2
2326	NMF	WB2
1754	NMF	WB1
2508	NMF	WB1
1272	NMF	RHADCP
1753	NMF	RHADCP
1756	NMF	IB5
1764	NMF	IB5
1757	NMF	IB4
2310	NMF	IB4
2311	NMF	IB3
2330	NMF	IB3
1758	NMF	DM

SN	Owner	Recovered JC238
1755	NMF	EB1
1999	NMF	EB1
1494	NMF	WB2
1502	NMF	WB2
1136	NMF	WB1
1752	NMF	WB1
1135	NMF	RHADCP
1137	NMF	RHADCP
1759	NMF	IB5
1765	NMF	IB5
1142	NMF	IB4
1270	NMF	IB4
1492	NMF	IB3
1766	NMF	IB3
1748	NMF	DM
2334	NMF	DM

APPENDIX L: MOORING DATA SUMMARY STATISTICS

OSNAP Mooring Array.
Simple Statisctics for Mooring:- rteb1_06_2020
Mooring deployment - start: 12/10/2020 20:00
end: 15/07/2022 10:30

SN	var	first record	last record	valid records	mean	stdev	min	max
9141	p	12/10/20 20:00	15/07/22 10:00	30749	62.2	17.3	50.9	204.9
	t	12/10/20 20:00	15/07/22 10:00	30749	10.6	0.8	9.2	14.1
	c	12/10/20 20:00	15/07/22 10:00	30749	39.0	0.8	37.8	42.3
11021	p	12/10/20 20:00	15/07/22 10:00	15375	108.8	17.1	98.0	249.3
	t	12/10/20 20:00	15/07/22 10:00	15375	10.3	0.5	9.2	12.2
	u	12/10/20 20:00	15/07/22 10:00	15375	-0.3	12.8	-48.0	43.4
	v	12/10/20 20:00	15/07/22 10:00	15375	6.4	16.5	-56.5	62.6
	spd	12/10/20 20:00	15/07/22 10:00	15375	6.4	11.1	0.1	63.5
	dir	12/10/20 20:00	15/07/22 10:00	15375	357.4	90.8	0.0	359.9
11322	p	12/10/20 20:00	15/07/22 10:00	30749	111.8	17.0	101.4	251.7
	t	12/10/20 20:00	15/07/22 10:00	30749	10.2	0.5	9.1	12.1
	c	12/10/20 20:00	15/07/22 10:00	30749	38.7	0.5	31.2	40.4
11023	p	12/10/20 20:00	15/07/22 10:00	15375	251.8	16.3	241.8	383.1
	t	12/10/20 20:00	15/07/22 10:00	15375	10.0	0.3	8.8	10.9
	u	12/10/20 20:00	15/07/22 10:00	15375	-0.2	11.6	-46.2	39.3
	v	12/10/20 20:00	15/07/22 10:00	15375	6.0	15.4	-54.2	59.5
	spd	12/10/20 20:00	15/07/22 10:00	15375	6.0	10.6	0.0	59.5
	dir	12/10/20 20:00	15/07/22 10:00	15373	358.5	91.5	0.0	359.9
9396	p	12/10/20 20:00	15/07/22 10:00	30749	260.4	16.2	251.1	391.0
	t	12/10/20 20:00	15/07/22 10:00	30749	9.9	0.3	8.7	10.8
	c	12/10/20 20:00	15/07/22 10:00	30749	38.5	0.3	37.3	39.4
11026	p	12/10/20 20:00	15/07/22 10:00	15375	503.9	12.3	496.4	600.6
	t	12/10/20 20:00	15/07/22 10:00	15375	9.6	0.3	8.0	10.4
	u	12/10/20 20:00	15/07/22 10:00	15375	-0.5	10.8	-47.5	33.5
	v	12/10/20 20:00	15/07/22 10:00	15375	4.5	14.1	-49.9	55.1
	spd	12/10/20 20:00	15/07/22 10:00	15375	4.5	9.6	0.1	56.6
	dir	12/10/20 20:00	15/07/22 10:00	15375	354.1	95.7	0.0	359.9
11327	p	12/10/20 20:00	15/07/22 10:00	30749	761.2	9.4	754.8	833.1
	t	12/10/20 20:00	15/07/22 10:00	30749	8.9	0.3	6.5	9.8
	c	12/10/20 20:00	15/07/22 10:00	30749	37.6	0.3	35.4	38.5
11028	p	12/10/20 20:00	15/07/22 10:00	15375	1016.0	7.2	1008.9	1071.7
	t	12/10/20 20:00	15/07/22 10:00	15375	7.3	0.5	5.3	8.4
	u	12/10/20 20:00	15/07/22 10:00	15375	0.1	8.4	-30.2	35.5
	v	12/10/20 20:00	15/07/22 10:00	15375	1.0	10.8	-40.0	38.0
	spd	12/10/20 20:00	15/07/22 10:00	15375	1.0	6.6	0.0	41.7
	dir	12/10/20 20:00	15/07/22 10:00	15374	3.8	102.4	0.0	359.8
11330	p	12/10/20 20:00	15/07/22 10:00	30749	1018.1	7.1	1013.0	1073.1
	t	12/10/20 20:00	15/07/22 10:00	30749	7.2	0.5	5.3	8.4
	c	12/10/20 20:00	15/07/22 10:00	30749	36.1	0.5	34.3	37.3
11334	p	12/10/20 20:00	15/07/22 10:00	30749	1267.6	4.9	1263.3	1306.2
	t	12/10/20 20:00	15/07/22 10:00	30749	5.4	0.3	4.5	6.3
	c	12/10/20 20:00	15/07/22 10:00	30749	34.5	0.3	33.5	35.3
11029	p	12/10/20 20:00	15/07/22 10:00	15375	1372.6	3.9	1368.9	1403.5
	t	12/10/20 20:00	15/07/22 10:00	15375	4.9	0.2	4.2	5.7
	u	12/10/20 20:00	15/07/22 10:00	15375	-0.0	5.0	-21.6	19.2
	v	12/10/20 20:00	15/07/22 10:00	15375	0.7	8.5	-33.1	32.1
	spd	12/10/20 20:00	15/07/22 10:00	15375	0.7	4.8	0.0	33.7
	dir	12/10/20 20:00	15/07/22 10:00	15372	357.5	104.8	0.0	359.7
11335	p	12/10/20 20:00	15/07/22 10:00	30749	1521.0	2.5	1517.5	1540.8
	t	12/10/20 20:00	15/07/22 10:00	30749	4.4	0.1	4.0	4.9
	c	12/10/20 20:00	15/07/22 10:00	30749	33.5	0.1	33.1	34.0
9390	p	12/10/20 20:00	15/07/22 10:00	30749	1676.2	1.5	1673.5	1687.1
	t	12/10/20 20:00	15/07/22 10:00	30749	4.0	0.1	3.7	4.4
	c	12/10/20 20:00	15/07/22 10:00	30749	33.2	0.1	33.0	33.6
11338	p	12/10/20 20:00	15/07/22 10:00	30749	1790.2	0.9	1787.3	1793.7
	t	12/10/20 20:00	15/07/22 10:00	30749	3.8	0.1	3.4	4.2
	c	12/10/20 20:00	15/07/22 10:00	30749	33.1	0.1	32.8	33.4
11030	p	No valid data						
	t	No valid data						
	u	No valid data						
	v	No valid data						
	spd	No valid data						
	dir	No valid data						

OSNAP Mooring Array.
Simple Statisctics for Mooring:- rtwb1_06_2020
Mooring deployment - start: 15/10/2020 10:30
end: 18/07/2022 12:00

SN	var	first record	last record	valid records	mean	stdev	min	max
11343	p	15/10/20 10:30	18/07/22 11:30	30771	44.5	5.4	35.0	107.6
	t	15/10/20 10:30	18/07/22 11:30	30771	10.5	1.0	9.0	14.6
	c	15/10/20 10:30	18/07/22 11:30	30771	38.9	0.9	37.4	42.8
11047	p	15/10/20 11:00	18/07/22 12:00	15386	95.2	5.3	90.7	156.7
	t	15/10/20 11:00	18/07/22 12:00	15386	10.1	0.4	9.0	11.7
	u	15/10/20 11:00	18/07/22 12:00	15386	2.4	12.3	-42.4	56.6
	v	15/10/20 11:00	18/07/22 12:00	15386	-0.6	14.7	-51.4	52.5
	spd	15/10/20 11:00	18/07/22 12:00	15386	2.5	9.6	0.0	66.3
	dir	15/10/20 11:00	18/07/22 12:00	15385	105.1	94.6	0.0	359.8
11342	p	15/10/20 10:30	18/07/22 11:30	30771	100.4	5.3	93.5	161.9
	t	15/10/20 10:30	18/07/22 11:30	30771	10.0	0.4	9.0	11.6
	c	15/10/20 10:30	18/07/22 11:30	30771	38.4	0.4	37.4	40.0
14364	p	15/10/20 10:30	18/07/22 11:30	30771	243.9	4.8	239.6	299.3
	t	15/10/20 10:30	18/07/22 11:30	30771	9.6	0.3	8.9	10.4
	c	15/10/20 10:30	18/07/22 11:30	30771	38.2	0.3	37.4	38.9
11048	p	15/10/20 11:00	18/07/22 12:00	15386	491.4	3.2	488.3	526.4
	t	15/10/20 11:00	18/07/22 12:00	15386	9.3	0.2	8.6	9.9
	u	15/10/20 11:00	18/07/22 12:00	15386	0.1	8.9	-35.2	37.8
	v	15/10/20 11:00	18/07/22 12:00	15386	-1.4	12.7	-50.7	45.2
	spd	15/10/20 11:00	18/07/22 12:00	15386	1.4	7.8	0.1	52.7
	dir	15/10/20 11:00	18/07/22 12:00	15386	175.8	101.5	0.0	359.7
7923	p	15/10/20 10:30	18/07/22 11:30	30771	497.2	3.2	492.8	532.0
	t	15/10/20 10:30	18/07/22 11:30	30771	9.2	0.2	8.5	9.8
	c	15/10/20 10:30	18/07/22 11:30	30771	37.8	0.2	37.2	38.5
7924	p	15/10/20 10:30	18/07/22 11:30	30771	753.6	2.6	750.6	781.7
	t	15/10/20 10:30	18/07/22 11:30	30771	8.5	0.3	7.1	9.1
	c	15/10/20 10:30	18/07/22 11:30	30771	37.2	0.3	35.9	37.9
11055	p	15/10/20 10:30	18/07/22 12:00	30772	1003.9	1.8	1001.2	1023.5
	t	15/10/20 10:30	18/07/22 12:00	30772	6.9	0.4	5.5	8.0
	u	15/10/20 10:30	18/07/22 12:00	30772	-0.8	7.3	-29.6	29.5
	v	15/10/20 10:30	18/07/22 12:00	30772	-3.8	11.2	-40.2	39.9
	spd	15/10/20 10:30	18/07/22 12:00	30772	3.9	6.6	0.0	42.0
	dir	15/10/20 10:30	18/07/22 12:00	30771	191.5	93.2	0.0	359.7
11137	p	15/10/20 10:30	18/07/22 11:30	30771	1009.7	1.7	1007.2	1029.0
	t	15/10/20 10:30	18/07/22 11:30	30771	6.7	0.4	5.4	7.9
	c	15/10/20 10:30	18/07/22 11:30	30771	35.6	0.4	34.4	36.8
11139	p	15/10/20 10:30	18/07/22 11:30	30771	1262.4	1.1	1260.3	1273.3
	t	15/10/20 10:30	18/07/22 11:30	30771	5.3	0.2	4.4	6.0
	c	15/10/20 10:30	18/07/22 11:30	30771	34.3	0.2	33.5	35.0
13018	p	15/10/20 11:00	18/07/22 12:00	15386	1372.9	0.9	1370.9	1380.7
	t	15/10/20 11:00	18/07/22 12:00	15386	4.9	0.2	4.2	5.6
	u	15/10/20 11:00	18/07/22 12:00	15386	-1.1	8.7	-36.4	35.4
	v	15/10/20 11:00	18/07/22 12:00	15386	-5.5	11.0	-46.4	35.0
	spd	15/10/20 11:00	18/07/22 12:00	15386	5.6	7.6	0.1	48.7
	dir	15/10/20 11:00	18/07/22 12:00	15386	191.0	86.8	0.0	359.7
10576	p	15/10/20 10:30	18/07/22 11:30	30771	1517.6	0.7	1515.4	1521.4
	t	15/10/20 10:30	18/07/22 11:30	30771	4.4	0.2	3.7	5.3
	c	15/10/20 10:30	18/07/22 11:30	30771	33.6	0.2	32.9	34.5
9861	p	15/10/20 11:00	18/07/22 12:00	15386	1589.4	0.7	1587.6	1591.7
	t	15/10/20 11:00	18/07/22 12:00	15386	4.2	0.2	3.4	5.1
	u	15/10/20 11:00	18/07/22 12:00	15386	-1.4	8.2	-38.1	33.3
	v	15/10/20 11:00	18/07/22 12:00	15386	-5.4	11.6	-53.5	38.4
	spd	15/10/20 11:00	18/07/22 12:00	15386	5.6	8.0	0.1	58.9
	dir	15/10/20 11:00	18/07/22 12:00	15386	194.0	87.5	0.0	359.7
11465	p	15/10/20 10:30	18/07/22 11:30	30771	1593.9	0.7	1591.0	1595.8
	t	15/10/20 10:30	18/07/22 11:30	30771	4.2	0.2	3.4	5.1
	c	15/10/20 10:30	18/07/22 11:30	30771	33.4	0.2	32.7	34.3

OSNAP Mooring Array.
Simple Statisctics for Mooring:- rtwb2_06_2020
Mooring deployment - start: 14/10/2020 18:00
end: 18/07/2022 07:00

SN	var	first record	last record	valid records	mean	stdev	min	max
8080	p	14/10/20 18:00	17/07/22 10:00	15377	1011.2	9.7	0.0	1089.2
	t	14/10/20 18:00	17/07/22 10:00	15377	6.8	0.5	5.2	12.8
	u	14/10/20 18:00	17/07/22 10:00	15377	0.8	8.1	-32.3	64.8
	v	14/10/20 18:00	17/07/22 10:00	15377	1.7	9.6	-44.6	33.4
	spd	14/10/20 18:00	17/07/22 10:00	15377	1.8	6.1	0.0	78.7
	dir	14/10/20 18:00	17/07/22 10:00	15374	24.5	98.4	0.0	359.8
10575	p	14/10/20 18:00	17/07/22 09:30	30752	1017.0	7.8	7.7	1098.7
	t	14/10/20 18:00	17/07/22 09:30	30752	6.8	0.5	5.2	12.8
	c	14/10/20 18:00	17/07/22 09:30	30752	35.7	0.5	34.1	41.1
11042	p	14/10/20 18:00	17/07/22 10:00	15377	1369.7	11.9	2.1	1441.5
	t	14/10/20 18:00	17/07/22 10:00	15377	5.0	0.2	4.2	13.0
	u	14/10/20 18:00	17/07/22 10:00	15377	0.5	10.1	-28.3	35.9
	v	14/10/20 18:00	17/07/22 10:00	15377	1.3	11.8	-36.8	43.2
	spd	14/10/20 18:00	17/07/22 10:00	15377	1.3	6.6	0.1	49.1
	dir	14/10/20 18:00	17/07/22 10:00	15377	20.2	102.4	0.0	359.7
11341	p	14/10/20 18:00	17/07/22 10:00	30753	1595.0	11.5	191.2	1651.1
	t	14/10/20 18:00	17/07/22 10:00	30753	4.2	0.1	3.8	10.1
	c	14/10/20 18:00	17/07/22 10:00	30753	33.4	0.1	33.0	38.6
11046	p	14/10/20 18:00	17/07/22 10:00	15377	1792.2	14.5	0.0	1800.2
	t	14/10/20 18:00	17/07/22 10:00	15377	3.8	0.1	3.2	12.9
	u	14/10/20 18:00	17/07/22 10:00	15377	0.1	12.3	-36.2	42.8
	v	14/10/20 18:00	17/07/22 10:00	15377	0.1	13.9	-40.3	50.1
	spd	14/10/20 18:00	17/07/22 10:00	15377	0.2	7.3	0.2	57.6
	dir	14/10/20 18:00	17/07/22 10:00	15377	41.6	105.4	0.0	359.8
13020	p	14/10/20 18:00	17/07/22 10:00	30753	1804.6	13.4	9.3	1809.5
	t	14/10/20 18:00	17/07/22 10:00	30753	3.7	0.1	3.2	12.9
	c	14/10/20 18:00	17/07/22 10:00	30753	33.1	0.1	32.6	41.3

OSNAP Mooring Array.
Simple Statisctics for Mooring:- ib5_02_2020
Mooring deployment - start: 16/10/2020 19:00
end: 21/07/2022 07:00

SN	var	first record	last record	valid records	mean	stdev	min	max
10560	p	16/10/20 19:00	21/07/22 06:30	30840	79.4	4.2	74.5	161.6
	t	16/10/20 19:00	21/07/22 06:30	30840	10.1	0.6	8.9	12.5
	c	16/10/20 19:00	21/07/22 06:30	30840	38.5	0.6	37.2	40.7
11289	p	16/10/20 19:00	21/07/22 06:30	30840	136.5	3.9	133.0	213.7
	t	16/10/20 19:00	21/07/22 06:30	30840	9.9	0.5	8.8	11.4
	c	16/10/20 19:00	21/07/22 06:30	30840	38.3	0.4	37.2	39.8
11288	p	16/10/20 19:00	21/07/22 06:30	30840	233.0	3.7	229.9	307.4
	t	16/10/20 19:00	21/07/22 06:30	30840	9.7	0.4	8.8	10.9
	c	16/10/20 19:00	21/07/22 06:30	30840	38.2	0.4	37.3	39.4
11110	p	16/10/20 19:00	21/07/22 06:30	30840	379.0	3.3	376.7	444.4
	t	16/10/20 19:00	21/07/22 06:30	30840	9.4	0.3	8.3	10.5
	c	16/10/20 19:00	21/07/22 06:30	30840	37.9	0.3	36.8	39.0
14365	p	16/10/20 19:00	21/07/22 06:30	30840	530.3	2.6	528.1	580.6
	t	16/10/20 19:00	21/07/22 06:30	30840	9.0	0.3	7.6	9.8
	c	16/10/20 19:00	21/07/22 06:30	30840	37.6	0.3	36.2	38.5
11069	p	16/10/20 19:00	21/07/22 07:00	15421	541.4	5.0	2.4	589.8
	t	16/10/20 19:00	21/07/22 07:00	15421	9.0	0.3	7.7	12.3
	u	16/10/20 19:00	21/07/22 07:00	15421	2.3	9.4	-34.0	51.2
	v	16/10/20 19:00	21/07/22 07:00	15421	4.4	10.4	-29.1	40.7
	spd	16/10/20 19:00	21/07/22 07:00	15421	5.0	7.2	0.1	56.4
	dir	16/10/20 19:00	21/07/22 07:00	15421	27.6	86.7	0.0	359.7
11320	p	16/10/20 19:00	21/07/22 06:30	30840	740.9	1.6	738.8	768.3
	t	16/10/20 19:00	21/07/22 06:30	30840	7.7	0.4	6.2	9.0
	c	16/10/20 19:00	21/07/22 06:30	30840	36.4	0.4	34.9	37.7
9375	p	16/10/20 19:00	21/07/22 06:30	30840	932.2	0.6	930.6	935.8
	t	16/10/20 19:00	21/07/22 06:30	30840	6.2	0.5	4.3	7.9
	c	16/10/20 19:00	21/07/22 06:30	30840	35.1	0.5	33.2	36.6
11063	p	16/10/20 19:00	21/07/22 07:00	15421	938.9	7.6	0.7	941.8
	t	16/10/20 19:00	21/07/22 07:00	15421	6.3	0.5	4.4	12.2
	u	16/10/20 19:00	21/07/22 07:00	15421	4.5	6.7	-24.7	31.5
	v	16/10/20 19:00	21/07/22 07:00	15421	5.7	7.8	-31.8	46.9
	spd	16/10/20 19:00	21/07/22 07:00	15421	7.3	6.4	0.0	48.9
	dir	16/10/20 19:00	21/07/22 07:00	15416	38.2	68.0	0.0	359.7

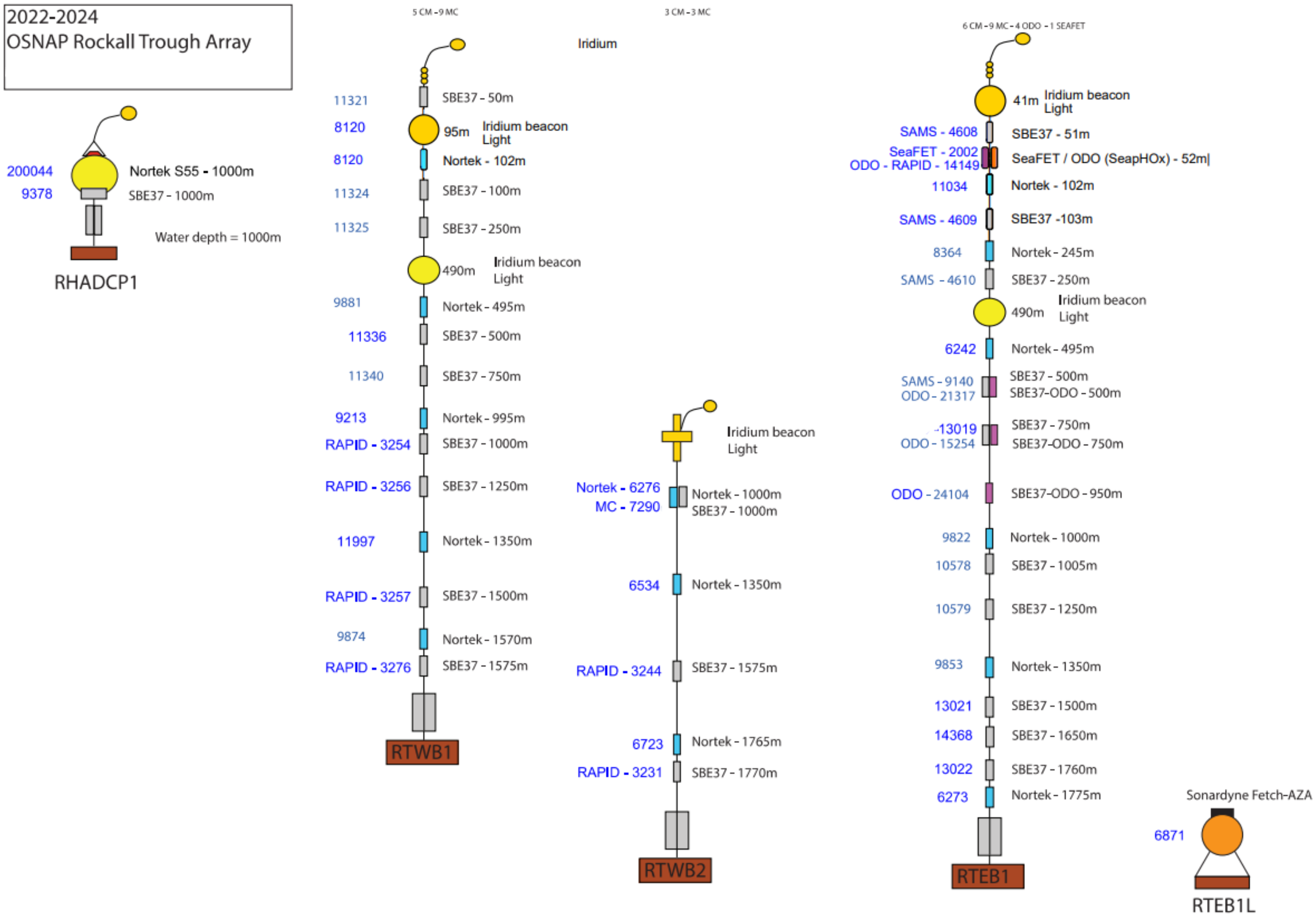
OSNAP Mooring Array.
Simple Statisctics for Mooring:- ib4_02_2020
Mooring deployment - start: 18/10/2020 13:30
end: 22/07/2022 08:00

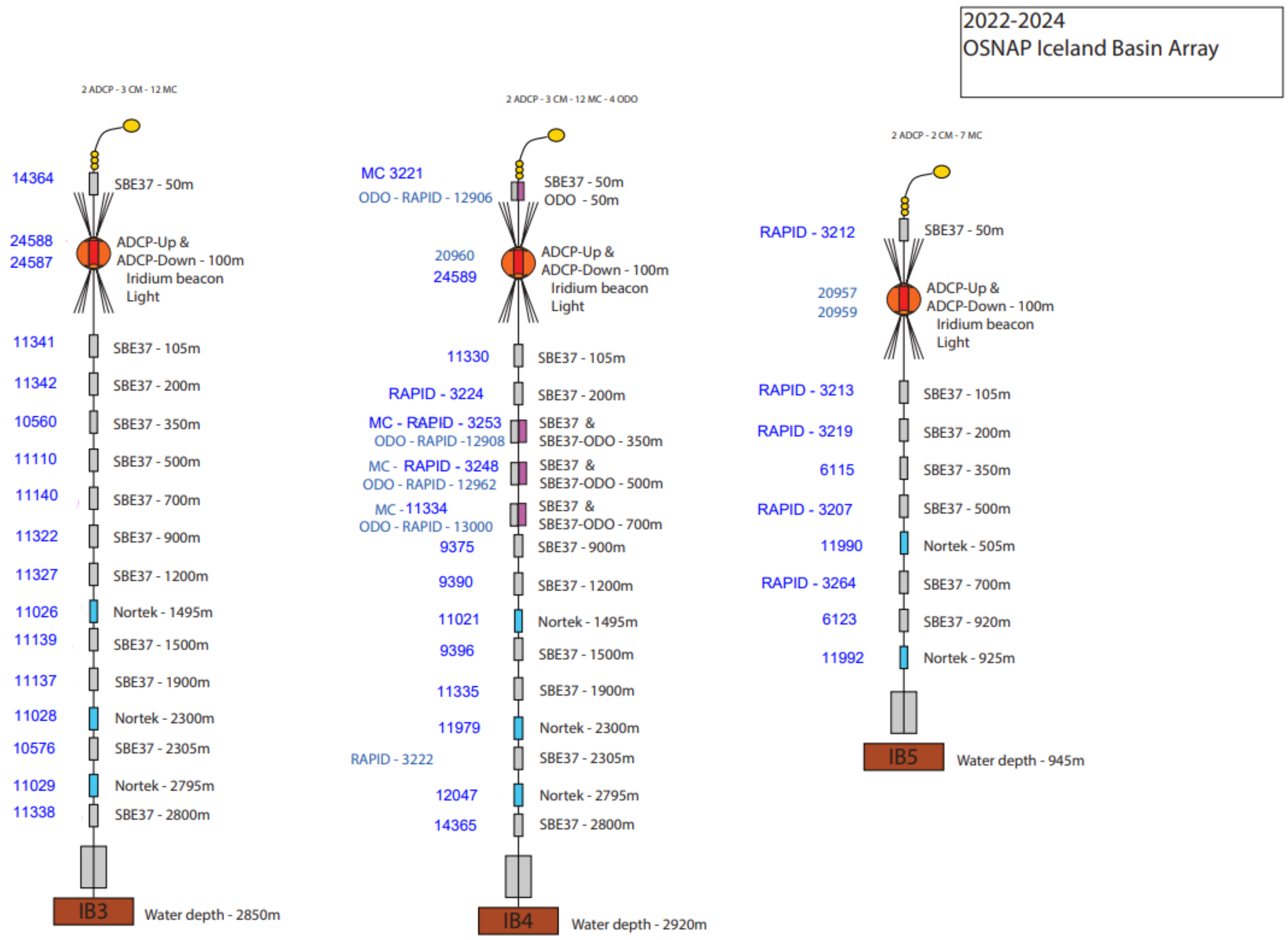
SN	var	first record	last record	valid records	mean	stdev	min	max
9391	p	18/10/20 13:30	22/07/22 07:30	30805	45.8	22.6	1.3	261.4
	t	18/10/20 13:30	22/07/22 07:30	30805	10.2	1.2	8.3	14.2
	c	18/10/20 13:30	22/07/22 07:30	30805	38.4	1.1	36.6	42.2
14353	p	18/10/20 13:30	22/07/22 07:30	30805	103.2	21.8	10.8	311.3
	t	18/10/20 13:30	22/07/22 07:30	30805	9.7	0.6	8.2	12.0
	c	18/10/20 13:30	22/07/22 07:30	30805	38.0	0.6	36.5	40.2
14354	p	18/10/20 13:30	22/07/22 07:30	30805	200.6	21.6	74.7	405.1
	t	18/10/20 13:30	22/07/22 07:30	30805	9.4	0.5	7.8	10.9
	c	18/10/20 13:30	22/07/22 07:30	30805	37.8	0.5	36.2	39.4
11333	p	18/10/20 13:30	22/07/22 07:30	30805	350.0	21.0	45.9	543.6
	t	18/10/20 13:30	22/07/22 07:30	30805	9.0	0.4	7.4	11.8
	c	18/10/20 13:30	22/07/22 07:30	30805	37.5	0.4	35.8	40.0
11109	p	18/10/20 13:30	22/07/22 07:30	30805	505.2	20.3	199.3	688.5
	t	18/10/20 13:30	22/07/22 07:30	30805	8.2	0.5	6.2	9.8
	c	18/10/20 13:30	22/07/22 07:30	30805	36.8	0.5	34.7	38.2
11111	p	18/10/20 13:30	22/07/22 07:30	30805	709.1	18.9	199.0	878.6
	t	18/10/20 13:30	22/07/22 07:30	30805	6.8	0.5	5.2	9.8
	c	18/10/20 13:30	22/07/22 07:30	30805	35.5	0.5	34.0	38.2
9372	p	18/10/20 13:30	22/07/22 07:30	30805	914.7	17.7	7.5	1068.0
	t	18/10/20 13:30	22/07/22 07:30	30805	5.4	0.3	4.5	12.1
	c	18/10/20 13:30	22/07/22 07:30	30805	34.2	0.3	33.4	40.2
3218	p	18/10/20 13:30	22/07/22 07:30	30805	1216.2	15.5	299.9	1348.8
	t	18/10/20 13:30	22/07/22 07:30	30805	4.3	0.1	4.0	9.6
	c	18/10/20 13:30	22/07/22 07:30	30805	33.3	0.1	32.8	38.0
11064	p	18/10/20 14:00	22/07/22 08:00	15403	1525.5	17.1	1.8	1633.4
	t	18/10/20 14:00	22/07/22 08:00	15403	3.8	0.1	3.7	12.1
	u	18/10/20 14:00	22/07/22 08:00	15403	-0.8	6.6	-24.3	20.5
	v	18/10/20 14:00	22/07/22 08:00	15403	-1.4	5.5	-25.8	17.5
	spd	18/10/20 14:00	22/07/22 08:00	15403	1.7	4.5	0.0	29.7
	dir	18/10/20 14:00	22/07/22 08:00	15396	208.7	93.2	0.0	359.4
11140	p	18/10/20 13:30	22/07/22 07:30	30805	1526.4	14.7	10.8	1633.4
	t	18/10/20 13:30	22/07/22 07:30	30805	3.8	0.1	3.7	12.1
	c	18/10/20 13:30	22/07/22 07:30	30805	33.0	0.1	32.5	40.2
10562	p	18/10/20 13:30	22/07/22 07:30	30805	1939.2	13.9	10.3	2014.5
	t	18/10/20 13:30	22/07/22 07:30	30805	3.6	0.1	3.4	12.1
	c	18/10/20 13:30	22/07/22 07:30	30805	33.0	0.0	32.8	40.2
11067	p	18/10/20 14:00	22/07/22 08:00	15403	2339.0	19.7	1.8	2384.9
	t	18/10/20 14:00	22/07/22 08:00	15403	3.2	0.1	2.9	12.0
	u	18/10/20 14:00	22/07/22 08:00	15403	2.3	6.5	-24.2	26.0
	v	18/10/20 14:00	22/07/22 08:00	15403	0.0	5.5	-21.4	89.4
	spd	18/10/20 14:00	22/07/22 08:00	15403	2.3	4.8	0.0	91.1
	dir	18/10/20 14:00	22/07/22 08:00	15399	89.7	88.2	0.0	359.6
10577	p	18/10/20 13:30	22/07/22 07:30	30805	2344.0	13.6	149.2	2389.1
	t	18/10/20 13:30	22/07/22 07:30	30805	3.3	0.1	3.0	10.2
	c	18/10/20 13:30	22/07/22 07:30	30805	32.9	0.1	32.6	38.6
11058	p	18/10/20 14:00	22/07/22 08:00	15403	2853.6	22.8	38.7	2862.9
	t	18/10/20 14:00	22/07/22 08:00	15403	3.0	0.1	2.9	11.9
	u	18/10/20 14:00	22/07/22 08:00	15403	3.1	8.7	-27.7	34.1
	v	18/10/20 14:00	22/07/22 08:00	15403	2.5	7.9	-27.6	31.5
	spd	18/10/20 14:00	22/07/22 08:00	15403	4.0	7.3	0.0	44.1
	dir	18/10/20 14:00	22/07/22 08:00	15401	51.2	96.8	0.0	359.4
9377	p	18/10/20 13:30	22/07/22 07:30	30805	2849.8	15.1	226.5	2858.4
	t	18/10/20 13:30	22/07/22 07:30	30805	2.9	0.1	2.7	9.8
	c	18/10/20 13:30	22/07/22 07:30	30805	32.7	0.1	32.6	38.2

OSNAP Mooring Array.
Simple Statisctics for Mooring:- ib3_02_2020
Mooring deployment - start: 20/10/2020 13:00
end: 24/07/2022 12:30

SN	var	first record	last record	valid records	mean	stdev	min	max
10559	p	20/10/20 13:00	24/07/22 09:30	30810	53.6	35.2	1.8	284.3
	t	20/10/20 13:00	24/07/22 09:30	30810	9.8	1.4	7.4	14.0
	c	20/10/20 13:00	24/07/22 09:30	30810	38.0	1.3	35.7	41.9
11332	p	20/10/20 13:00	24/07/22 09:30	30810	111.1	34.3	12.1	337.0
	t	20/10/20 13:00	24/07/22 09:30	30810	9.2	0.8	7.1	12.5
	c	20/10/20 13:00	24/07/22 09:30	30810	37.5	0.8	35.4	40.6
11337	p	20/10/20 13:00	24/07/22 09:30	30810	207.5	33.9	88.6	431.5
	t	20/10/20 13:00	24/07/22 09:30	30810	8.7	0.7	6.2	10.5
	c	20/10/20 13:00	24/07/22 09:30	30810	37.0	0.7	34.6	39.0
11323	p	20/10/20 13:00	24/07/22 11:00	30813	357.2	33.0	0.7	574.8
	t	20/10/20 13:00	24/07/22 11:00	30813	7.9	0.8	5.3	18.5
	c	20/10/20 13:00	24/07/22 11:00	30813	36.3	0.9	0.0	39.2
9374	p	20/10/20 13:00	24/07/22 10:00	30811	507.7	31.7	194.6	719.2
	t	20/10/20 13:00	24/07/22 10:00	30811	6.8	0.8	4.7	9.5
	c	20/10/20 13:00	24/07/22 10:00	30811	35.4	0.8	33.5	38.1
3481	p	20/10/20 13:00	24/07/22 10:30	30812	707.6	30.1	6.0	907.7
	t	20/10/20 13:00	24/07/22 10:30	30812	5.6	0.6	4.5	12.5
	c	20/10/20 13:00	24/07/22 10:30	30812	34.3	0.6	33.3	40.4
11329	p	20/10/20 13:00	24/07/22 10:00	30811	914.6	28.4	7.6	1101.7
	t	20/10/20 13:00	24/07/22 10:00	30811	4.7	0.3	4.1	12.5
	c	20/10/20 13:00	24/07/22 10:00	30811	33.5	0.3	33.0	40.6
9373	p	20/10/20 13:00	24/07/22 11:00	30813	1214.9	27.2	-0.3	1382.6
	t	20/10/20 13:00	24/07/22 11:00	30813	4.0	0.1	3.8	14.2
	c	20/10/20 13:00	24/07/22 11:00	30813	33.0	0.2	0.5	37.8
13130	p	20/10/20 13:00	24/07/22 11:00	15407	1531.5	29.3	0.0	1674.2
	t	20/10/20 13:00	24/07/22 11:00	15407	3.8	0.1	3.6	13.6
	u	20/10/20 13:00	24/07/22 11:00	15407	1.1	9.6	-31.4	29.3
	v	20/10/20 13:00	24/07/22 11:00	15407	0.1	8.0	-26.1	28.8
	spd	20/10/20 13:00	24/07/22 11:00	15407	1.1	6.1	0.0	32.7
	dir	20/10/20 13:00	24/07/22 11:00	15406	84.8	103.1	0.0	359.7
14367	p	20/10/20 13:00	24/07/22 11:00	30813	1525.4	27.7	-1.0	1666.3
	t	20/10/20 13:00	24/07/22 11:00	30813	3.7	0.2	3.6	22.1
	c	20/10/20 13:00	24/07/22 11:00	30813	31.8	4.6	0.1	33.2
11328	p	20/10/20 13:00	24/07/22 11:00	30813	1929.2	28.4	1.8	2031.3
	t	20/10/20 13:00	24/07/22 11:00	30813	3.6	0.2	3.4	30.1
	c	20/10/20 13:00	24/07/22 11:00	30813	32.9	0.2	0.0	40.5
11051	p	20/10/20 13:00	24/07/22 11:00	15407	2334.8	32.6	1.9	2395.6
	t	20/10/20 13:00	24/07/22 11:00	15407	3.3	0.1	3.0	12.6
	u	20/10/20 13:00	24/07/22 11:00	15407	0.6	9.9	-32.6	36.4
	v	20/10/20 13:00	24/07/22 11:00	15407	-1.4	8.4	-28.7	28.4
	spd	20/10/20 13:00	24/07/22 11:00	15407	1.5	6.5	0.0	37.0
	dir	20/10/20 13:00	24/07/22 11:00	15404	155.9	94.8	0.0	359.8
11326	p	20/10/20 13:00	24/07/22 11:30	30814	2335.5	33.2	2.8	2395.5
	t	20/10/20 13:00	24/07/22 11:30	30814	3.2	0.2	3.0	25.8
	c	20/10/20 13:00	24/07/22 11:30	30814	32.8	0.2	0.0	40.6
13142	p	20/10/20 13:00	24/07/22 11:00	15407	2854.8	38.2	10.8	2862.1
	t	20/10/20 13:00	24/07/22 11:00	15407	2.8	0.1	2.7	12.6
	u	20/10/20 13:00	24/07/22 11:00	15407	0.6	9.8	-37.6	37.0
	v	20/10/20 13:00	24/07/22 11:00	15407	-3.8	8.2	-38.4	32.7
	spd	20/10/20 13:00	24/07/22 11:00	15407	3.8	6.7	0.0	41.5
	dir	20/10/20 13:00	24/07/22 11:00	15405	171.7	82.5	0.0	359.7
8443	p	20/10/20 13:00	24/07/22 11:30	30814	2843.5	38.7	-0.6	2849.9
	t	20/10/20 13:00	24/07/22 11:30	30814	2.7	0.2	2.6	21.7
	c	20/10/20 13:00	24/07/22 11:30	30814	32.6	0.2	0.0	40.6

APPENDIX M: Mooring Instrument Allocation Schematics



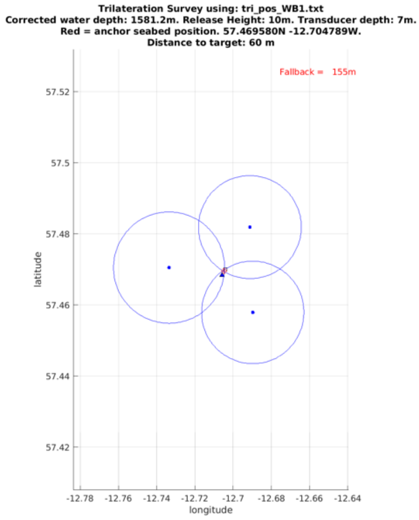

2022-2024
OSNAP Iceland Basin Array
2 ADCP - 3 CM - 12 MC
14364
SBE37 - 50m
24588
24587
ADCP-Up &
ADCP-Down - 100m
Iridium beacon
Light
11341
SBE37 - 105m
11342
SBE37 - 200m
10560
SBE37 - 350m
11110
SBE37 - 500m
11140
SBE37 - 700m
11322
SBE37 - 900m
11327
SBE37 - 1200m
11026
Nortek - 1495m
11139
SBE37 - 1500m
11137
SBE37 - 1900m
11028
Nortek - 2300m
10576
SBE37 - 2305m
11029
Nortek - 2795m
11338
SBE37 - 2800m
IB3
Water depth - 2850m
2 ADCP - 3 CM - 12 MC - 4 ODO
MC 3221
ODO - RAPID - 12906
SBE37 - 50m
ODO - 50m
20960
24589
ADCP-Up &
ADCP-Down - 100m
Iridium beacon
Light
11330
SBE37 - 105m
RAPID - 3224
SBE37 - 200m
MC - RAPID - 3253
ODO - RAPID -12908
SBE37 &
SBE37-ODO - 350m
MC - RAPID - 3248
ODO - RAPID - 12962
SBE37 &
SBE37-ODO - 500m
MC - 11334
ODO - RAPID - 13000
SBE37 &
SBE37-ODO - 700m
9375
SBE37 - 900m
9390
SBE37 - 1200m
11021
Nortek - 1495m
9396
SBE37 - 1500m
11335
SBE37 - 1900m
11979
Nortek - 2300m
RAPID - 3222
SBE37 - 2305m
12047
Nortek - 2795m
14365
SBE37 - 2800m
IB4
Water depth - 2920m
2 ADCP - 2 CM - 7 MC
RAPID - 3212
SBE37 - 50m
20957
20959
ADCP-Up &
ADCP-Down - 100m
Iridium beacon
Light
RAPID - 3213
SBE37 - 105m
RAPID - 3219
SBE37 - 200m
6115
SBE37 - 350m
RAPID - 3207
SBE37 - 500m
11990
Nortek - 505m
RAPID - 3264
SBE37 - 700m
6123
SBE37 - 920m
11992
Nortek - 925m
IB5
Water depth - 945m

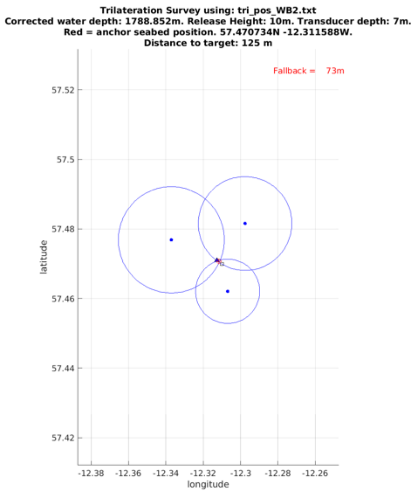
APPENDIX N: MOORING DEPLOYMENT SUMMARY TABLE

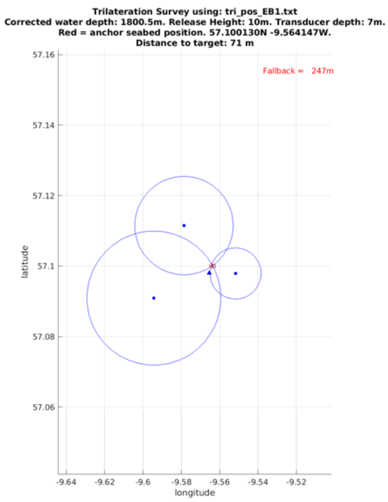
Moor	Date	Anchor Drop	Anchor Seabed (Trilateration)						Water depth	Setup distance	Planned Fallback
Name	dd/mm/yy	hh:mm	Lat (N)	Lon (W)	Lat	Lat	Lon	Lon	m	nm	m
RTEB1	16/07/2022	11:32	57.10013	009.56415	57	06.008	009	33.849	1800.5	2	225
RTWB2	17/07/2022	12:03	57.47073	012.31159	57	28.244	012	18.695	1788.9	1.5	125
RTWB1	19/07/2022	09:42	57.46958	012.70479	57	28.175	012	42.287	1581.2	1.5	200
RHADCP	20/07/2022	13:35	57.61457	015.41162	57	36.874	015	24.697	1079.0	0	100
IB5	21/07/2022	10:55	57.80096	019.16950	57	48.057	019	10.170	936.1	1.5	200
IB4	22/07/2022	15:02	57.98896	021.14654	57	59.338	021	08.792	2898.2	3	275
IB3	24/07/2022	15:19	58.01551	024.42199	58	00.931	024	25.319	2821.6	3	350
DMLTM	27/07/2022	10:33	59.86083	007.04438	59	51.649	007	02.663	1026.7	0	0
RTEBL1 From Ranger 2 USBL											
RTEBL1	16/07/21	13:12	57.09835	-009.55266	57°	05.901’	-009°	33.159’	1790.8	0	240
RTEBL1 Correction for new speed of sound											
RTEBL1	16/07/21	13:12	57.09836	-009.55265	57°	05.901’	-009°	33.159’	1797.2		

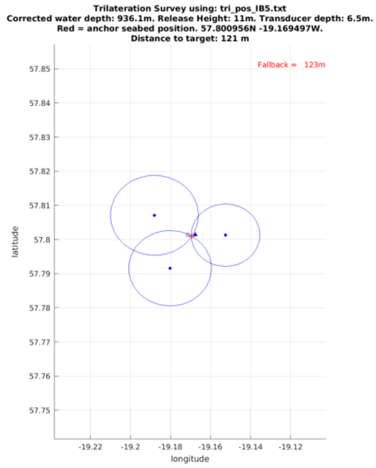
Moor	Date	Start deploy	Anchor Drop	Tow	Fallback from Trilateration	Distance from target	Irdium beacons		AR 1	AR2
Name	dd/mm/yy	hh:mm	hh:mm	min	m	m	IMEI	IMEI	S/N	S/N
RTEB1	16/07/2022	08:12	11:32	84	247	71	300234860477980	300234080570000	1761	2000
RTEBL1	16/07/2022	11:50	12:50	n/a	73	243			n/a	n/a
RTWB2	17/07/2022	12:56	14:20	35	73	125	300234060475980		2326	2307
RTWB1	19/07/2022	07:18	09:42	52	155	60	300023060673000	300234060474980	1754	2308
RHADCP	20/07/2022	13:21	13:35	1	44	47	300234060571000		1753	1272
IB5	21/07/2022	09:21	10:55	28	123	121	300234060475730		1756	1764
IB4	22/07/2022	12:36	16:02	60	314	98	300234060475990		2310	1757
IB3	24/07/2022	12:49	15:19	24	165	317	300234060572000		2330	2311
DMLTM	27/07/2022	10:25	10:33	1	64	15	ARGOS – B11-045		1758	

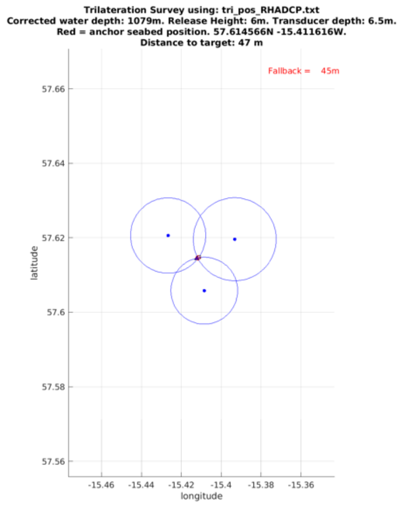
APPENDIX O: MOORING TRILATERATION RESULTS

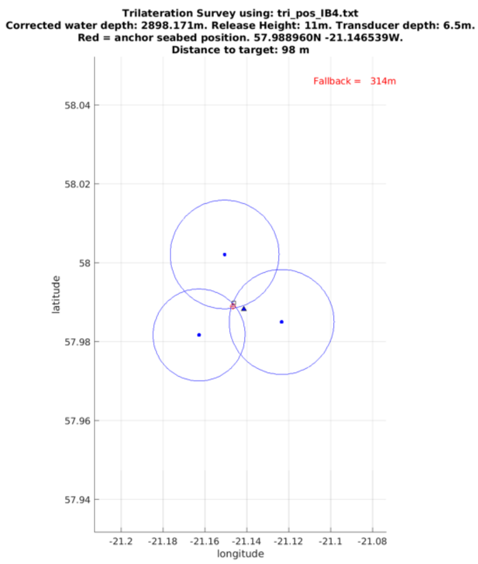


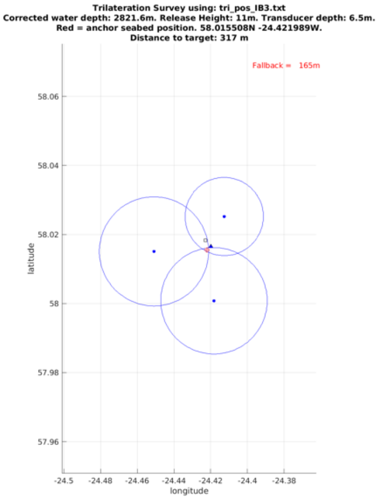


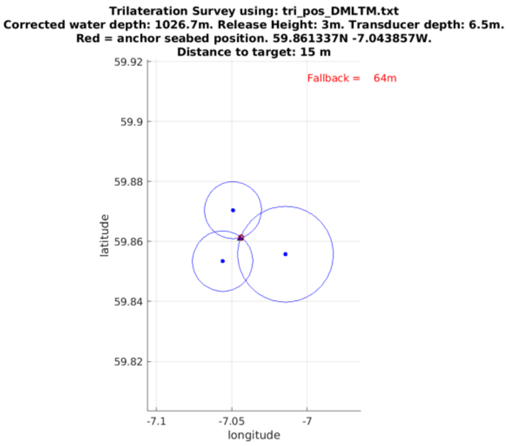




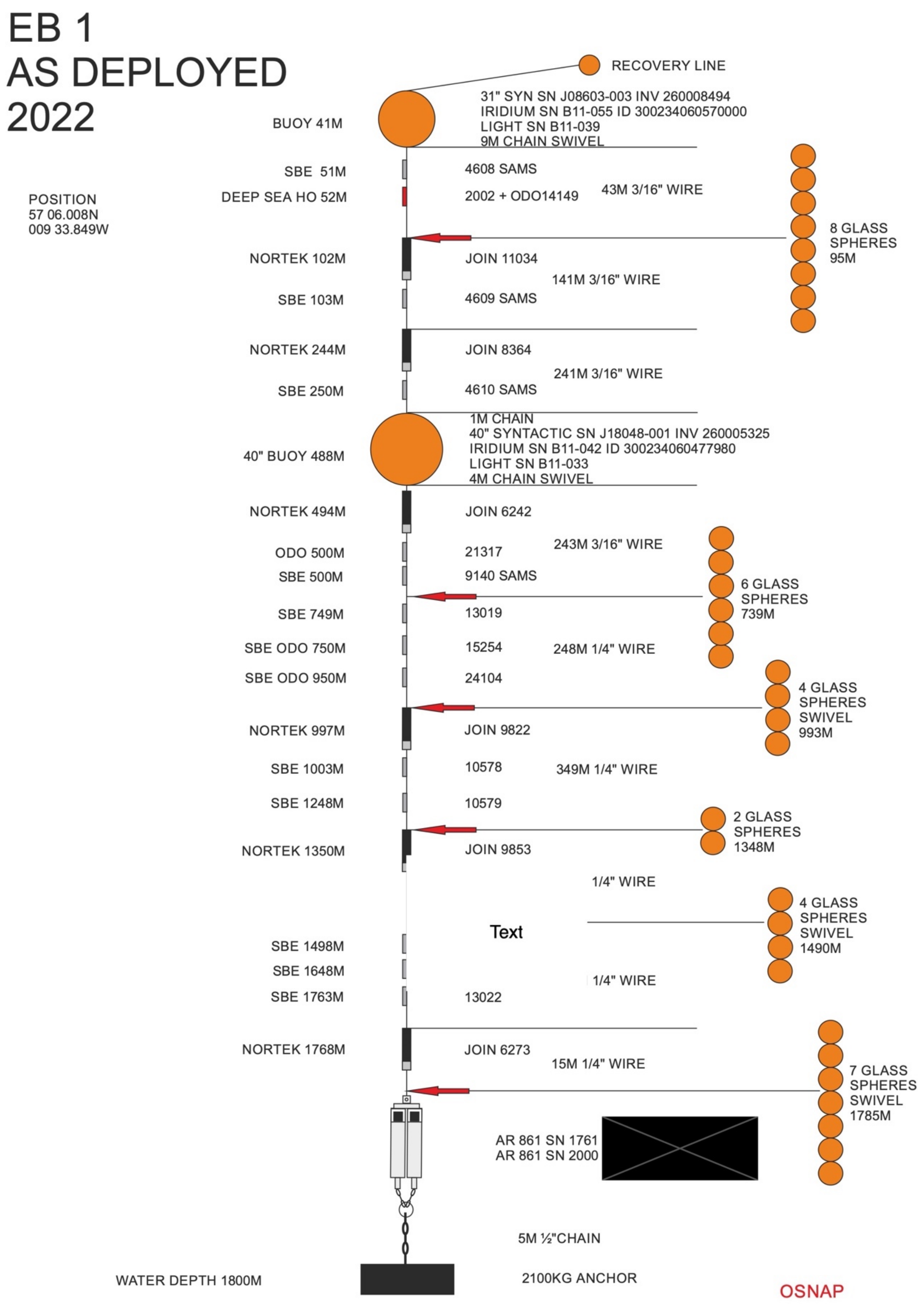


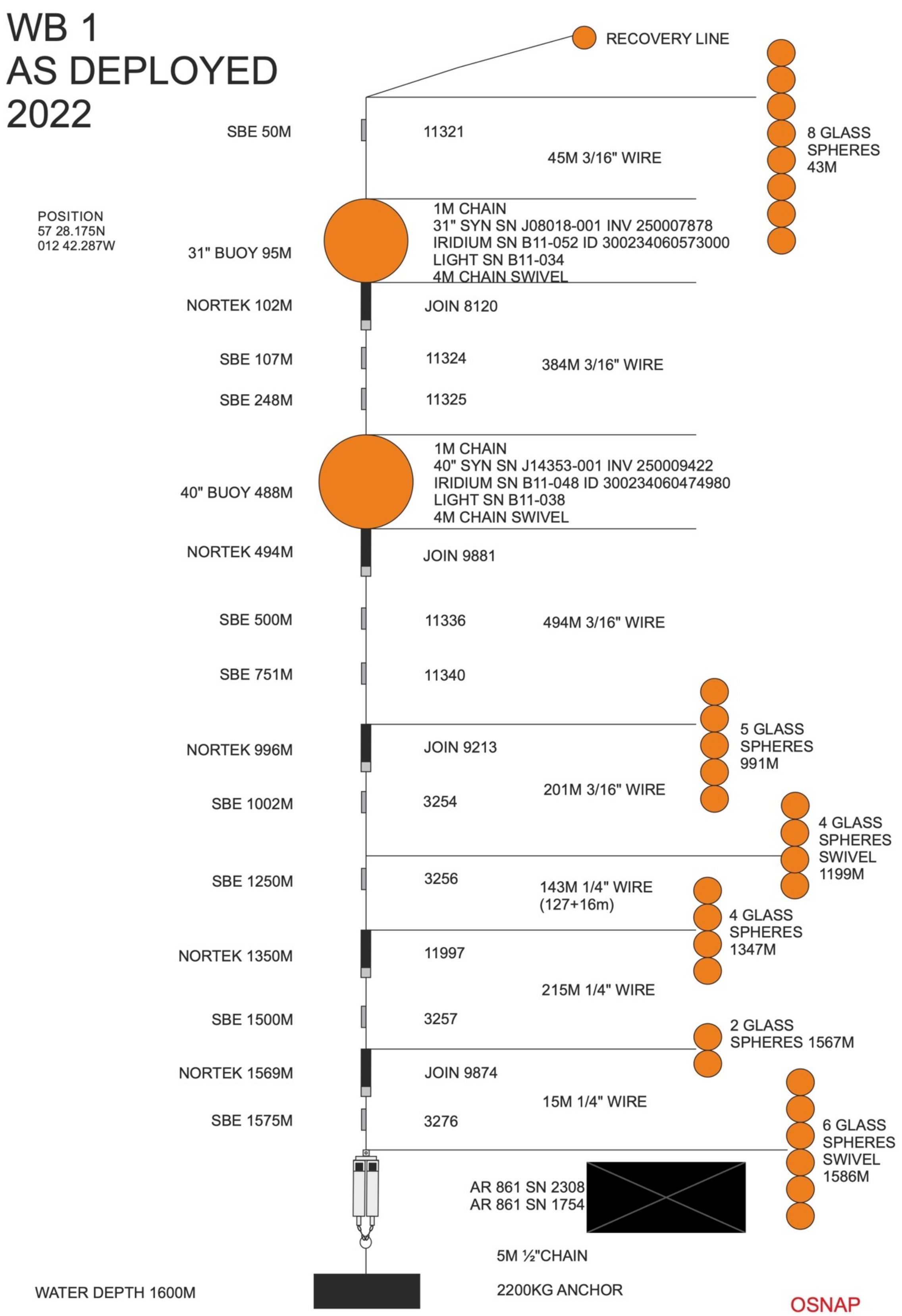


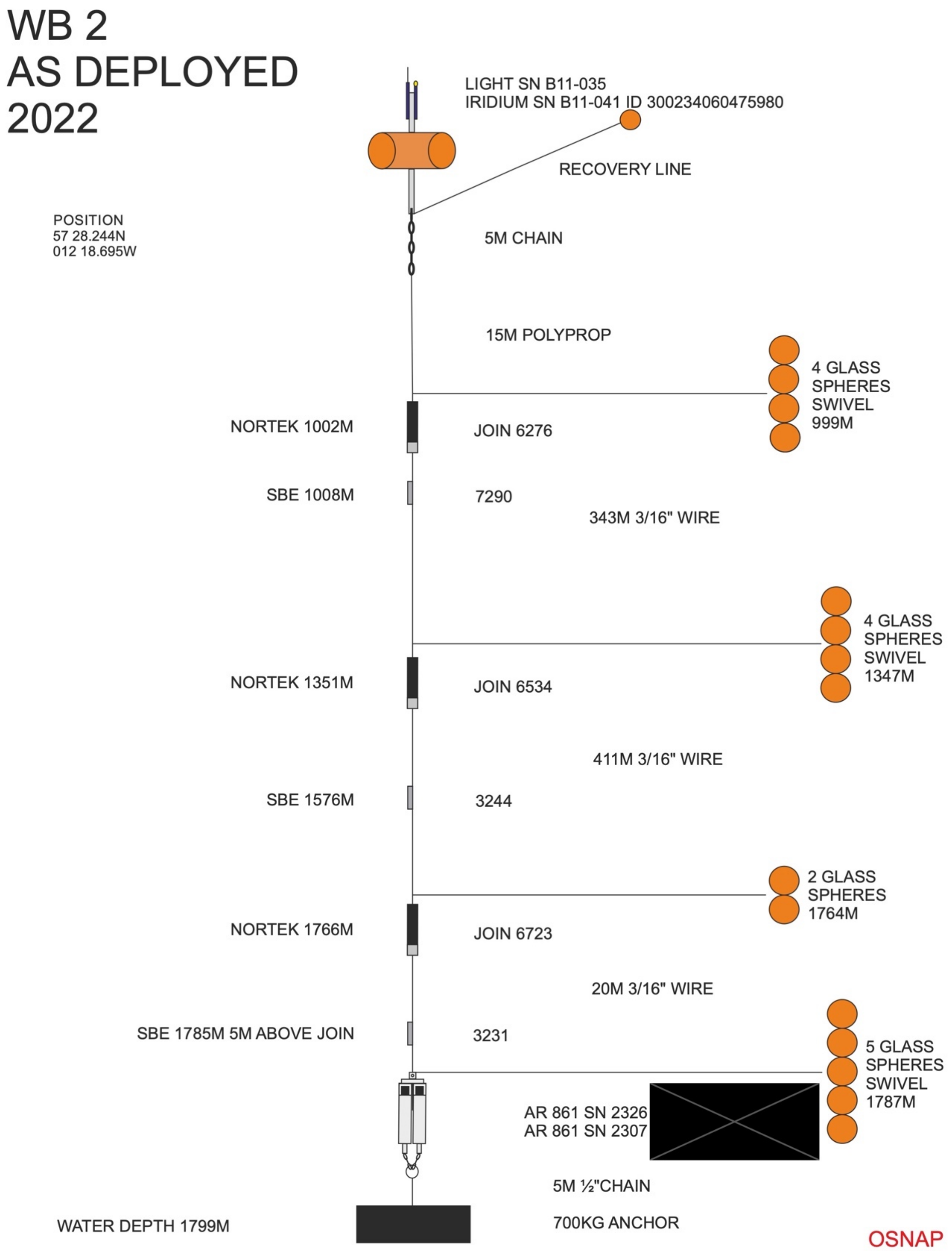

Trilateration Survey using: tri_pos_IB3.txt
Corrected water depth: 2821.6m. Release Height: 11m. Transducer depth: 6.5m.
Red = anchor seabed position. 58.015508N -24.421989W.
Distance to target: 317 m
Fallback = 165m
latitude
longitude


Trilateration Survey using: tri_pos_DMLTM.txt
Corrected water depth: 1026.7m. Release Height: 3m. Transducer depth: 6.5m.
Red = anchor seabed position. 59.861337N -7.043857W.
Distance to target: 15 m
Fallback = 64m
latitude
longitude

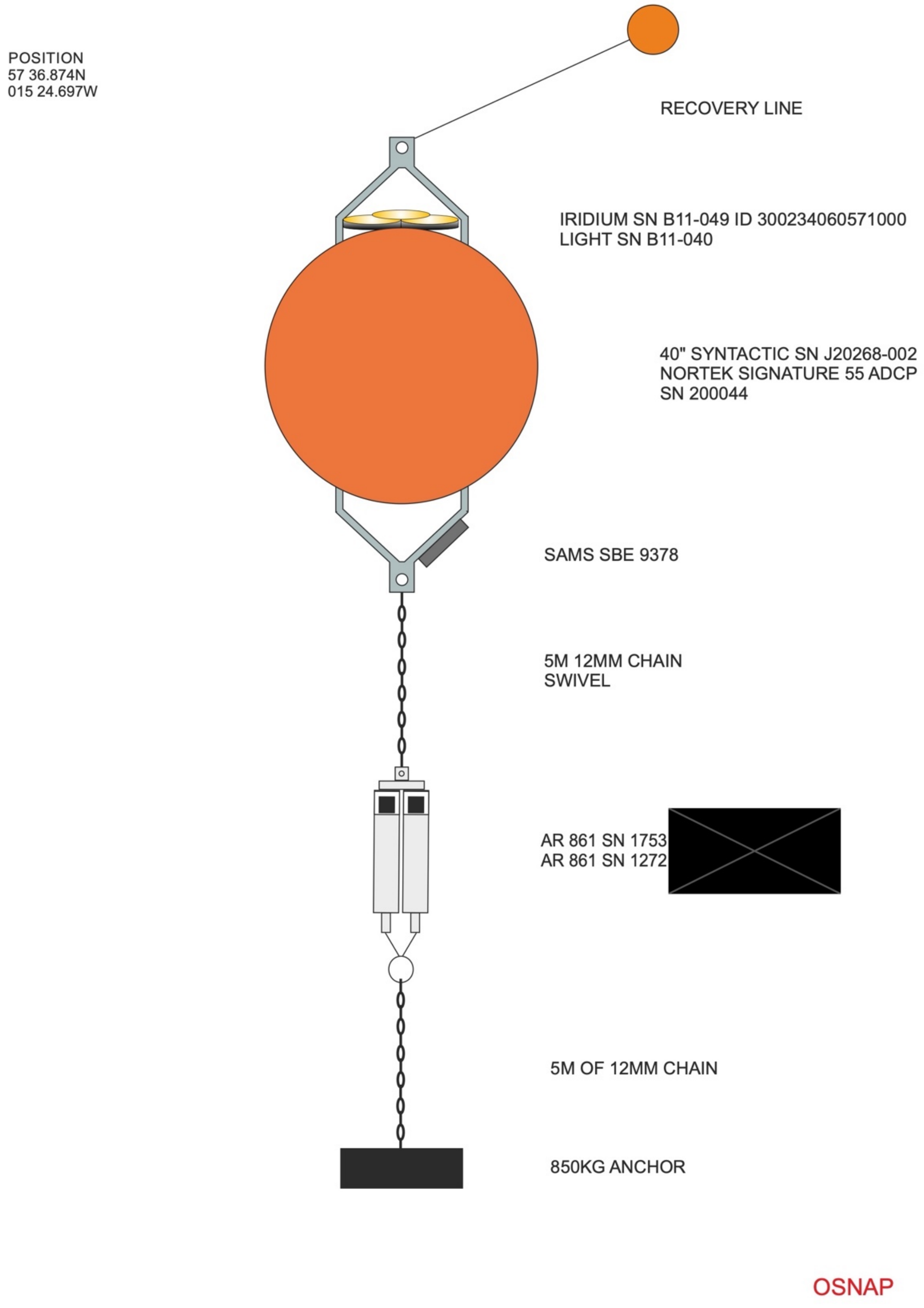
APPENDIX P: DIAGRAMS OF DEPLOYED MOORINGS

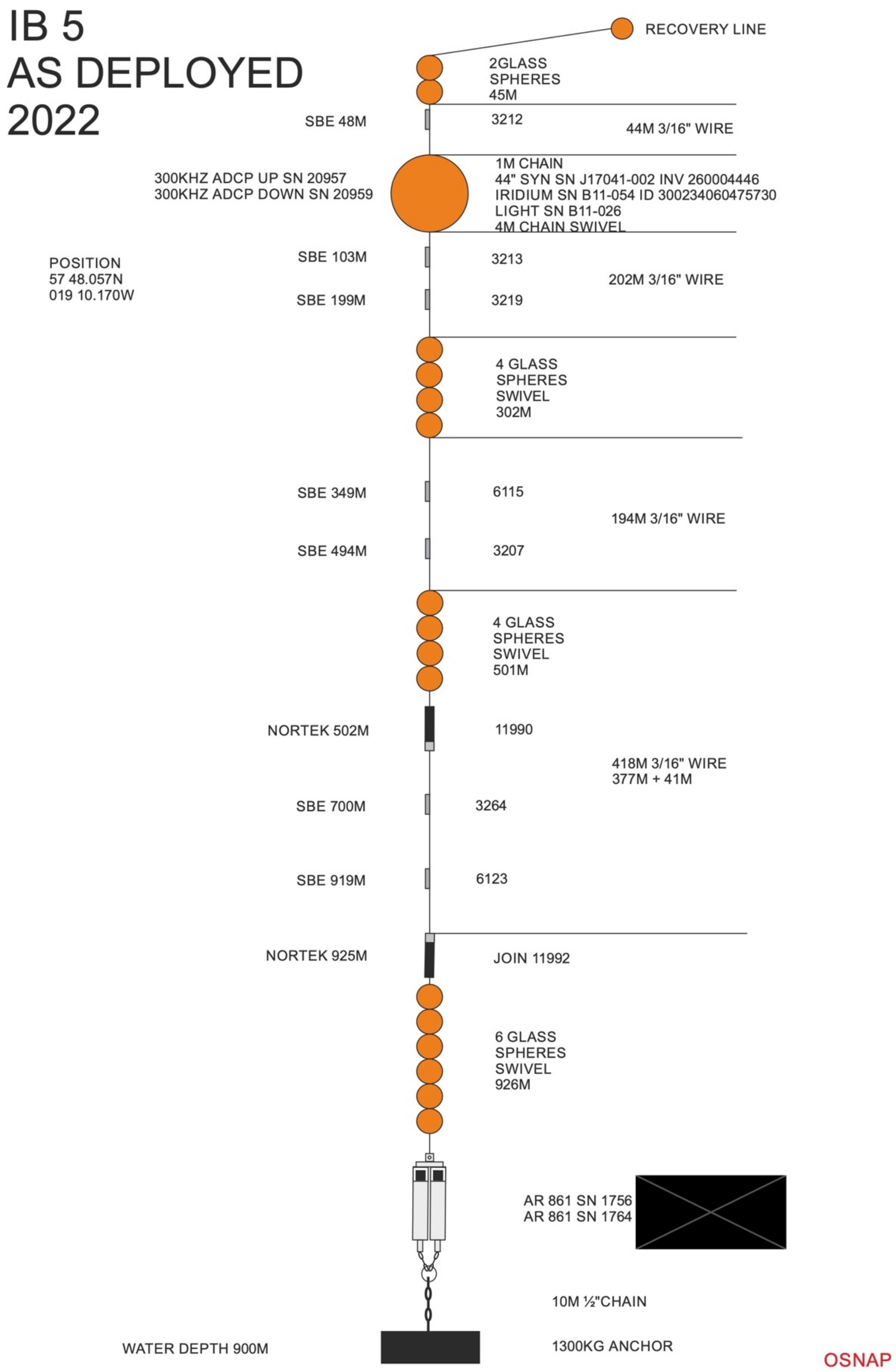


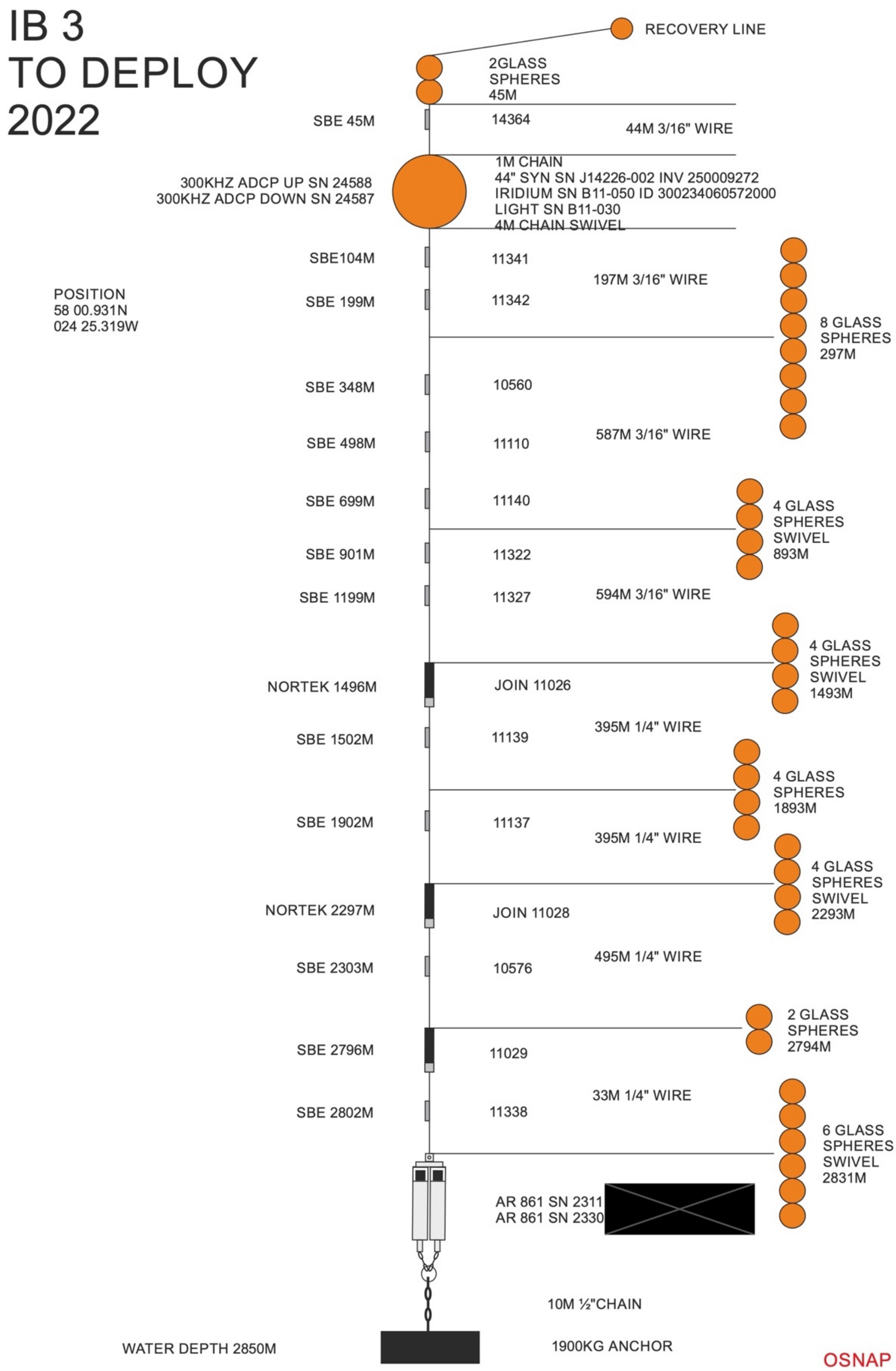

WB 1
AS DEPLOYED
2022
RECOVERY LINE
8 GLASS SPHERES 43M
SBE 50M
11321
45M 3/16" WIRE
POSITION
57 28.175N
012 42.287W
31" BUOY 95M
1M CHAIN
31" SYN SN J08018-001 INV 250007878
IRIDIUM SN B11-052 ID 300234060573000
LIGHT SN B11-034
4M CHAIN SWIVEL
NORTEK 102M
JOIN 8120
SBE 107M
11324
384M 3/16" WIRE
SBE 248M
11325
40" BUOY 488M
1M CHAIN
40" SYN SN J14353-001 INV 250009422
IRIDIUM SN B11-048 ID 300234060474980
LIGHT SN B11-038
4M CHAIN SWIVEL
NORTEK 494M
JOIN 9881
SBE 500M
11336
494M 3/16" WIRE
SBE 751M
11340
5 GLASS SPHERES 991M
NORTEK 996M
JOIN 9213
201M 3/16" WIRE
SBE 1002M
3254
4 GLASS SPHERES SWIVEL 1199M
SBE 1250M
3256
143M 1/4" WIRE
(127+16m)
4 GLASS SPHERES 1347M
NORTEK 1350M
11997
215M 1/4" WIRE
SBE 1500M
3257
2 GLASS SPHERES 1567M
NORTEK 1569M
JOIN 9874
15M 1/4" WIRE
SBE 1575M
3276
6 GLASS SPHERES SWIVEL 1586M
AR 861 SN 2308
AR 861 SN 1754
5M ½"CHAIN
2200KG ANCHOR
WATER DEPTH 1600M
OSNAP

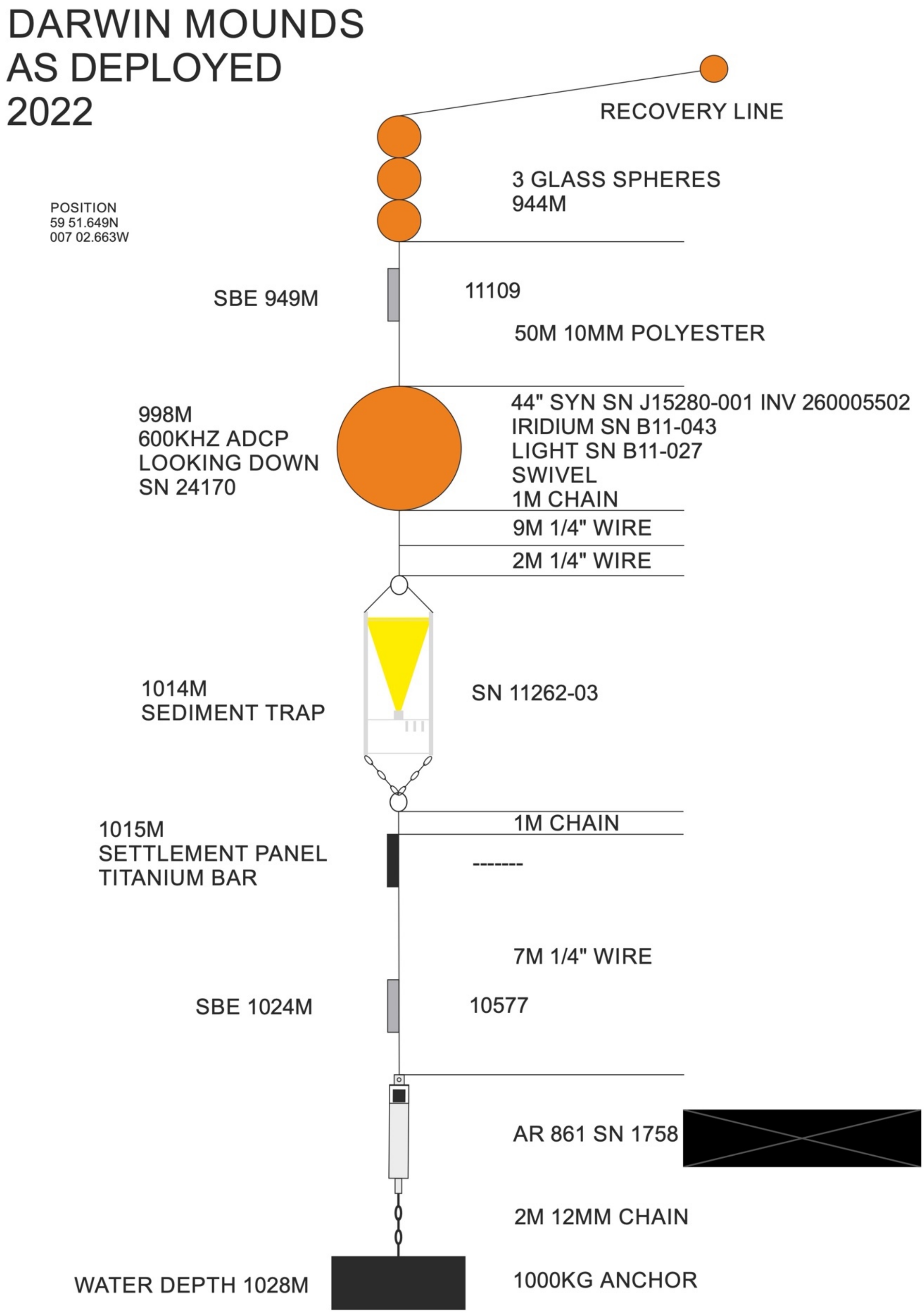

WB 2
AS DEPLOYED
2022
LIGHT SN B11-035
IRIDIUM SN B11-041 ID 300234060475980
RECOVERY LINE
POSITION
57 28.244N
012 18.695W
5M CHAIN
15M POLYPROP
4 GLASS
SPHERES
SWIVEL
999M
NORTEK 1002M
JOIN 6276
SBE 1008M
7290
343M 3/16" WIRE
4 GLASS
SPHERES
SWIVEL
1347M
NORTEK 1351M
JOIN 6534
411M 3/16" WIRE
SBE 1576M
3244
2 GLASS
SPHERES
1764M
NORTEK 1766M
JOIN 6723
20M 3/16" WIRE
SBE 1785M 5M ABOVE JOIN
3231
5 GLASS
SPHERES
SWIVEL
1787M
AR 861 SN 2326
AR 861 SN 2307
5M ½"CHAIN
WATER DEPTH 1799M
700KG ANCHOR
OSNAP

RH ADCP AS DEPLOYED 2022




IB 5
AS DEPLOYED
2022
RECOVERY LINE
2GLASS
SPHERES
45M
SBE 48M
3212
44M 3/16" WIRE
300KHZ ADCP UP SN 20957
300KHZ ADCP DOWN SN 20959
1M CHAIN
44" SYN SN J17041-002 INV 260004446
IRIDIUM SN B11-054 ID 300234060475730
LIGHT SN B11-026
4M CHAIN SWIVEL
POSITION
57 48.057N
019 10.170W
SBE 103M
3213
202M 3/16" WIRE
SBE 199M
3219
4 GLASS
SPHERES
SWIVEL
302M
SBE 349M
6115
194M 3/16" WIRE
SBE 494M
3207
4 GLASS
SPHERES
SWIVEL
501M
NORTEK 502M
11990
418M 3/16" WIRE
377M + 41M
SBE 700M
3264
SBE 919M
6123
NORTEK 925M
JOIN 11992
6 GLASS
SPHERES
SWIVEL
926M
AR 861 SN 1756
AR 861 SN 1764
10M ½"CHAIN
WATER DEPTH 900M
1300KG ANCHOR
OSNAP


IB 3
TO DEPLOY
2022
RECOVERY LINE
2GLASS
SPHERES
45M
SBE 45M
14364
44M 3/16" WIRE
1M CHAIN
44" SYN SN J14226-002 INV 250009272
IRIDIUM SN B11-050 ID 300234060572000
LIGHT SN B11-030
4M CHAIN SWIVEL
300KHZ ADCP UP SN 24588
300KHZ ADCP DOWN SN 24587
SBE104M
11341
197M 3/16" WIRE
POSITION
58 00.931N
024 25.319W
SBE 199M
11342
8 GLASS
SPHERES
297M
SBE 348M
10560
SBE 498M
11110
587M 3/16" WIRE
SBE 699M
11140
4 GLASS
SPHERES
SWIVEL
893M
SBE 901M
11322
SBE 1199M
11327
594M 3/16" WIRE
4 GLASS
SPHERES
SWIVEL
1493M
NORTEK 1496M
JOIN 11026
395M 1/4" WIRE
SBE 1502M
11139
4 GLASS
SPHERES
1893M
SBE 1902M
11137
395M 1/4" WIRE
4 GLASS
SPHERES
SWIVEL
2293M
NORTEK 2297M
JOIN 11028
495M 1/4" WIRE
SBE 2303M
10576
2 GLASS
SPHERES
2794M
SBE 2796M
11029
33M 1/4" WIRE
SBE 2802M
11338
6 GLASS
SPHERES
SWIVEL
2831M
AR 861 SN 2311
AR 861 SN 2330
10M ½"CHAIN
WATER DEPTH 2850M
1900KG ANCHOR
OSNAP


DARWIN MOUNDS
AS DEPLOYED
2022
RECOVERY LINE
3 GLASS SPHERES
944M
POSITION
59 51.649N
007 02.663W
SBE 949M
11109
50M 10MM POLYESTER
998M
600KHZ ADCP
LOOKING DOWN
SN 24170
44" SYN SN J15280-001 INV 260005502
IRIDIUM SN B11-043
LIGHT SN B11-027
SWIVEL
1M CHAIN
9M 1/4" WIRE
2M 1/4" WIRE
1014M
SEDIMENT TRAP
SN 11262-03
1M CHAIN
1015M
SETTLEMENT PANEL
TITANIUM BAR

7M 1/4" WIRE
SBE 1024M
10577
AR 861 SN 1758
2M 12MM CHAIN
WATER DEPTH 1028M
1000KG ANCHOR

APPENDIX Q: META DATA FROM DEPLOYED MOORINGS

Cruise JC238

Mooring deployment metadata log

Mooring: EB1

Date: 16/7/2022

Arrival on site time: 0744 UTC Setup distance: .... nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment	08:12	57 7.83	009 31.97	1722	
End deployment (winch)	10:08	57° 6.32	009 32.88	1753	
Anchor drop	11:32:06	57 5.88	009 33.92	18065	

Deployment comments:

Trilateration:

1) 12:43:05 1963m 1963m

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 2000 1761

ARM code: [redacted]

DIAG code:

Mooring on seabed time: ....

Trilaterated latitude: 57.10013 N

Trilaterated longitude: 9.56415W

Corrected depth: 1800 m

Fallback distance: 247 m

Cruise JC238 Mooring deployment metadata log

Mooring: WB2

Date: 17/7/2022

Arrival on site time: 1203 Setup distance: 0.5 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment 1256	~~1219~~	57.4736	-12.2628	1801.2	1794.7
End deployment (winch)	1345	57.4729	-12.2889	1794.7	1791.3
Anchor drop	14:20:44	57.4710	-12.3127	1794.8	1788.9

Deployment comments:

0.5 kn ahead → not paying out fast enough → 0.7 kn check

1223 coming back in as current not as predicted

1232 All instruments/Packages back on deck

1250 re-positioned, re-start operations

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 2326 / 2307

ARM code: [redacted]

DIAG code:

Mooring on seabed time: 14:56

Trilaterated latitude: 57.47073

Trilaterated longitude: -12.31153

Corrected depth: 1788.9 m

Fallback distance: 73 m

Cruise JC238 Mooring deployment metadata log

Mooring: WB2

Date: 17/7/2022

Arrival on site time: 1203 Setup distance: 0.5 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment 1256	~~1214~~	57.4736	-12.2628	1801.2	1794.7
End deployment (winch)	1345	57.4729	-12.2889	1794.7	1791.3
Anchor drop	14:20:44	57.4710	-12.3127	1794.8	1788.9

Deployment comments:

0.5 km ahead → not paying out fast enough → 0.7 km ahead
1223 coming back in as current not as predicted
1232 All instruments/Packages back on deck
1250 re-positioned, re-start operations

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 2326 / 2307

ARM code: [redacted]

DIAG code:

Mooring on seabed time: 14:56

Trilaterated latitude: 57.47073

Trilaterated longitude: -12.31153

Corrected depth: 1788.9 m

Fallback distance: 73 m

Cruise JC238

Mooring deployment metadata log

RHADCP.deploy log

Mooring: RHADCP

Date: 20/7/2022

Arrival on site time: 1300 Setup distance: 100 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment	1321	57. 6148	-15.4104	1111,9	1108.8
End deployment (winch)	1334	57.6144	-15.4122	1082.2m	1079.8
Anchor drop	1335	57.6144	-15.4123	1082.4	1083.4m

Deployment comments:

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 1753 / 1272

ARM code: [redacted]

DIAG code:

Mooring on seabed time:

Trilaterated latitude: 57.614558N

Trilaterated longitude: 15.411617W

Corrected depth: 1083.4 m

Fallback distance: 44 m

Cruise JC238

Mooring deployment metadata log

Mooring: IB5

Date: 21/7/2022

Arrival on site time: 0910   Setup distance: 1.5 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment	0921	57.4810	-19.1310	960.2	957.2
End deployment (winch)	1027	57.8016	-19.1841	955.4	952.4
Anchor drop	1055	57.8014	-19.1676	942.1	939.1

Deployment comments:

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 1756 / 1764

ARM code: [redacted]

DIAG code:

Mooring on seabed time:

Trilaterated latitude: 57.800986 N

Trilaterated longitude: -19.169497 W

Corrected depth: 936.1 m

Fallback distance: 123 m

Cruise JC238 — Mooring deployment metadata log

Mooring: IB4

Date: 22/7/2022

Arrival on site time: 12:00 Setup distance: 3 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment	1236	58.0167N	-21.2256.W	2974.4	2966.1
End deployment (winch)	1502	57.9969 N	-21.1666 W	2953.8	2945.4
Anchor drop	1602	57.9882 N	-21.1414 W	2907.1	2898.2

Deployment comments:

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 2310 | 1757

ARM code: [redacted]

DIAG code:

Mooring on seabed time:

Trilaterated latitude: 57.988960N

Trilaterated longitude: -21.146539 W

Corrected depth: 2898.2 m

Fallback distance: 314 m

Cruise JC238

Mooring deployment metadata log

Mooring: IB3

Date: 24/7/2022

Arrival on site time: 1240 Setup distance: 3 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment	12:49	57.9685 N	-24.4625 W	2834.2	2819.2
End deployment (winch)	~~14~~ 14:55	58.0101 N	-24.4257	2836.3	2821.3
Anchor drop	15:19	58.0165 N	-24.4199 W	2836.6	2821.6

Deployment comments:

1505 Rope from anchor release caught in chain (temporarily)

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 2330, 2311

ARM code: [redacted]

DIAG code:

Mooring on seabed time:

Trilaterated latitude: 58.015508 N

Trilaterated longitude: -24.421989 W

Corrected depth: 2821.6 m

Fallback distance: 165 m

Cruise JC238

Mooring deployment metadata log

Mooring: DMLTM

Date: 27/7/2022

Arrival on site time: 10:08   Setup distance: 0 nm

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Start deployment	10:25	59.86117°N	7.04381°W	1026.4m	1023.4
End deployment (winch)	10:32	59.86091°N	7.04425°W	1026.9	1023.9
Anchor drop	10:33	59.86080°N	7.04438°W	1029.7	1026.7

Deployment comments:

recovery buoy top 10:26 + MC

light B11-027 } 10:29
iridium B11-043 300254060473980

Sed trap 11262-03 10:29

release sn1758, Arm 1A0D : 1031   MicroCAT sn 11109, 949m
rel 1A55   sn 10577, 1024m 10:29

Acoustic tracking of descent	
Time (UTC)	Range (m)

Acoustic release S/N: 1758

ARM code: [redacted]

DIAG code:

Mooring on seabed time:

Trilaterated latitude: 59.861337°N

Trilaterated longitude: 007.043854°W

Corrected depth: 1026.7 m

Fallback distance: 64 m

APPENDIX R: FETCH AZA DEPLOYMENT METADATA

SAMS Fetch AZA logsheet Version 1

Date	16/7/2022	Serial Number	6871
Cruise	JC238	Acoustic ID	2501
Operators	LD | ED	Job file name	FBL_1_DEPLOY

Pre-test

Job file name (n/a if test only)

Magnet removed? OFF/S ... ☑ ✓

Check internal pressure gauge (green = OK)? ✓

Comms check? (get status) ✓ ☐

→ get AZA status ✓

Stop logging and Set Time (if not using PC time) ☑ ✓

Set Transponder to job configuration? ☑ ✓

Clear memory? ☐

Check configuration and generate report? ☐

Get AZA status > set launch/Recovery mode ☐
(This should only be done < 6 hours prior to deployment)

Lat	57 5.88	Lon	009 33.10
Depth	1791.5 m	Weather	F 3/4, ...

Comments
(e.g. time over rail, in water, out of water)

Seabed mode ✓
Start AZA logging ✓
Check tabs ✓

1754
ARM 1A09
REL 1A55

Set max dep. depth to 1900 m
↳ run single AZA ...

SAMS Fetch AZA logsheet

Version 1

Freefall acoustic tracking log table

	Time	Depth	Lat	Lon	Comment
Release	12:51:16?	~55m			
	12:51:30	82.1			Drifting NW
	52:00	128.0			
	52:30	168.3			
	53:00	211.2			
	54:00	291.7			
	55:00	371.5			
	56:00	454.7			~50m away from ship
	57:00	536.7			
	58:00	620.7			
	59:00	701.1			
	13:00:00	785.2			
	01:00	865.9			
	02:00	947.5			100m away – changed direction to NE
	04:00	1112.4			Kind of stationary
	06:00	1280.6			
	08:00	1447.3			Moving South, ~75m away
	10:00	1612.3			
	11:00	1697.1			
	11:30	1737.7			
	12:00	1752.1			

12:10 1762.3

12:20 1762.4

12:30 1762.3

57° 05.9008'N 9° 33.1578'W

Switch to SAFE when on bottom

AZA -> Get AZA Status = Seabed mode
(temp 14.9 / 15°C ?)

Check = config ✓ 14.0V, 14.6°C battery temp, telemetry 900 bps, batt SOH 99%

time & logging ✓

Sensors

inclinometer +0.67 +0.56 AG6

press 18261.0 AG4

temp 6.86 AG13

press 18257.1 AG0

logging active

PDF ✓

Sonardyne
SOUND IN DEPTH

Test Report

Configured at	2022/07/15 13:21:17 UTC	**Memory Card In Use**	1
Checked at	2022/07/16 13:17:21 UTC	**Card 1 Size**	1004 Mb, 0% Used
Log Due	2022/07/16 10:30:00 UTC	**Card 1 Pages**	Logging to page 54
Battery Test	Full (99 %)	**Card 2 Size**	504 Mb, 0% Used
		Card 2 Pages	Logging to page 54

Unit Settings			
Acoustic Address	2501	Unit ID	006871
Transducer	Omni		

Settings			
Turn Around Time	80	Linear Gain	20dB
Navigation Power Level	190dB	Telemetry Power Level	190dB
Blocking	100ms	Common Interrogate Channel	1
HPR Channel	26, Disabled	Activity Time	2 seconds
		LCIS	0

Battery Status			
Battery 1 type	Lithium	Battery 1 voltage	14.0V
Battery 1 current	-30.5	Battery 1 capacity	504.0
Battery 1 capacity left	99	Battery 1 temperature	14.4

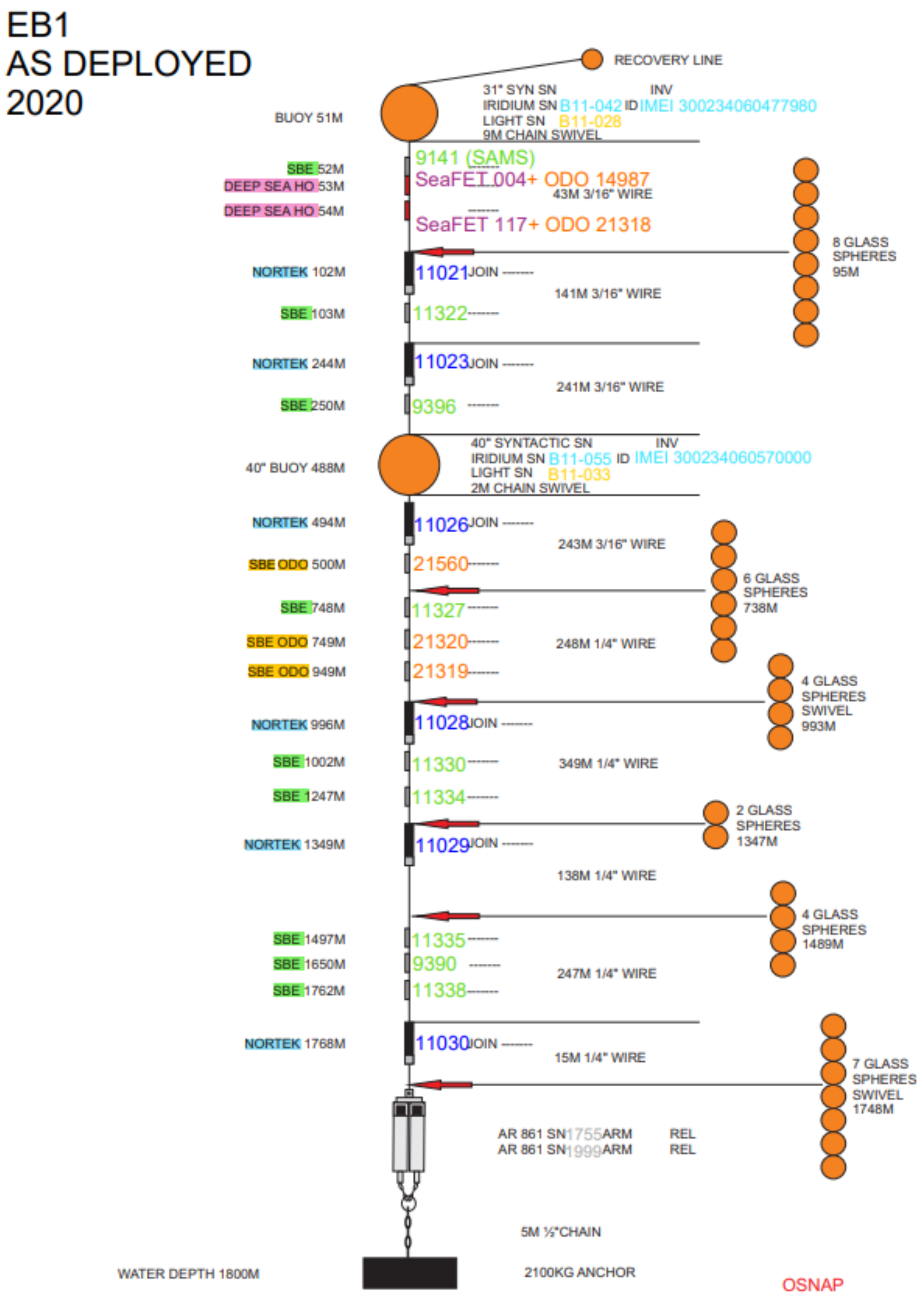
Sensors

Slot	Serial Number	Name	Count	Period (s)	Reading
1	-1	Inclinometer (0103)	1	0	INC+0.67+0.56;AG6
2	-1	AZS (0106)	1	0	PR18261.0;AG4
3	149405	Digiquartz (0102)	1	0	T6.86;AG13
4	-1	Temperature (0101)	1	55	PR18257.1;AG0
5	862600094	RS485 Presens (0202)	1	0	JX3.789394
6	0	RS485 Terps (0502)	1	0	-
7	0	RS485 Terps (0502)	1	0	-

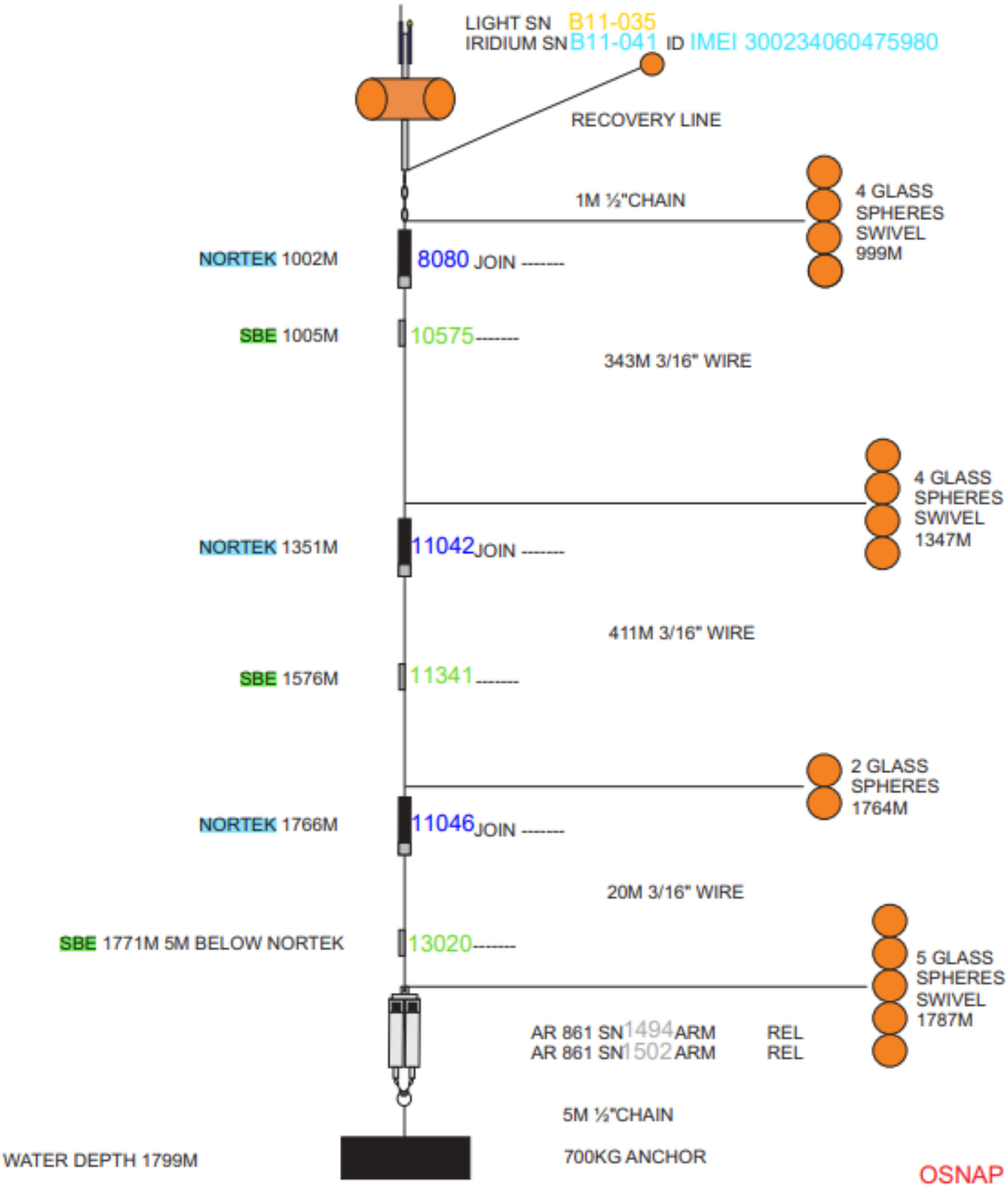
Logging

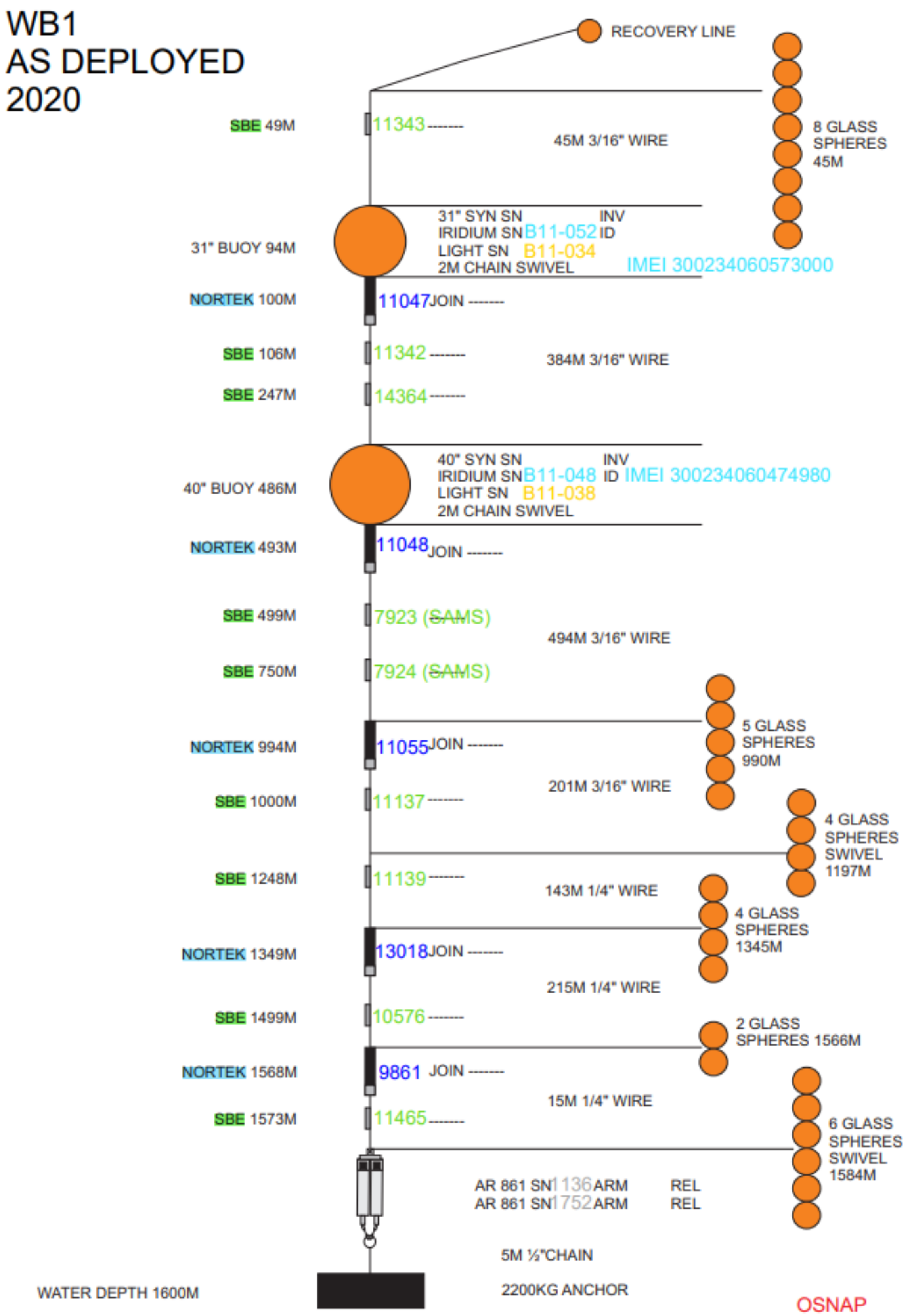
Event	Due	Sensors	Period (s)	Jitter (s)
2	2022/07/16 15:00:00	Inclinometer,Digiquartz,Temperature,RS485 Presens	3600	0
3	2022/07/16 15:00:00	Battery	864000	0
1	2022/07/17 15:00:00	AZA,System Rest Check	172800	0
Woken	-	-	Block	100s

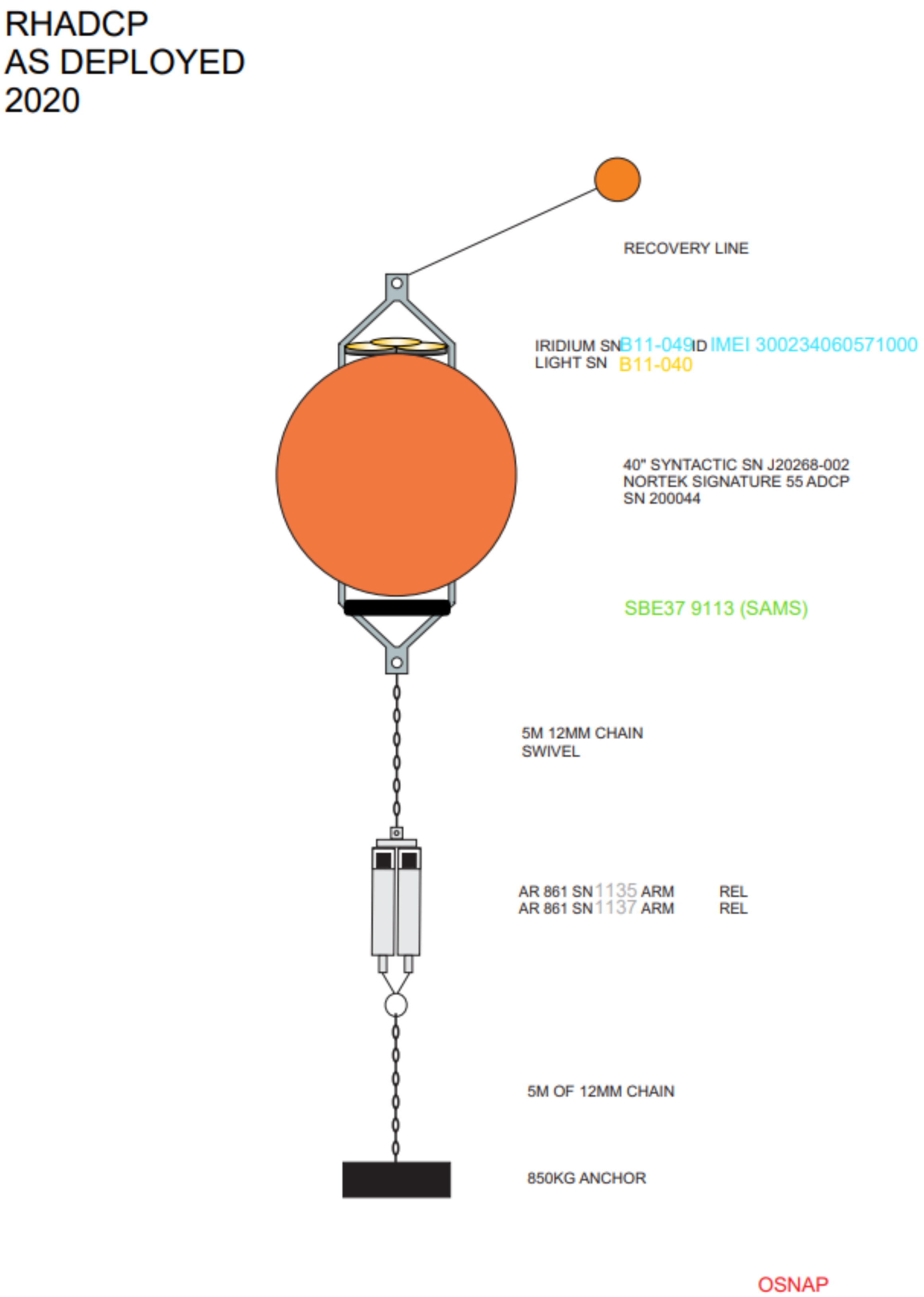
APPENDIX S: DIAGRAMS OF RECOVERED MOORINGS

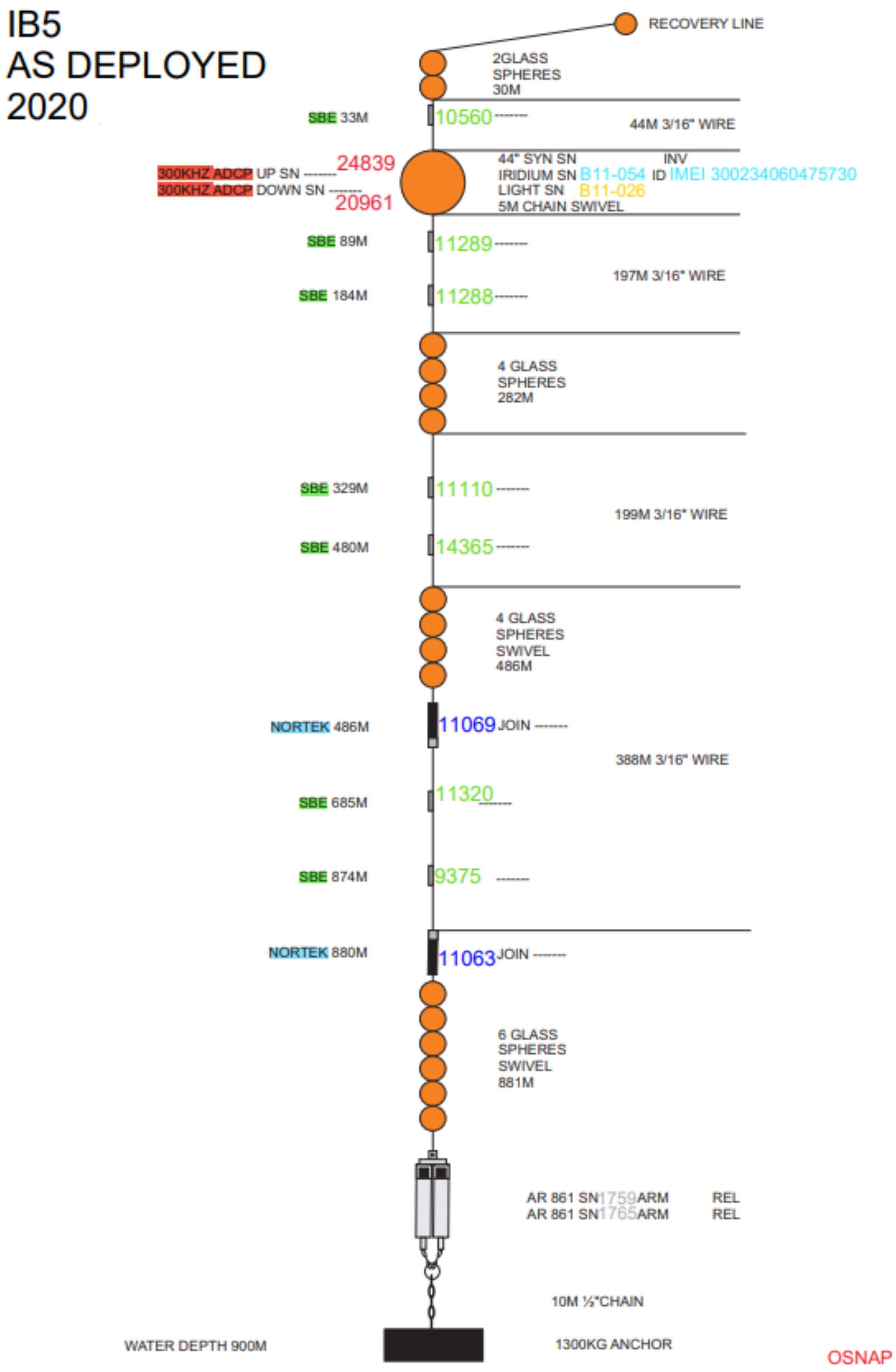


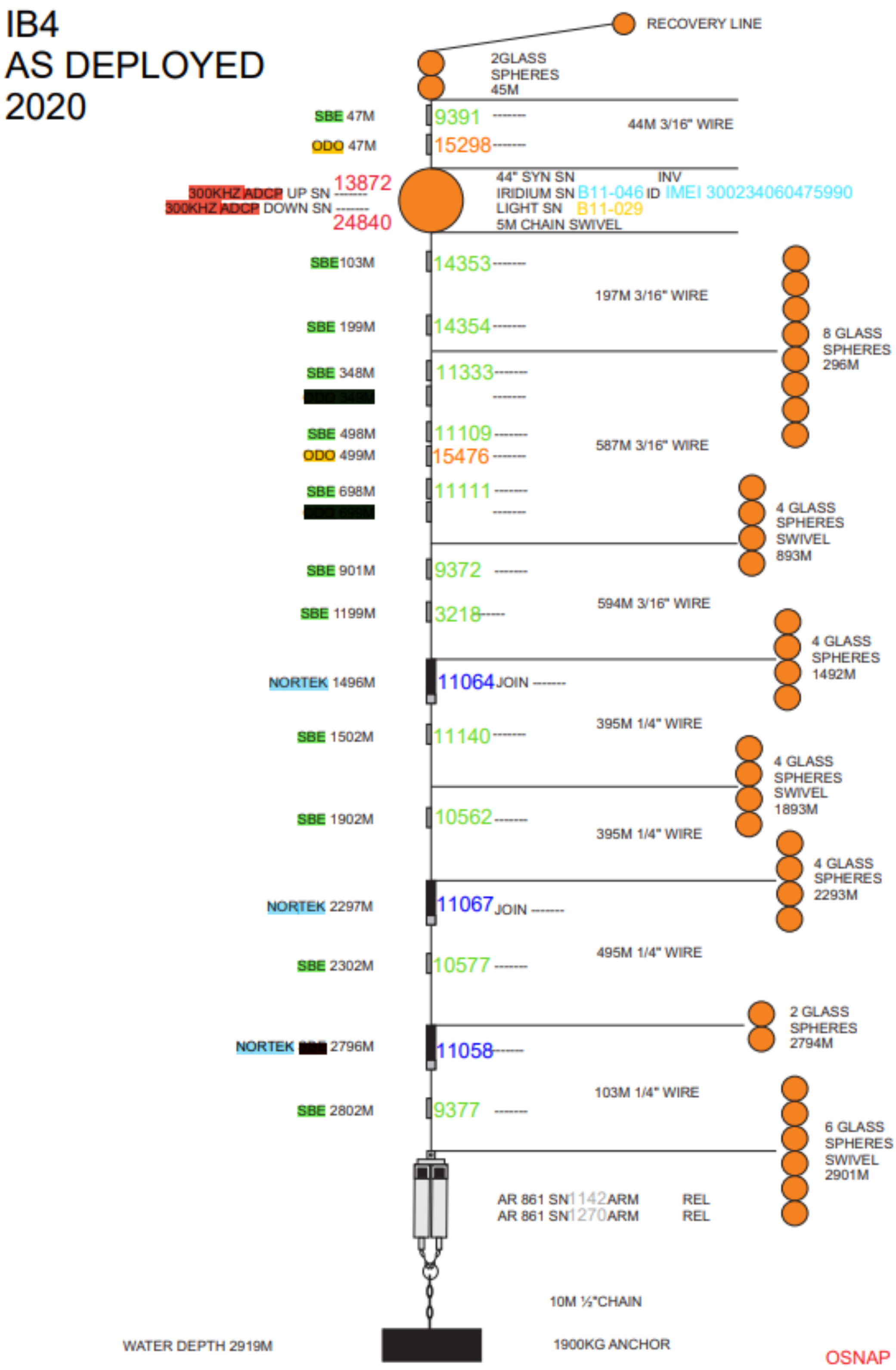
WB 2
AS DEPLOYED
2020

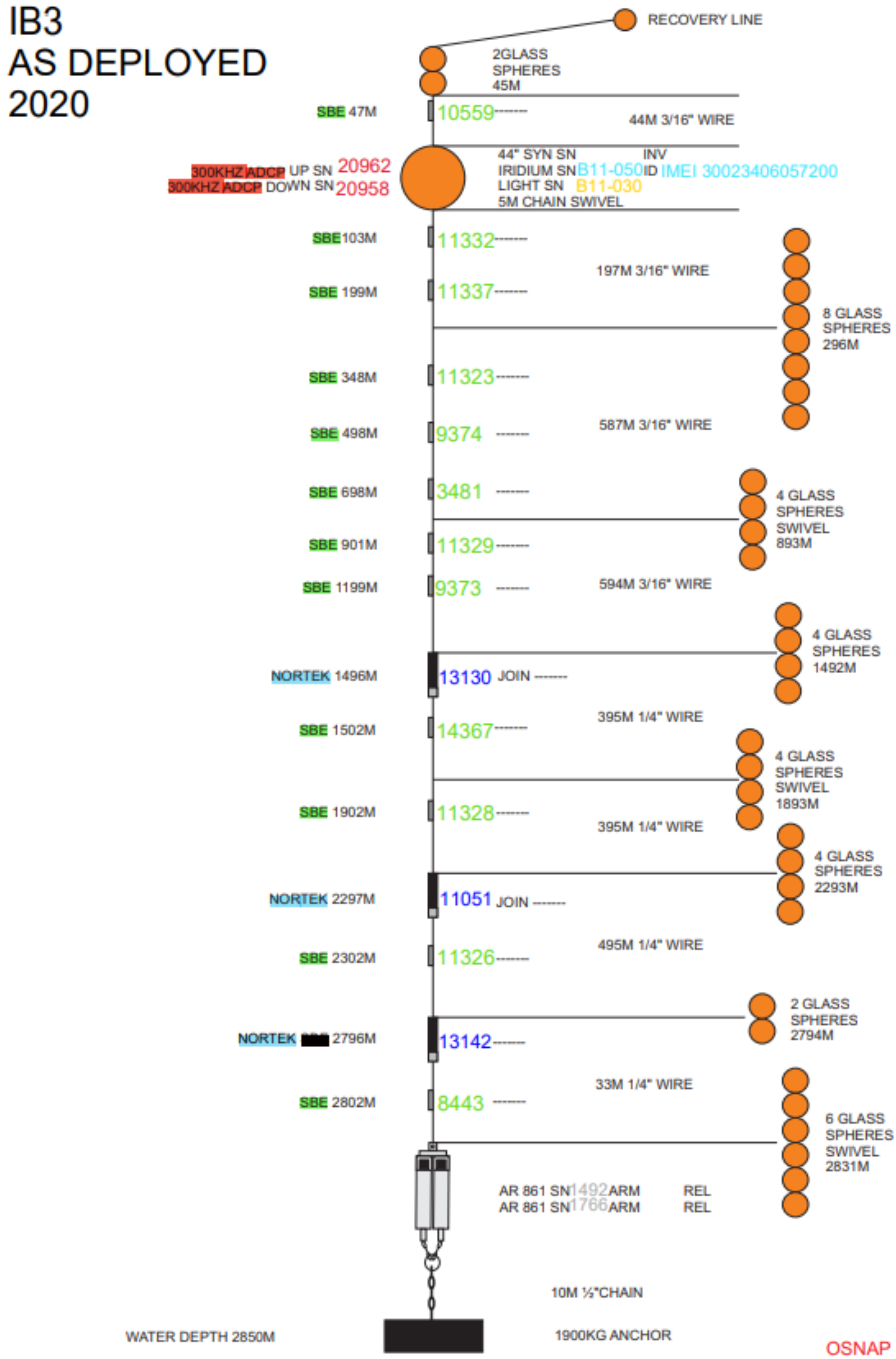


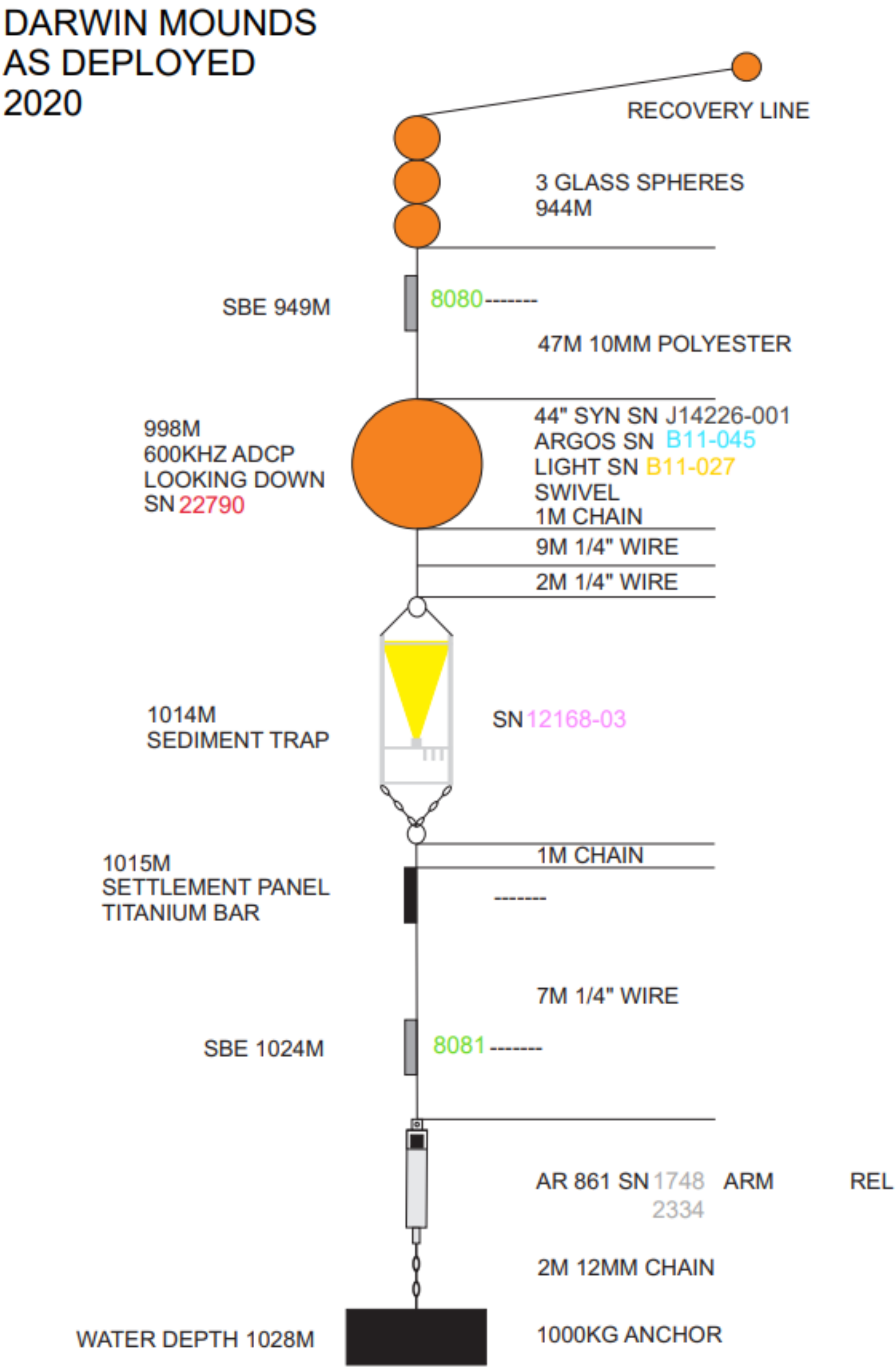

WB1
AS DEPLOYED
2020
RECOVERY LINE
SBE 49M
11343 -------
45M 3/16" WIRE
8 GLASS
SPHERES
45M
31" BUOY 94M
31" SYN SN
INV
IRIDIUM SN B11-052 ID
LIGHT SN B11-034
2M CHAIN SWIVEL
IMEI 300234060573000
NORTEK 100M
11047 JOIN -------
SBE 106M
11342 -------
384M 3/16" WIRE
SBE 247M
14364 -------
40" BUOY 486M
40" SYN SN
INV
IRIDIUM SN B11-048 ID IMEI 300234060474980
LIGHT SN B11-038
2M CHAIN SWIVEL
NORTEK 493M
11048 JOIN -------
SBE 499M
7923 (SAMS)
494M 3/16" WIRE
SBE 750M
7924 (SAMS)
5 GLASS
SPHERES
990M
NORTEK 994M
11055 JOIN -------
201M 3/16" WIRE
SBE 1000M
11137 -------
4 GLASS
SPHERES
SWIVEL
1197M
SBE 1248M
11139 -------
143M 1/4" WIRE
4 GLASS
SPHERES
1345M
NORTEK 1349M
13018 JOIN -------
215M 1/4" WIRE
SBE 1499M
10576 -------
2 GLASS
SPHERES 1566M
NORTEK 1568M
9861 JOIN -------
15M 1/4" WIRE
SBE 1573M
11465 -------
6 GLASS
SPHERES
SWIVEL
1584M
AR 861 SN 1136 ARM REL
AR 861 SN 1752 ARM REL
5M ½"CHAIN
WATER DEPTH 1600M
2200KG ANCHOR
OSNAP


RHADCP
AS DEPLOYED
2020
RECOVERY LINE
IRIDIUM SN B11-049 ID IMEI 300234060571000
LIGHT SN B11-040
40" SYNTACTIC SN J20268-002
NORTEK SIGNATURE 55 ADCP
SN 200044
SBE37 9113 (SAMS)
5M 12MM CHAIN
SWIVEL
AR 861 SN 1135 ARM REL
AR 861 SN 1137 ARM REL
5M OF 12MM CHAIN
850KG ANCHOR
OSNAP


IB5
AS DEPLOYED
2020
RECOVERY LINE
2GLASS SPHERES 30M
SBE 33M
10560
44M 3/16" WIRE
300KHZ ADCP UP SN 24839
300KHZ ADCP DOWN SN 20961
44" SYN SN INV
IRIDIUM SN B11-054 ID IMEI 300234060475730
LIGHT SN B11-026
5M CHAIN SWIVEL
SBE 89M
11289
197M 3/16" WIRE
SBE 184M
11288
4 GLASS SPHERES 282M
SBE 329M
11110
199M 3/16" WIRE
SBE 480M
14365
4 GLASS SPHERES SWIVEL 486M
NORTEK 486M
11069 JOIN
388M 3/16" WIRE
SBE 685M
11320
SBE 874M
9375
NORTEK 880M
11063 JOIN
6 GLASS SPHERES SWIVEL 881M
AR 861 SN1759ARM REL
AR 861 SN1765ARM REL
10M ½"CHAIN
WATER DEPTH 900M
1300KG ANCHOR
OSNAP

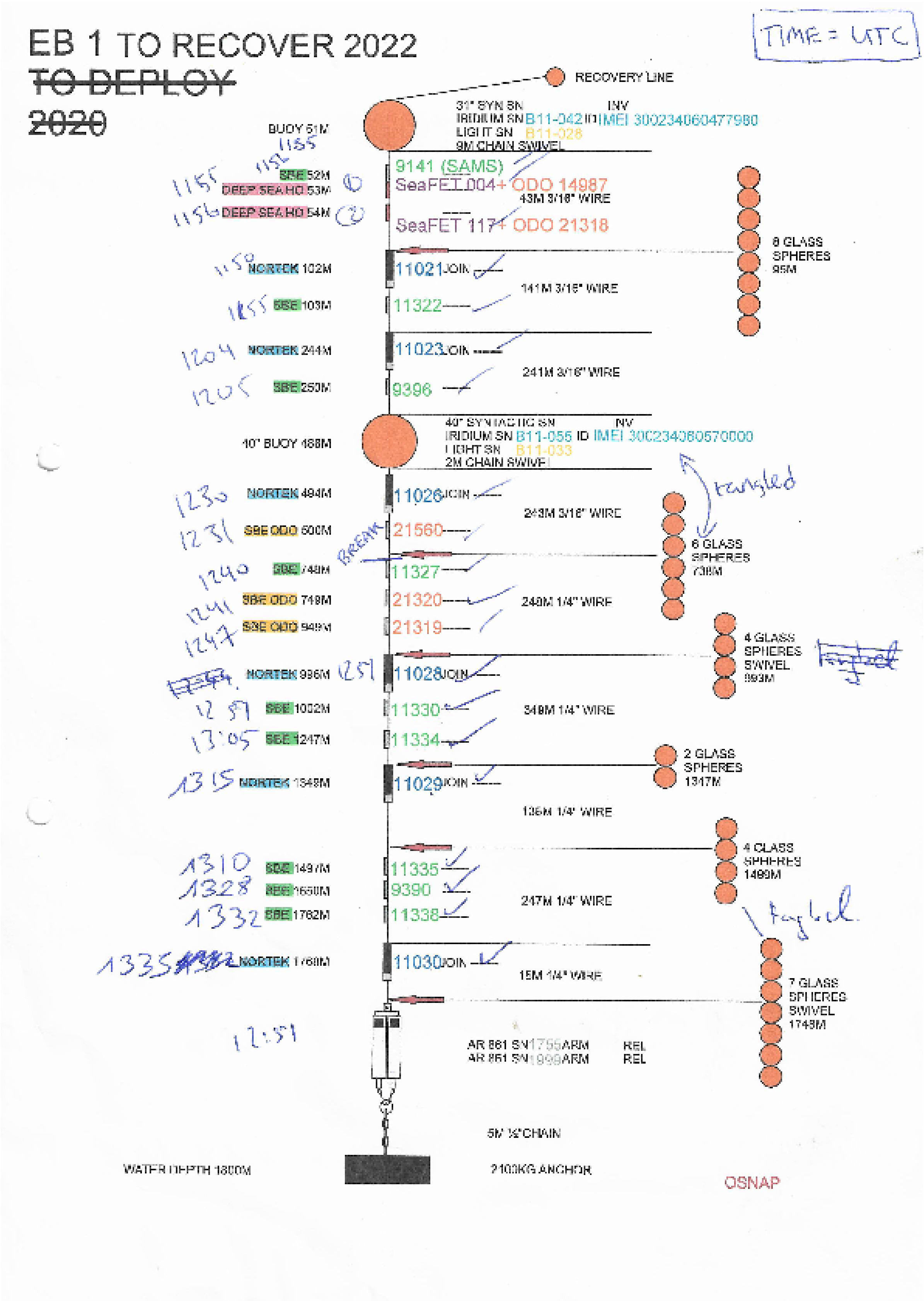

IB4
AS DEPLOYED
2020
RECOVERY LINE
2GLASS SPHERES 45M
SBE 47M 9391
ODO 47M 15298
44M 3/16" WIRE
300KHZ ADCP UP SN 13872
300KHZ ADCP DOWN SN 24840
44" SYN SN
INV
IRIDIUM SN B11-046 ID IMEI 300234060475990
LIGHT SN B11-029
5M CHAIN SWIVEL
SBE 103M 14353
197M 3/16" WIRE
SBE 199M 14354
8 GLASS SPHERES 296M
SBE 348M 11333
[redacted]
SBE 498M 11109
ODO 499M 15476
587M 3/16" WIRE
SBE 698M 11111
[redacted]
4 GLASS SPHERES SWIVEL 893M
SBE 901M 9372
594M 3/16" WIRE
SBE 1199M 3218
4 GLASS SPHERES 1492M
NORTEK 1496M 11064 JOIN
395M 1/4" WIRE
SBE 1502M 11140
4 GLASS SPHERES SWIVEL 1893M
SBE 1902M 10562
395M 1/4" WIRE
4 GLASS SPHERES 2293M
NORTEK 2297M 11067 JOIN
495M 1/4" WIRE
SBE 2302M 10577
2 GLASS SPHERES 2794M
NORTEK [redacted] 2796M 11058
103M 1/4" WIRE
SBE 2802M 9377
6 GLASS SPHERES SWIVEL 2901M
AR 861 SN1142 ARM REL
AR 861 SN1270 ARM REL
10M ½"CHAIN
WATER DEPTH 2919M
1900KG ANCHOR
OSNAP

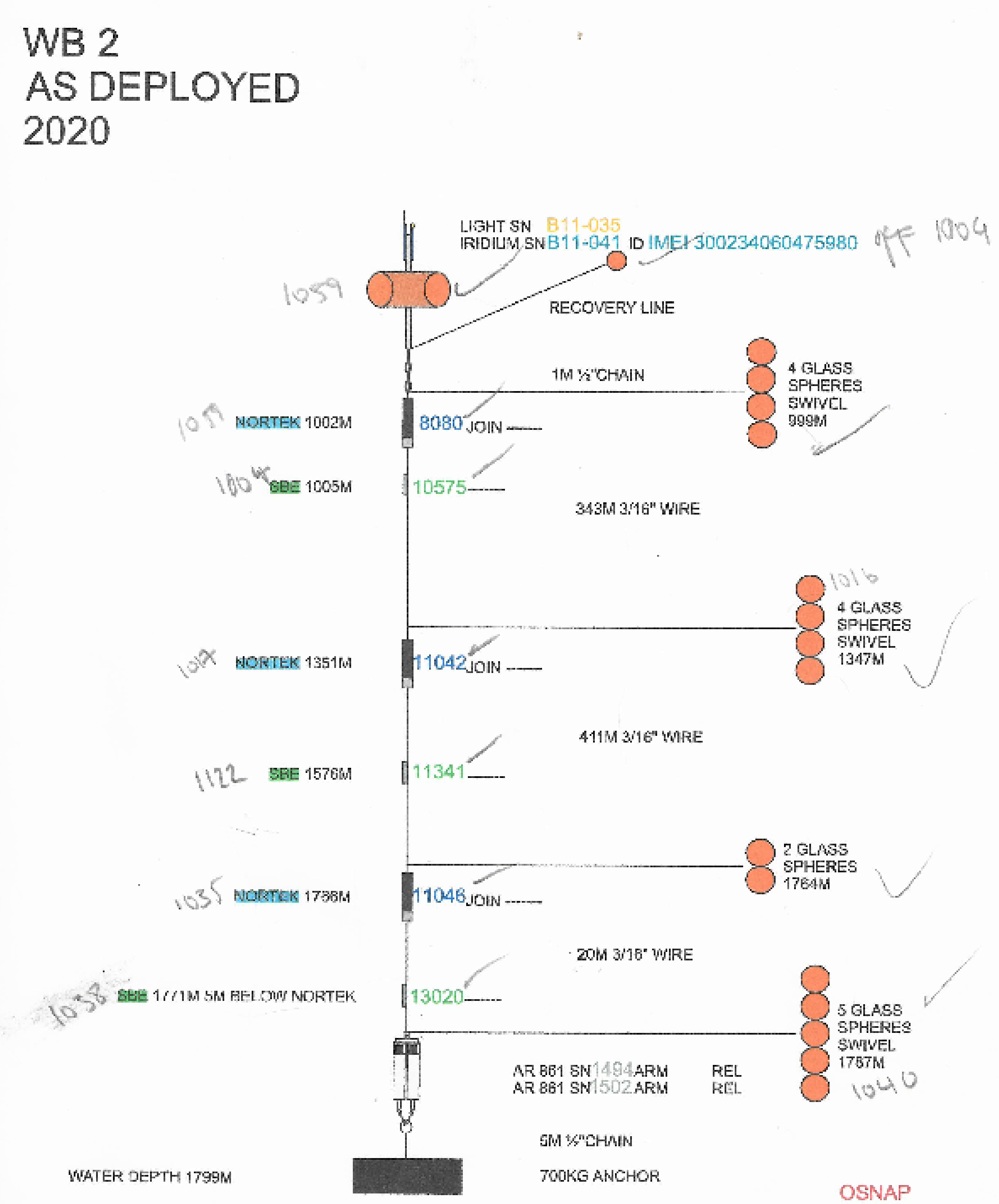

IB3
AS DEPLOYED
2020
RECOVERY LINE
2GLASS SPHERES 45M
SBE 47M
10559
44M 3/16" WIRE
300KHZ ADCP UP SN 20962
300KHZ ADCP DOWN SN 20958
44" SYN SN
INV
IRIDIUM SN B11-050 ID IMEI 300234060572000
LIGHT SN B11-030
5M CHAIN SWIVEL
SBE 103M
11332
197M 3/16" WIRE
SBE 199M
11337
8 GLASS SPHERES 296M
SBE 348M
11323
SBE 498M
9374
587M 3/16" WIRE
SBE 698M
3481
4 GLASS SPHERES SWIVEL 893M
SBE 901M
11329
SBE 1199M
9373
594M 3/16" WIRE
4 GLASS SPHERES 1492M
NORTEK 1496M
13130 JOIN
395M 1/4" WIRE
SBE 1502M
14367
4 GLASS SPHERES SWIVEL 1893M
SBE 1902M
11328
395M 1/4" WIRE
4 GLASS SPHERES 2293M
NORTEK 2297M
11051 JOIN
495M 1/4" WIRE
SBE 2302M
11326
2 GLASS SPHERES 2794M
NORTEK [redacted] 2796M
13142
33M 1/4" WIRE
SBE 2802M
8443
6 GLASS SPHERES SWIVEL 2831M
AR 861 SN 1492 ARM REL
AR 861 SN 1766 ARM REL
10M ½"CHAIN
WATER DEPTH 2850M
1900KG ANCHOR
OSNAP

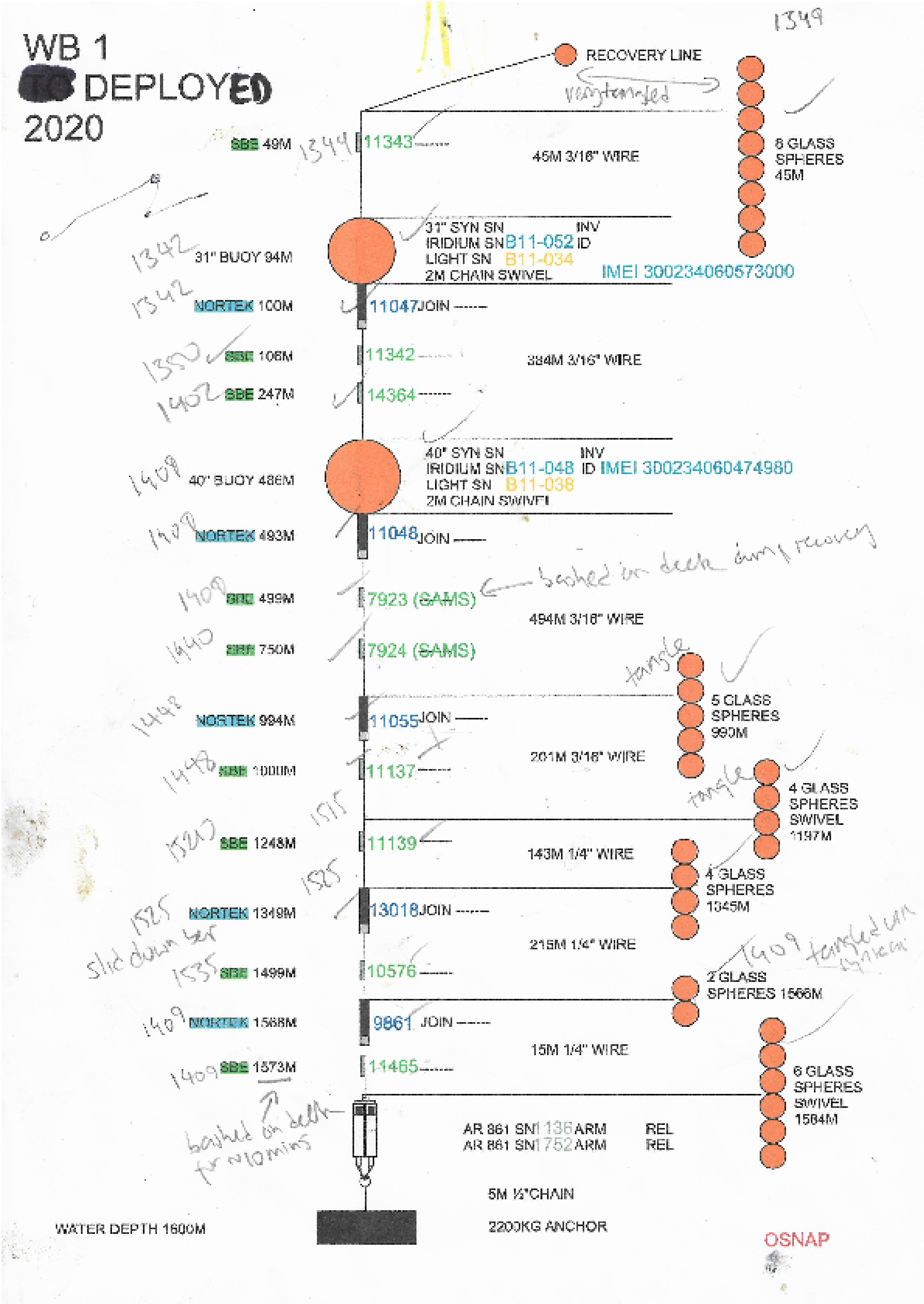

DARWIN MOUNDS
AS DEPLOYED
2020
RECOVERY LINE
3 GLASS SPHERES
944M
SBE 949M
8080-------
47M 10MM POLYESTER
998M
600KHZ ADCP
LOOKING DOWN
SN 22790
44" SYN SN J14226-001
ARGOS SN B11-045
LIGHT SN B11-027
SWIVEL
1M CHAIN
9M 1/4" WIRE
2M 1/4" WIRE
1014M
SEDIMENT TRAP
SN 12168-03
1M CHAIN
1015M
SETTLEMENT PANEL
TITANIUM BAR

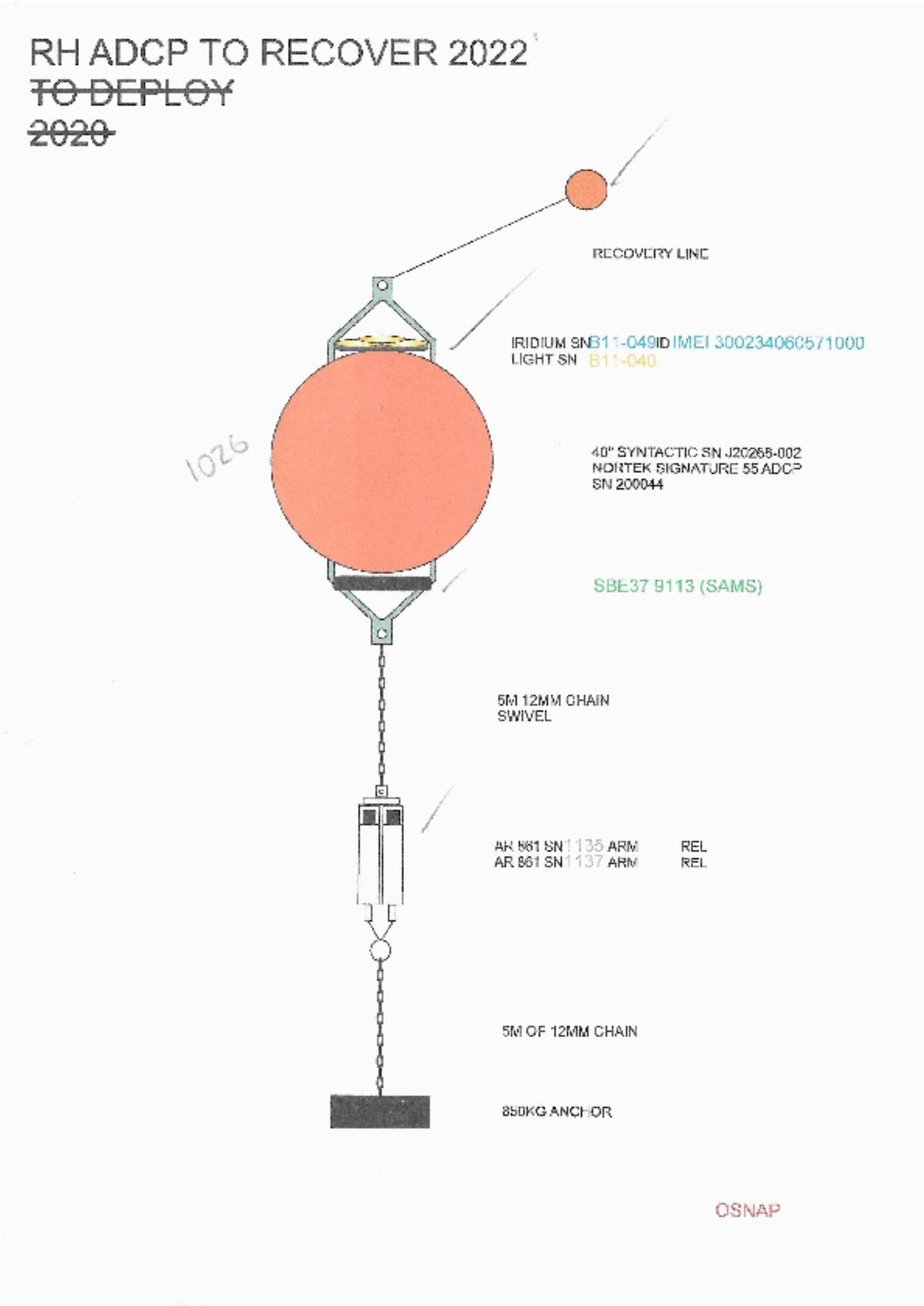
7M 1/4" WIRE
SBE 1024M
8081 -------
AR 861 SN 1748 ARM REL
2334
2M 12MM CHAIN
WATER DEPTH 1028M
1000KG ANCHOR

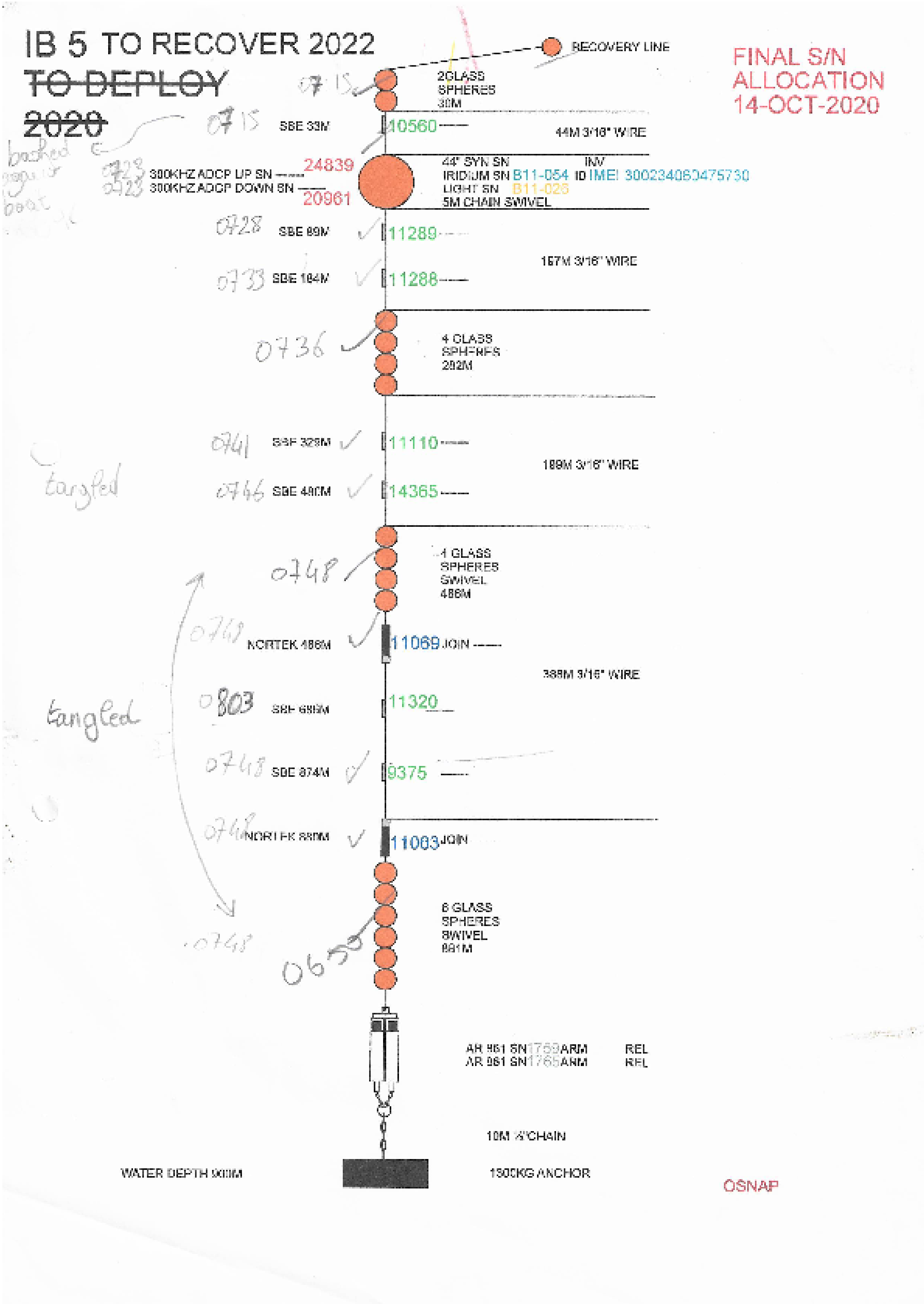
APPENDIX T: DECK LOGS OF RECOVERED MOORINGS

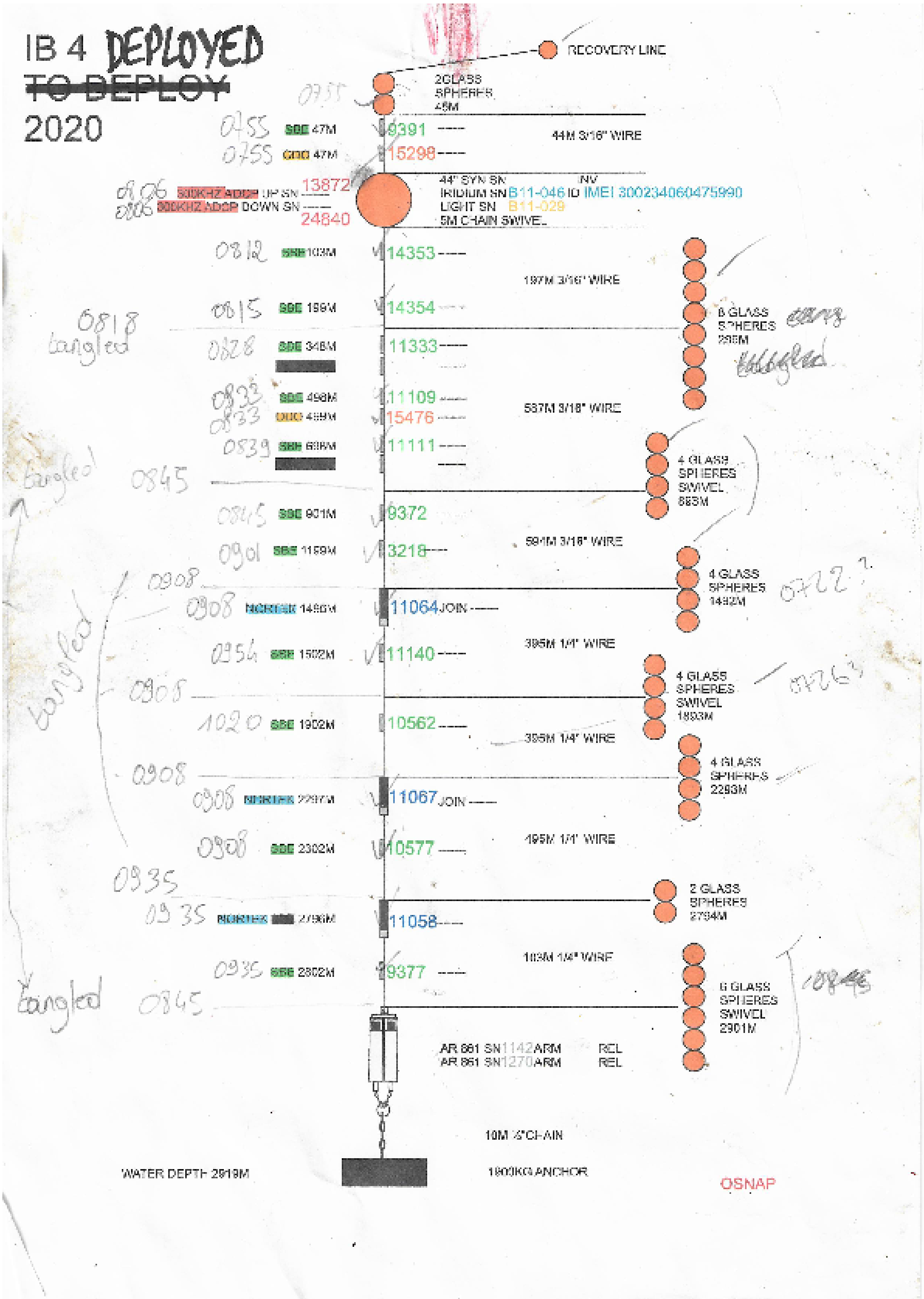


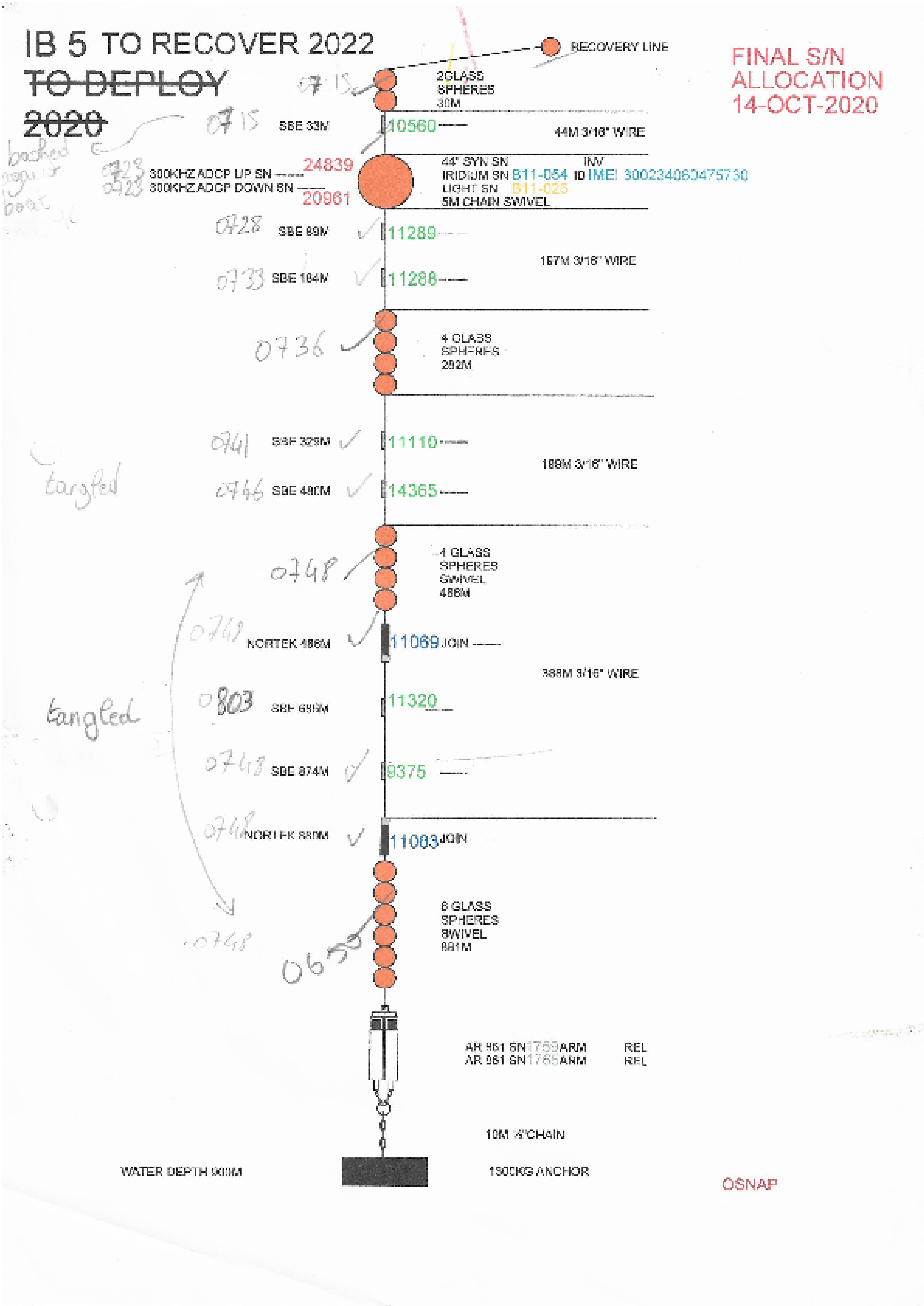

WB 2
AS DEPLOYED
2020
LIGHT SN B11-035
IRIDIUM SN B11-041 ID IMEI 300234060475980
RECOVERY LINE
1M ½"CHAIN
4 GLASS SPHERES SWIVEL 999M
NORTEK 1002M
8080 JOIN
SBE 1005M
10575
343M 3/16" WIRE
4 GLASS SPHERES SWIVEL 1347M
NORTEK 1351M
11042 JOIN
411M 3/16" WIRE
SBE 1576M
11341
2 GLASS SPHERES 1764M
NORTEK 1766M
11046 JOIN
20M 3/16" WIRE
SBE 1771M 5M BELOW NORTEK
13020
5 GLASS SPHERES SWIVEL 1767M
AR 861 SN 1494 ARM REL
AR 861 SN 1502 ARM REL
5M ½"CHAIN
WATER DEPTH 1799M
700KG ANCHOR
OSNAP

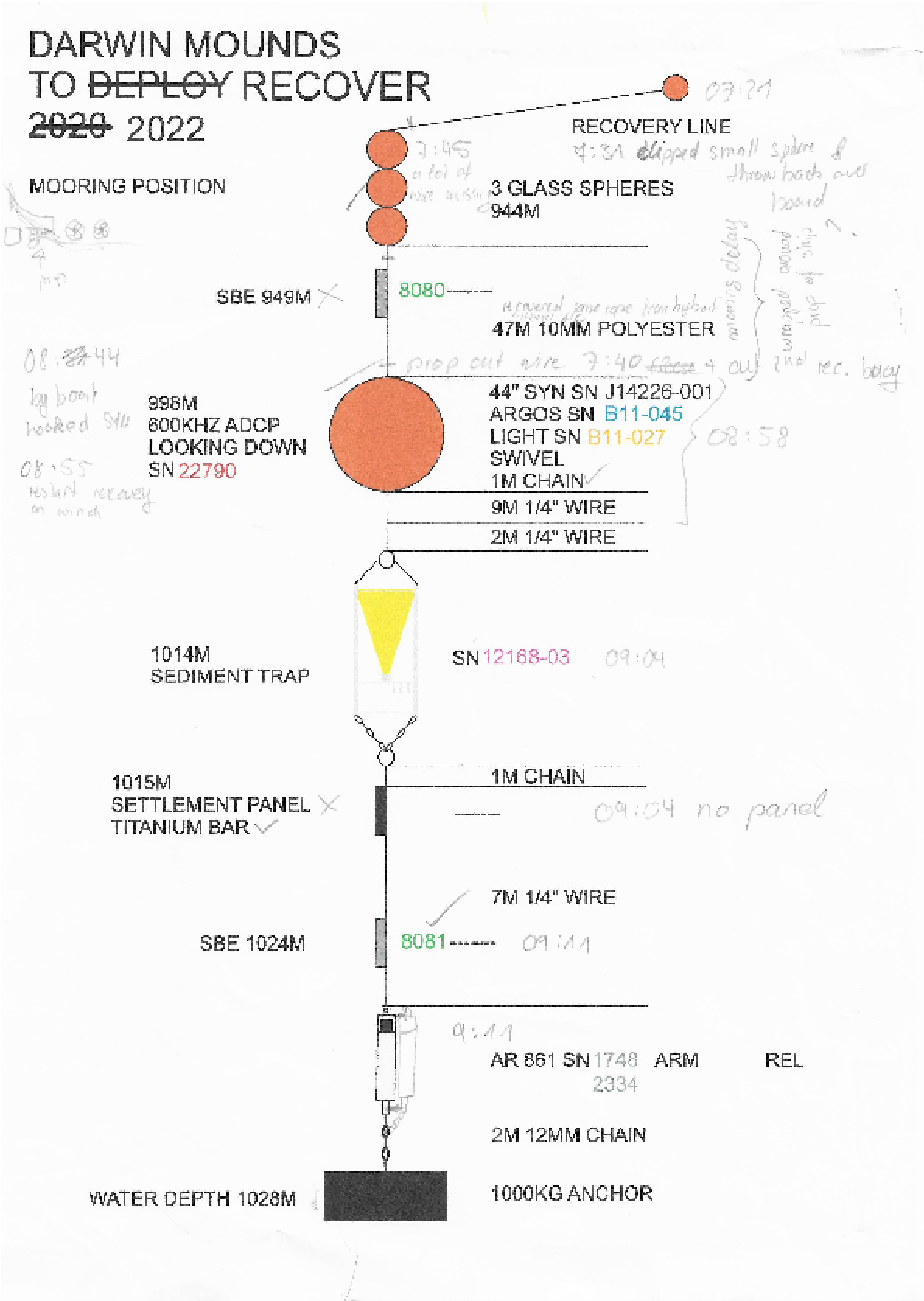

WB 1
DEPLOYED
2020
RECOVERY LINE
SBE 49M
11343
45M 3/16" WIRE
6 GLASS SPHERES 45M
31" BUOY 94M
31" SYN SN INV
IRIDIUM SN B11-052 ID
LIGHT SN B11-034
2M CHAIN SWIVEL
IMEI 300234060573000
NORTEK 100M
11047 JOIN
SBE 106M
11342
334M 3/16" WIRE
SBE 247M
14364
40" BUOY 486M
40" SYN SN INV
IRIDIUM SN B11-048 ID IMEI 300234060474980
LIGHT SN B11-038
2M CHAIN SWIVEL
NORTEK 493M
11048 JOIN
SBE 499M
7923 (SAMS)
494M 3/16" WIRE
SBE 750M
7924 (SAMS)
5 GLASS SPHERES 990M
NORTEK 994M
11055 JOIN
SBE 1000M
11137
201M 3/16" WIRE
4 GLASS SPHERES SWIVEL 1197M
SBE 1248M
11139
143M 1/4" WIRE
4 GLASS SPHERES 1345M
NORTEK 1349M
13018 JOIN
215M 1/4" WIRE
SBE 1499M
10576
2 GLASS SPHERES 1566M
NORTEK 1568M
9861 JOIN
15M 1/4" WIRE
SBE 1573M
11465
6 GLASS SPHERES SWIVEL 1584M
AR 861 SN 136 ARM REL
AR 861 SN 1752 ARM REL
5M ½"CHAIN
2200KG ANCHOR
WATER DEPTH 1600M
OSNAP


RH ADCP TO RECOVER 2022
TO DEPLOY
2020
RECOVERY LINE
IRIDIUM SN B11-049 ID IMEI 300234060571000
LIGHT SN B11-040
1026
40" SYNTACTIC SN J20265-002
NORTEK SIGNATURE 55 ADCP
SN 200044
SBE37 9113 (SAMS)
5M 12MM CHAIN
SWIVEL
AR 861 SN 1135 ARM REL
AR 861 SN 1137 ARM REL
5M OF 12MM CHAIN
850KG ANCHOR
OSNAP


IB 5 TO RECOVER 2022
TO DEPLOY
2020
RECOVERY LINE
FINAL S/N
ALLOCATION
14-OCT-2020
2GLASS
SPHERES
30M
SBE 33M
10560
44M 3/16" WIRE
300KHZ ADCP UP SN 24839
300KHZ ADCP DOWN SN 20961
44" SYN SN
IRIDIUM SN B11-054 ID IMEI 300234060475730
LIGHT SN B11-028
5M CHAIN SWIVEL
SBE 89M 11289
157M 3/16" WIRE
SBE 104M 11288
4 GLASS
SPHERES
292M
SBE 329M 11110
189M 3/16" WIRE
SBE 480M 14365
4 GLASS
SPHERES
SWIVEL
486M
NORTEK 496M 11069 JOIN
388M 3/16" WIRE
11320
SBE 874M 9375
NORTEK 880M 11063 JOIN
6 GLASS
SPHERES
SWIVEL
881M
REL
REL
10M ½"CHAIN
WATER DEPTH 900M
1500KG ANCHOR
OSNAP


IB 4 DEPLOYED
TO DEPLOY
2020
RECOVERY LINE
2GLASS SPHERES 45M
SBE 47M
9391
15298
44M 3/16" WIRE
300KHZ ADCP UP SN 13872
300KHZ ADCP DOWN SN 24840
44" SYN SN
IRIDIUM SN B11-046 ID IMEI 300234060475990
LIGHT SN B11-029
5M CHAIN SWIVEL
SBE 103M
14353
197M 3/16" WIRE
SBE 199M
14354
8 GLASS SPHERES 295M
SBE 348M
11333
SBE 498M
11109
15476
537M 3/16" WIRE
SBE 698M
11111
4 GLASS SPHERES SWIVEL 883M
SBE 901M
9372
SBE 1159M
3218
594M 3/16" WIRE
4 GLASS SPHERES 1492M
11064 JOIN
SBE 1502M
11140
395M 1/4" WIRE
4 GLASS SPHERES SWIVEL 1893M
SBE 1902M
10562
395M 1/4" WIRE
4 GLASS SPHERES 2293M
11067 JOIN
SBE 2302M
10577
495M 1/4" WIRE
2 GLASS SPHERES 2794M
11058
103M 1/4" WIRE
SBE 2802M
9377
6 GLASS SPHERES SWIVEL 2901M
AR 861 SN1142ARM REL
AR 861 SN1270ARM REL
10M ½" CHAIN
WATER DEPTH 2919M
1800KG ANCHOR
OSNAP


IB 5 TO RECOVER 2022
TO DEPLOY
2020
RECOVERY LINE
FINAL S/N
ALLOCATION
14-OCT-2020
2GLASS
SPHERES
30M
SBE 33M
10560
44M 3/16" WIRE
300KHZ ADCP UP SN
24839
300KHZ ADCP DOWN SN
20961
44" SYN SN
INV
IRIDIUM SN B11-054
ID IMEI 300234060475730
LIGHT SN B11-028
5M CHAIN SWIVEL
SBE 89M
11289
157M 3/16" WIRE
SBE 104M
11288
4 GLASS
SPHERES
282M
SBE 328M
11110
189M 3/16" WIRE
SBE 480M
14365
4 GLASS
SPHERES
SWIVEL
486M
NORTEK 486M
11069 JOIN
388M 3/16" WIRE
11320
SBE 874M
9375
11063 JOIN
6 GLASS
SPHERES
SWIVEL
881M
AR 861 SN
ARM
REL
AR 861 SN
ARM
REL
10M CHAIN
1500KG ANCHOR
OSNAP
tangled
tangled
0715
0728
0733
0736
0741
0746
0748
0803
0650


DARWIN MOUNDS
TO DEPLOY RECOVER
2020 2022
MOORING POSITION
RECOVERY LINE
3 GLASS SPHERES
944M
SBE 949M
8080
47M 10MM POLYESTER
998M
600KHZ ADCP
LOOKING DOWN
SN 22790
44" SYN SN J14226-001
ARGOS SN B11-045
LIGHT SN B11-027
SWIVEL
1M CHAIN
9M 1/4" WIRE
2M 1/4" WIRE
1014M
SEDIMENT TRAP
SN 12168-03
1015M
SETTLEMENT PANEL
TITANIUM BAR
1M CHAIN
7M 1/4" WIRE
SBE 1024M
8081
AR 861 SN 1748 ARM REL
2334
2M 12MM CHAIN
WATER DEPTH 1028M
1000KG ANCHOR

APPENDIX U: META DATA FROM RECOVERED MOORINGS

Cruise JC238

Mooring recovery metadata log

Mooring: EB1

Date: 15/07/2022

Trilaterated latitude: 57° 05.92'N

Trilaterated longitude: 009° 33.57'W

Corrected depth: 1811 m

Acoustic release S/N: 1755 1999

ARM code: [redacted]

DIAG code: [redacted]

RELEASE code:

Arrival on site time (UTC): 10:15

Ship location relative to mooring (distance + direction): 500m - mooring to the NE

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	10:16:40	57°05.755'N	9° 33.047'W	1792	
Surface (acoustic tracking)	/	---	---	---	---
Surface (spotted)	10:17	---	---	---	---
Start recovery	11:06	57° 6.14 N	9° 33.88 W	1817	
End recovery					

Recovery comments:

Ranging 1903m before release.
Visible on surface immediately.

1040 all packages on surface, mooring very tangled
~~11:00 grapple~~
11:06 grapple, release first?
11:10 line snapped
11:24 Grapple (2nd) successful 57 6.20 N 9 33.82 W
1237 line broken

Cruise JC238

Mooring recovery metadata log

Mooring: WB2

Date: 17/7/2022

Trilaterated latitude: 57.4715 N

Trilaterated longitude: -12.3143 W

Corrected depth: 1801 m

Acoustic release S/N: 1499 / 1502

ARM code:

DIAG code:

RELEASE code:

Arrival on site time (UTC): 0910

Ship location relative to mooring (distance + direction): mooring ~ 520m to 45° from ship

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	0911	57.4712 N	-12.3069W	1798.9	1792.9
Surface (acoustic tracking)		---	---	---	---
Surface (spotted)	0925	---	---	---	---
Start recovery	0955	57.4711 N	-12.3240 W	1796.2	1790.2
End recovery	1040	57.4703N	-12.3418 W	1794.3	1788.3

Recovery comments:

0935 all packages on surface streamed in order

0954 successful grapple, recovery buoy inboard

Cruise JC238 Mooring recovery metadata log

Mooring: WB1
Date: 18/7/2022

Trilateral latitude: 57.46946 N
Trilateral longitude: -12.70291 W
Corrected depth: 1599.6 m

Acoustic release S/N: 1752 1136
ARM code: [redacted]
DIAG code: [redacted]
RELEASE code:

Arrival on site time (UTC): 12:43 – Acoustics off ~12:44 / back on 12:47 – off again 12:53 – on 12:54
Ship location relative to mooring (distance + direction): 500m off, ship NorthWest

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	125315	57.4733N	-12.6944W	1604	1603.8
Surface (acoustic tracking)	125400	---	---	---	---
Surface (spotted)	1253	---	---	---	---
Start recovery	1335	57.4727 N	-12.7063 W		1585.4
End recovery	1544	57.4836	-12.6683 W		1632.4

Recovery comments:

1717 – 1718 Ranges after release end
1699 – 1688 coming up
Grappled @ 1335, not coming in nicely as recovery float is tangled with top 8
40" syntactic tangled with
2 x microCATs bashed against aft deck due to severe tangle

Cruise JC238 Mooring recovery metadata log

Mooring: RHADCP
Date: 20/7/2022

Trilaterated latitude: 57.61482 N
Trilaterated longitude: -15.41099 W
Corrected depth: 1083 m

Acoustic release S/N: 1137 / 1135
ARM code: [redacted]
DIAG code:
RELEASE code:

Arrival on site time (UTC): 09:46

Ship location relative to mooring (distance + direction):

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	09:48:14	57.6167	-15.4015	1050.8	1047.8
Surface (acoustic tracking)		---	---	---	---
Surface (spotted)	10:02	---	---	---	---
Start recovery	10:20	57.6173	-15.4101	1098	1095.0
End recovery	10:27	57.6179	-15.4114	1081.8	1078.8

Recovery comments:

1137
0947 comms check, 1226m
release → 1225m
1224m
0949 1219 m
0950 1210 m, 1209m
0952 1206 m, 1206m
0953 1206m, 1206m

1135 (m)
0954 1207,
- release ok
0954:30 1188m,
1174m
0955 1136 m,
1125 m
0956 1073m
1072m

Grappled @ 10:20

Cruise JC238 Mooring recovery metadata log

Mooring: IB5
Date: 21/7/2022

Trilaterated latitude: 57.80140
Trilaterated longitude: -19.17139
Corrected depth: .... m

Acoustic release S/N: 1759 | 1765
ARM code: [redacted]
RELEASE code: ....

Arrival on site time (UTC): 0630
Ship location relative to mooring (distance + direction): 500m

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	0640	57.8012	-19.1557	935.2	932.2
Surface (acoustic tracking)	0641	---	---	---	---
Surface (spotted)	0642	---	---	---	---
Start recovery	0712	57.7994	-19.1688	943.8	940.8
End recovery	0803	57.7983	-19.1560	938.3	935.3

Recovery comments:

0635 range 1705m
" 1664m
1597m
} - Still coming on to station

0640
Anchor rel, 1276
1259
1216
1200

0710 recovery line grappled

Cruise JC238 Mooring recovery metadata log

Mooring: IB4
Date: 22/07/22

Trilaterated latitude: 57° 59.39'N
Trilaterated longitude: 21° 08.77'W
Corrected depth: 2922 m

Acoustic release S/N: 1142 1270
ARM code: [redacted]
DIAG code:
RELEASE code:

Arrival on site time (UTC): ~03:00
Ship location relative to mooring (distance + direction): 400m

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	065337	57.9930 N	-21.1433W	2929.7	2920.9
Surface (acoustic tracking)		---	---	---	---
Surface (spotted)	06:56	---	---	---	---
Start recovery	0751	57.9881N	-21.1483W	2916.0	2907.1
End recovery	1020	57.9693N	-21.1144W	2781.0	2771.3

Recovery comments: SN 1270

06:52:05 wake up no comms
06:52:49 2936, 2939m
06:53:40 2940, 2940 m
06:55:11 2940, 2940m
06:55:16 Release Ok 2941, 2942m

SN 1142
06:56:08 no answer (comms

0701 recovery float onboard

Cruise JC238 Mooring recovery metadata log

Mooring: IB3

Date: 24/7/2022

Trilaterated latitude: 58.012771 N

Trilaterated longitude: 24.425715 W

Corrected depth: 2838 m

Acoustic release S/N: 1492, 1766

ARM code: [redacted]

DIAG code:

RELEASE code:

Arrival on site time (UTC): 08:27

Ship location relative to mooring (distance + direction): 500 m

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	08:29:13	58.0078N	-24.4285W	2836.2	2821.2
Surface (acoustic tracking)		---	---	---	---
Surface (spotted)	08:30	---	---	---	---
Start recovery	09:50	58.0109N	-24.4237W	2835.5	2820.5
End recovery	1124	58.0056N	-24.4549W	2838.7	2823.7

Recovery comments: Sn 1492

Several grapple attempts made off stbd aft quarter

range

08:28:15 2891 m

release ok 2891, 2891 m

0829 30

0829:42 2866 2856 m

Grappled on wire below pellet + 2x spheres,

using capstan winch on stbd quarter, MicroCAT (10559) trapped on gunwhale,

Cruise JC238

Mooring recovery metadata log

Mooring: DMLTM

Date: 27/7/2022

Trilaterated latitude: 58.8630

Trilaterated longitude: -7.04454

Corrected depth: 1036 m

Acoustic release S/N:

ARM code:

DIAG code:

RELEASE code:

Arrival on site time (UTC): 06 15

Ship location relative to mooring (distance + direction): 356m + 192°

	Time (UTC)	Latitude	Longitude	Uncorrected depth (m)	Corrected depth (m)
Anchor release	06:50:45	59.86443°	-7.04293°E	1024.1m	1021.1m
Surface (acoustic tracking)		---	---	---	---
Surface (spotted)	07:01	---	---	---	---
Start recovery	7:20	59.86588°N	7.04177°W	1019.9	1016.9
End recovery	09:11	59.87476°N	7.02521°W	986.5	983.5

Recovery comments:

interrogate
06:49:52 1018.5m

Release surf 1041 m
1032 m

7:31 : clipped new (recovery line) small buoy on wire & realese back to water because mooring wrapped around prop of boat -> wire cut by prop @07:40

: syntactic buoys rec. started

08:55 . restart recovery

APPENDIX V: SET-UP CAPTURE FILES FOR DEPLOYED INSTRUMENTS

A. SBE37

```
S>ds
SBE37SM-RS232 v4.1  SERIAL NO. 9140  16 Jul 2022 07:03:51
vMain = 13.44, vLith =  2.98
samplenumber = 618, free = 558622
not logging, stop command
sample interval = 10 seconds
data format = converted engineering alternate
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3134.5
<Executed/>
OutputExecutedTag=N
S>OutputFormat=3
S>DateTime=07162022120000
S>DateTime=07162022070500
S>ds
SBE37SM-RS232 v4.1  SERIAL NO. 9140  16 Jul 2022 07:05:19
vMain = 13.40, vLith =  2.98
samplenumber = 618, free = 558622
not logging, stop command
sample interval = 10 seconds
data format = converted engineering alternate
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3134.5
S>SampleInterval=1800
S>TxRealTime=N
S>SampleNumber=0
this command will modify memory pointers
repeat the command to confirm
SampleNumber=0
S>StartDateTime=07162022120000
<start dateTime = 16 Jul 2022 12:00:00/>
S>StartLater
<!--start logging at = 16 Jul 2022 12:00:00, sample interval = 1800 seconds-->
S>ds
SBE37SM-RS232 v4.1  SERIAL NO. 9140  16 Jul 2022 07:06:34
vMain = 13.36, vLith =  2.98
samplenumber = 0, free = 559240
not logging, waiting to start at 16 Jul 2022 12:00:00
sample interval = 1800 seconds
data format = converted engineering alternate
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3134.5
S>
```

B. SBE37-ODO


```
S><Executed/>
GetHD
<HardwareData DeviceType='SBE37SMP-ODO-RS232' SerialNumber='03724104'>
  <Manufacturer>Sea-Bird Scientific</Manufacturer>
  <FirmwareVersion>6.2.0</FirmwareVersion>
  <FirmwareDate>May  1 2019 13:15:54</FirmwareDate>
  <CommandSetVersion>1.3</CommandSetVersion>
  <PCBAssembly SerialNum='256482' AssemblyNum='41661E'/>
  <PCBAssembly SerialNum='256490' AssemblyNum='41783.1S'/>
  <PCBAssembly SerialNum='256486' AssemblyNum='41785C'/>
  <PCBAssembly SerialNum='256494' AssemblyNum='41787F'/>
  <MfgDate>11Feb2022</MfgDate>
  <FirmwareLoader>SBE 37-232-V3 FirmwareLoader V 1.0</FirmwareLoader>
  <InternalSensors>
    <Sensor id='Temperature'>
      <type>temperature-1</type>
      <SerialNumber>03724104</SerialNumber>
    </Sensor>
    <Sensor id='Conductivity'>
      <type>conductivity-1</type>
      <SerialNumber>03724104</SerialNumber>
    </Sensor>
    <Sensor id='Pressure'>
      <type>strain-0</type>
      <SerialNumber>5021151</SerialNumber>
    </Sensor>
    <Sensor id='Oxygen'>
      <type>oxygen-1</type>
      <SerialNumber>3114</SerialNumber>
    </Sensor>
  </InternalSensors>
</HardwareData>
<Executed/>
ds
SBE37SMP-ODO-RS232 v6.2.0  SERIAL NO. 24104  16 Jul 2022 07:07:39
vMain = 13.54, vLith =  3.01
samplenumber = 817, free = 398640
not logging, stop command
sample interval = 15 seconds
data format = converted engineering
output temperature, Celsius
output conductivity, S/m
output pressure, Decibar
output oxygen, ml/L
output salinity, PSU
transmit real time data = no
sync mode = no
minimum conductivity frequency = 3162.7
adaptive pump control disabled, pump on time 1.0 * 7.0 = 7.0 sec
```

```
<Executed/>
OutputExecutedTag=n
S>OutputFormat=1
S>OutputTemp=1
S>OutputCond=1
S>OutputPress==1
S>POutputOx=1
S>OutputSal=1
S>AdaptivePumpControl=y
S>OxNTau=7
S>OxTau20=5.5
S>DateTime=07162022070957
S>ds
SBE37SMP-ODO-RS232 v6.2.0  SERIAL NO. 24104  16 Jul 2022 07:09:59
vMain = 13.53, vLith =  3.01
samplenumber = 817, free = 398640
not logging, stop command
sample interval = 15 seconds
data format = converted engineering
output temperature, Celsius
output conductivity, S/m
output pressure, Decibar
output oxygen, ml/L
output salinity, PSU
transmit real time data = no
sync mode = no
minimum conductivity frequency = 3162.7
adaptive pump control enabled
nTau = 7.0
S>SampleInterval=4500
S>TxRealTime=n
S>SampleNumber=0
memory pointers will be modified
repeat command to confirm:
SampleNumber=0
S>StartDateTime=07162022120000
<start dateTime = 16 Jul 2022 12:00:00/>
S>StartLater
<!--start logging at = 16 Jul 2022 12:00:00, sample interval = 4500 seconds-->
S>ds
SBE37SMP-ODO-RS232 v6.2.0  SERIAL NO. 24104  16 Jul 2022 07:11:38
vMain = 13.48, vLith =  3.01
samplenumber = 0, free = 399457
not logging, start at 16 Jul 2022 12:00:00
sample interval = 4500 seconds
data format = converted engineering
output temperature, Celsius
output conductivity, S/m
output pressure, Decibar
output oxygen, ml/L
```

output salinity, PSU
transmit real time data = no
sync mode = no
minimum conductivity frequency = 3162.7
adaptive pump control enabled
nTau = 7.0
S>

C. SEAFET

Deep SeapHox2 DeploymentReport

SeaFET 0002002

Operator: SA01ED

Comment:

EB! 50m deployment 2022

Battery Endurance Inputs

Deployment Sample/Polling Interval: 3600 seconds

Minimum Deployment Temperature: 9.0 Celsius

Battery Capacity = 761270.4 Joules

Battery Endurance is: 5543 days

Ancillary	Value
Recorded Events	0
Stored Samples	0
Free Samples	883011
Power Supply Voltage	12.4
Main Battery Voltage	12.9
Clock Battery Voltage	3.1
Isolated Circuit Voltage	6.4
Clock Time	16 Jul 2022 07:18:24 +0000

Setting	Value
Baud Rate	19200
CTD Power	false
Temperature Units	Celsius
Pressure Units	Decibar
Conductivity Units	S/m
Oxygen Units	mg/L
Transmit Data Realtime	false
Sample Interval (seconds)	3600
Logging Start DateTime	16 Jul 2022 12:00:00 UTC
Pump Time (s)	65

2022/07/16 07:18:33 GMT

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Calibration Coefficients

Sensor	Coefficient	Value
pH	F1	2.0291E-5
pH	F2	-3.2248E-8
pH	F3	0.0
pH	F4	-1.5414E-14
pH	F5	4.3003E-18
pH	F6	-5.04E-22
pH	K0	-1.410098
pH	K2	-0.001192104
temperature	A0	-1.214157E-4
temperature	A1	3.149227E-4
temperature	A2	-5.268973E-6
temperature	A3	2.198542E-7
conductivity	G	-0.9899448
conductivity	H	0.1320664
conductivity	I	-8.694029E-5
conductivity	J	2.371331E-5
conductivity	PCOR	-9.57E-8
conductivity	TCOR	3.25E-6
conductivity	WBOTC	3.04279E-8
conductivity	Z	0.0
pressure	PA0	1.599498
pressure	PA1	0.03262451
pressure	PA2	2.616436E-9
pressure	PTCA0	524811.5
pressure	PTCA1	-1.645788
pressure	PTCA2	0.1822825
pressure	PTCB0	98.31599
pressure	PTCB1	-9.467397E-4

7/16/22 7:18 AM

Page 2 of 4

Sensor	Coefficient	Value
pressure	PTCB2	0.0
pressure	PTEMPA0	-94.62245
pressure	PTEMPA1	0.03992439
pressure	PTEMPA2	1.253323E-6
pressure	POFFSET	0.0
pressure	PRANGE	10153.0
oxygen	TAU20	7.0
oxygen	OXA0	1.0513
oxygen	OXA1	-0.0015
oxygen	OXA2	0.46423
oxygen	OXB0	-0.232022
oxygen	OXB1	1.68351
oxygen	OXC0	0.0943862
oxygen	OXC1	0.00398292
oxygen	OXC2	5.35379E-5
oxygen	OXTA0	7.118672E-4
oxygen	OXTA1	2.48717E-4
oxygen	OXTA2	9.03875E-7
oxygen	OXTA3	9.561271E-8
oxygen	OXE	0.011

CTD Settings Report

Setting	Value
Device Type	SBE37SMP-ODO-RS232
Serial Number	03714149
Pressure Installed	true
Output Format	raw decimal
Sample Interval (seconds)	15
Transmit Data Realtime	false
Min Conductivity Frequency (Hz)	3238.7
Adaptive Pump Control	false
Pump Time Multiplier (OxNTau)	1.0
Pump On Time (seconds)	7.0

7/16/22 7:18 AM

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D. NORTEK AQUADOPP

```
=====================================================================
Deployment   : 11034
Current time : 13/07/2022 12:48:11
Start at     : 14/07/2022 12:00:00
Comment:
EB1 dep 2022 osnap
---------------------------------------------------------------------
Measurement interval  (s) : 3600
Average interval      (s) : 60
Blanking distance     (m) : 0.50
Measurement load      (%) : 4
Power level               : HIGH
Diagnostics interval(min) : 720:00
Diagnostics samples       : 20
Compass upd. rate     (s) : 1
Coordinate System         : ENU
Speed of sound      (m/s) : 1500
Salinity            (ppt) : N/A
Analog input 1            : NONE
Analog input 2            : NONE
Analog input power out    : DISABLED
Raw magnetometer out      : OFF
File wrapping             : OFF
TellTale                  : OFF
AcousticModem             : OFF
Serial output             : OFF
Baud rate                 : 9600
---------------------------------------------------------------------
Assumed duration   (days) : 730.0
Battery utilization   (%) : 79.0
Battery level         (V) : 13.9
Recorder size        (MB) : 9
Recorder free space  (MB) : 8.973
Memory required      (MB) : 1.9
Vertical vel. prec (cm/s) : 1.4
Horizon. vel. prec (cm/s) : 0.9
---------------------------------------------------------------------
Instrument ID             : AQD11034
Head ID                   : A6L 5962
Firmware version          : 3.37
---------------------------------------------------------------------
Aquadopp Deep Water Version 1.40.16
Copyright (C) Nortek AS
=====================================================================
```

E. RDI ADCP

```
CR1
CF11111
EA0
EB0
ED19700
ES35
EX11111
EZ1111101
WA50
WB0
WD111100000
WF176
WN28
WP42
WS400
WV175
TE01:00:00.00
TP01:25.71
TF20/10/15 15:00:00
CK
```

F. NORTEK S55

#$DeployFileVersion,4,603f0b3eb133d0decef78319ceccea91
#$SWSource,"Deployment-v4.6.4.1"
#$InstrumentId,{"InstrumentType":"Signature55","HeadFrequency":55,"IsDeepWater":false,"IsLADCP":false,"FWVersion":"2211.4"}
#$DeploymentName,"RHAD2_JC238"
#$Comment,null
#$ApplicationConfig,[{"Enabled":true,"Application":"AvgCoarse","Mounting":"Subsurface Buoy","Orientation":"UpLooking","Geography$C
#$":"OpenOcean","SoundVelocity":"Fixed","SoundVelocityValue":1500.0,"Salinity":35.0,"StrongWaves":false,"ProfileRange":1000.0,"$C
#$InstrumentDepth":1000.0,"TidalRange":1.0,"BurstHR":false,"BurstHR5":false},{"Enabled":false,"Application":"None","Mounting":"$C
#$SubsurfaceBuoy","Orientation":"UpLooking","Geography":"OpenOcean","SoundVelocity":"Fixed","SoundVelocityValue":1500.0,"Salini$C
#$ty":35.0,"StrongWaves":false,"ProfileRange":1000.0,"InstrumentDepth":1000.0,"TidalRange":1.0,"BurstHR":false,"BurstHR5":false$C
#$}]
#$AlternatingRatio,[3,1]
#$DeploymentConfigExtensions,[{"AvgDesiredRange":1022.0,"BurstDesiredRange":1000.0,"BurstHrDesiredRange":1000.0,"EchoSounderDes$C
#$iredRange":1000.0,"AvgEndProfile":1124.2,"BurstEndProfile":1100.0,"BurstHrEndProfile":1100.0,"EchoSounderEndProfile":1100.0,"$C
#$AIStep":6,"RangeStep":1.0,"BurstMeasurementContinuous":false,"AvgMeasurementLoad":100.0,"MinAvgMeasurementLoad":10.0,"MaxAvgM$C
#$easurementLoad":100.0,"AvgAutoMeasurementLoad":true,"AvgMeasurementLoadTick":10.0,"BurstMeasurementLoad":100.0,"BurstAutoMeas$C
#$urementLoad":true,"BurstMeasurementLoadTick":1.0,"PulseDistanceAutoOption":3,"PulseDistance":3,"DistanceToBottom":2.0,"Distan$C
#$ceToSurface":2.0,"DesiredVelocityRange":0.25,"ValidBurstIntervals":[],"MeasurementIntervalAlternate":0},{"AvgDesiredRange":10$C
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#$e,"AvgMeasurementLoadTick":1.0,"BurstMeasurementLoad":100.0,"BurstAutoMeasurementLoad":true,"BurstMeasurementLoadTick":1.0,"P$C
#$ulseDistanceAutoOption":3,"PulseDistance":3,"DistanceToBottom":2.0,"DistanceToSurface":2.0,"DesiredVelocityRange":0.25,"Valid$C
#$BurstIntervals":[],"MeasurementIntervalAlternate":0}]
#$BatteryItem,null
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#$Volume":3600.0,"Voltage":18.0},"Volume":3600.0,"Voltage":18.0}
#$RecorderItem,{"Name":"16 GB","Capacity":16000000000}
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#$DeploymentDays,790

```
SETDEFAULT,ALL
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=120,DIBURST=0,SV=1500,FN="RHAD2_JC238.ad2cp",SO=0,FREQ=55,NSTT=0
SETAVG,NC=56,CS=20,BD=2,CY="ENU",PL=-
2,AI=60,VR=1,DF=3,NPING=10,NB=3,CH=0,MUX=1,BW="NARROW",ALTI=0,BT=0,I
CE=0,ALTISTART=0.5,ALTIEND=150,RAWALTI=1
SETTMAVG,EN=0,CD=1,PD=1,AVG=60,TV=1,TA=1,TC=1,CY="ENU",FO=0,SO=0,DF=
100,DISTILT=0,TPG=0,MAPBINS=0
SAVE,ALL
```