Scottish Association for Marine Science

JR17006 Cruise Report

RRS James Clark Ross

11 June – 6 July 2018

Changing Arctic Ocean

Principal Scientist

Finlo Cottier

2019

Scottish Association for Marine Science
Oban
PA37 1QA

Tel: 01631 559323
Email: finlo.cottier@sams.ac.uk

Acknowledgements

We are grateful to all the officers and crew of the RRS James Clark Ross for their efforts in making this cruise a success. We also thank staff at NMF and BAS for their support during the cruise planning and mobilization. Finally, we thank those colleagues at home institutes for their assistance with cruise preparations and to our colleagues in Norway for essential logistical support at the start and end of the cruise.

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1 Introduction and Cruise Summary

1.1 Background and Scientific Objectives of JR17006

The Arctic environment is changing, rapidly. Sea ice concentrations and ice extent are decreasing, the ocean and atmosphere are warming, fresh water discharges are increasing and ocean stratification, vertical mixing and circulation regimes are altering. All these changes impact the Arctic Ocean's ecosystem, from the sea surface to the sea floor. For example, longer and more expansive open water periods influence the timing and longevity of phytoplankton blooms which are important for sustaining life at all trophic levels, from tiny zooplankton in the water column and microscopic benthic fauna, right up to the whales and seals at the top of the food chain. Changes in the light and nutrient regimes have consequences for the amount and quality of particulate and dissolved organic matter, the cycling of nutrients in the water and sediments, and consequently the biodiversity of life that can be supported. The migration and grazing of zooplankton, behaviours that transfer huge quantities of carbon into the ocean interior, may also be affected.

In 2017 the Natural Environment Research Council (NERC) started an investment of £16 million in its 5-year Changing Arctic Ocean Programme (www.changing-arctic-ocean.ac.uk). The overarching aim of the programme is to better understand and quantify the impacts of climate change on Arctic ecosystems. The findings will ultimately inform our conservation and management strategies of polar regions. Four large projects were initially funded: ARISE (led by Claire Mahaffey, Uni. Liverpool), Arctic PRIZE (led by Finlo Cottier, SAMS), ChAOS (led by Christian März, Uni. Leeds) and DIAPOD (led by David Pond, Uni. Stirling).

[this background is taken from Cruise Report JR16006 by Jo Hopkins]

JR17006 was the third (and final) of a series of cruises for the Arctic PRIZE project in 2018. The first was in January 2018 studying the conditions during the Polar Night. The second was in April/May 2018 studying the spring bloom and JR17006 was the summer cruise. The project aimed to investigate the relationships between the physical, optical, chemical and biological parameters in the Barents Sea during the seasonal progression from winter to summer. The cruises were supported with a glider program operating from January to June 2018 and two moorings deployed on the Northern Barents Shelf in September 2017 which were recovered during JR17006 and redeployed for collection during 2019. The Arctic PRIZE project was focussed on occupying stations along the 30E line of longitude to complete a suite of sampling that spanned the oceanography, water column optics and chemistry, phytoplankton communities and their physiological state, zooplankton response to light cycles and benthic communities.

In addition there were sampling objectives linked to the Arctic SIZE project based in UIT, The Arctic University of Norway in Tromsø. These projects were highly integrated into the PRIZE and Polar Night sampling requirements. An incidental objective was the capacity building between the distinct teams. Finally the cruise also support the CHASE project funded through the Changing Arctic Ocean Program.

1.1.1 Arctic PRIZE overview

Arctic PRIZE: Arctic productivity in the seasonal ice zone
Project Website: https://www.changing-arctic-ocean.ac.uk/project/arctic-prize/

Arctic PRIZE will address a fundamental question in Arctic biology: "Will more light in an ice-free Arctic Ocean lead to more productivity?" Arctic PRIZE will conduct a programme of novel and coordinated physical, chemical and biological observations of the water column within the seasonal ice zone of the Barents Sea. Arctic PRIZE has a strong seasonal perspective and focuses on the critically important but under-sampled transition from polar winter into the post-bloom summer.

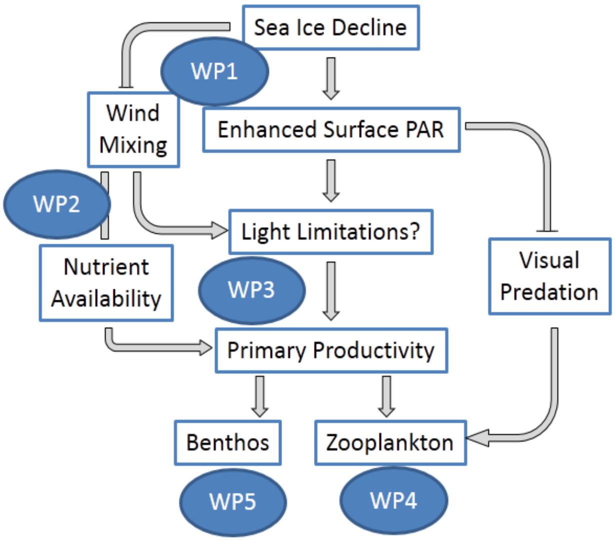


Figure 1.1: Key relationships that are driven by changing sea ice cover and the respective Arctic PRIZE work packages.

Overarching Question for Arctic PRIZE: "How will projected shifts in the spatial distribution of sea ice in the Arctic Ocean modify mixing and light in the surface ocean, and what is the net effect of these physical changes on the quantities, timing and rates of primary productivity (PP), phytoplankton taxonomic composition, and their pelagic and benthic consumers?" The framework for this question is illustrated in Figure 1.1.

1.1.2 CHASE overview

CHASE: Chronobiology of changing Arctic Sea Ecosystems
Project Website: https://www.changing-arctic-ocean.ac.uk/project/chase/

The CHASE programme seeks to understand and predict how ecologically important species will respond to climate change. As the Arctic Ocean is warming, zooplankton such as copepods and krill are undergoing habitat range extensions polewards. This will result in exposure to new and more extreme day-length (photoperiodic) climates of the higher latitudes – known in many terrestrial species to have negative consequences on fitness. CHASE will therefore aim to investigate the behaviour, physiology and genetic responses of copepods and krill to their natural and new photoperiodic environments. It will focus on the circadian biological clock, central in day-length measurement and in orchestrating key seasonal life-cycle events.

1.1.3 Arctic SIZE overview

Arctic SIZE: Arctic Seasonal Ice Zone Ecology
Project Website: http://site.uit.no/arcticsize/science

Nowhere is global climate change greater than in the ice-covered waters of the High North with climate feedbacks impacting human living conditions of the entire northern hemisphere. The Arctic Seasonal Ice Zone (SIZ), arguably the region in which the direct effects are at its strongest, is the main focus of the group. In order to promote ecosystem understanding of the SIZ, the group has a distinct pan-Arctic research strategy. Also, the group scores very high in supplementary sectors of priority such as international cooperation, research-based education and communication to the public. They are working on a large variety of organisms, spanning from bacteria and plankton up to benthic animals, fish and sea birds in ice-covered waters. The main ambition of the group is to provide the best knowledge and the most comprehensive understanding of the SIZ in the northern Barents Sea, Svalbard and the adjacent deep Polar Ocean.

1.2 Scientific and Ship's Personnel

Scientific Personnel

Finlo Cottier	PSO + Physical Oceanography	Scottish Association for Marine Science (SAMS)
Marie Porter	Oceanography/Gliders	SAMS
Emily Venables	CTD/Gliders	SAMS
Colin Abernethy	Benthos	SAMS
Ina Lefering	Optics	Strathclyde
Sian Henley	Nutrients/Isotope chemistry	Edinburgh
Judith Braun	15N uptake	SAMS
Sharon McNeill	Primary Productivity	SAMS
Andrew Orkney	Phytoplankton	Oxford
Jamie Rodgers	Physical Oceanography	SAMS
Kim Last	Zooplankton	SAMS
Ashlie McIvor	Benthos	SAMS
Callum Whyte	Primary Productivity	SAMS
Tim Brand	Macronutrients	SAMS
Raphaelle Descoteaux	Arctic SIZE project	UiT
Joana Beja	BODC Data Manager	BODC
David Wilcockson	CHASE - zooplankton	Uni. Aberystwyth
Lukas Hüppe	CHASE - zooplankton	Oldenburg
Bhavani Narayanaswamy	Benthos	SAMS

Engineering and IT Personnel

Richard Phipps	Coring	National Marine Facilities
Billy Platt	Moorings and autosal	National Marine Facilities
Andrew England	IT	BAS
Sean Vincent	IT	BAS
Carson McAfee	AME	BAS

Ship's Crew

Simon Evans	Master
Georgina Delph	Chief Officer
Colin O'Donnell	2nd Officer
Dominic Hills	3rd Officer
Nigel Garnett	3rd Officer
John Newsom	ETO Comms
Andris Kubulins	Chief Engineer
Christopher Donaldson	2nd Engineer
Aleksandr Hardy	3rd Engineer
Steven Eadie	4th Engineer
Douglas Stevens	ETO
Thomas Biggs	Deck Engineer
Robert Sutton	Deck Engineer
Lloyd Sutton	Purser
Andre Dubois	Doctor
Clifford Mullaney	Bosun Science
Grant Fraser	Bosun Science
Noel Littlehales	Bosun
John O'Duffy	Bosun's Mate
Craig Lennon	Launchman
Martins Neilands	SG1A
Paula Munoz Garcia	SG1B
Christopher Devitt	SG1A
Robert Leech	SG1A
Carlos Vargas Leon	MG1
Stephen Pictor	MG1
Romica Munteanu	Chief Cook
Brian Robertson	Cook
Derek Lee	Senior Stwd
Kevin Ward	Stwd
Oliver Burch	Steward
Thomas Patterson	Stwd

1.3 Cruise Diary

The following table provides a summary of the events that took place each day on the ship. ‘Enn’ (e.g. E21) refers to each deployment/activities unique event number. A full set of times and positions for each event can be found in the Event Log available from BODC.

Wind direction is FROM, i.e. southerly wind is a wind blowing from the south towards the north. All times are UTC.

Date	Weather/Ice	Activities
09/06/ 18 Day 160	Overcast	21:00 LT First of the science party arrive on board.
10/06/ 18 Day 161	Overcast	Loading of science equipment from UNIS Rubbhall, and frozen samples and chemicals from UNIS. 15:30 LT Further members of science party arrived Setting up of labs 21:00 LT Moved off main pier in Longyearbyen to anchorage
11/06/ 18 Day 162	Overcast Sunny evening Wind: 14 knots	Quick meeting of science team to talk through plan for the day Setting up of labs continued 10:00 LT Small boat transfer of remaining science party. 12:30 LT Pilot on board to leave anchorage Slowly steaming through Isfjorden. Lab set up continuing and stowing away in science hold. 13:15 LT Safety briefing 14:00 LT Lifeboat drill 16:00 LT Meeting with Captain and ship crew to present overview of the cruise objectives 17:45 LT Brief meeting with science team to talk through overall plan and activities for the first station

	Sea state: 3-4 Air temp: 2°C Water temp: 1.8°C Pressure: 1011 hPa	21:00 LT Walk through labs to ensure all is OK for heading out of Isfjorden Weekly Dip Clear report submitted
12/06/18 Day 163	Bright and breezy day 06:00 Wind: 22 knots Sea state: 5-6 Air temp: 0°C Water temp: 5°C Pressure: 1010 hPa 18:30 Wind: 21 knots Sea state: 5 Air temp: 0°C Water temp: 5°C Pressure: 1005 hPa	All times now GMT 06:13 aborted CTD at JR77 (E1) 06:42 CTD (E2) 07:40 MIK nets (E3-4) 10:11 CTD (E5) Toolbox talk for Agassiz trawl and MSS profiler 12:24 Agassiz (E6) 14:06 CTD to test A/R (E7) 15:16 MSS profiler test (E8) 17:21 Grab (E9) 18:15 Depart station
13/06/18 Day 164	Wind eased compared to previous day 04:30 Wind: 8 knots Sea state: 3 Air temp: 0°C Water temp: 4°C Pressure: 997 hPa Wind eased during CTD profiling 07:30 Wind: 2 knots Sea State: 1	06:04 CTD at JR78a (E10) 07:20 CTD at JR78b (E11) 08:29 CTD at JR78c (E12) 09:40 WP2 (E13) 10:15 WP2 (E14) 11:22 CTD at JR78d (E15) 14:06 CTD at JR78e (E16) 15:00 WP2 (E17)
14/06/18 Day 165	04:30 Wind: 7 knots	02:00 At mooring west station M(west)

	Sea state: 2 Air temp: 1.5°C Water temp: 2.5°C Pressure: 997 hPa	Pinger located mooring straightaway 02:33 CTD (E18) 03:26 WP2 (E19-20) 04:36 Mooring recovery (E21) 06:42 WP2 (E22-23) 07:25 WP2 (E24-25) 08:26 CTD (E26) 09:42 WP2 (E27-28) 10:50 MSS (E29) 11:30 WP2 (E30-31) 12:58 Box Core (E32) 13:33 MSS (E33) 14:18 Box Core (E34) 14:43 MSS (E35) 15:33 WP2 (E36) 17:34 Agassiz/Camera (E37) 19:43 WP2 (E38-39) 21:19 MSS (E40) 23:32 WP2 (E41)
15/06/18 Day 166	04:30 Wind: 8 knots Sea state: 3 Air temp: 1.3°C Water temp: 2.8°C Pressure: 1008 hPa 20:00 Wind: 11 knots Sea state: In Ice Air temp: -2.0°C	00:07 WP2 (E42) 00:42 MSS (E43) 03:25 WP2 (E44-45) 04:31 CTD (E46) Steaming north for the ice station Entering a very loose ice edge. Small floes blown south by a previous northerly wind. 11:53 CTD at station JR80 (E47) – 200m only 13:12 CTD (E48) – aborted due to oil leak 13:54 WP2 (E49-52) 15:08 CTD (E53) – aborted due to oil leak

	Water temp: --°C Pressure: 1008 hPa	15:25 WP2 (E54) 17:15 CTD (E55) (full depth 3000m)
16/06/18 Day 167	04:30 Wind: 40 knots Sea state: 6-7 Air temp: 1°C Water temp: --°C Pressure: 1005 hPa 17:30 Wind: 35 knots Sea state: 6-7 Air temp: 0°C Water temp: -1°C Pressure: 1004 hPa	00:12 CTD at Station J79 (E56) Weather picked up during the early hours. Wind and sea state too high for mooring deployment at Mooring (west) station. Steaming east to Northern Trough. Wind moderated a little during the day 11:00 Science meeting to discuss change of plan due to weather and options for Mooring station (East) 13:49 CTD at Station J81 (E57) 15:19 CTD at Station J82 (E58) 17:04 CTD at Station J83 (E59) 18:07 Camera Tow (E60) 21:21 CTD at Station B17 (E61)
17/06/18 Day 168	10:30 Wind: 20 knots Sea state: 4 Air temp: 0°C Water temp: -0.5°C Pressure: 1000 hPa 18:30 Wind: 19 knots Sea state: 4 Air temp: -0.5°C Water temp: -1.0°C Pressure: 997 hPa	00:08 Camera Tow at Station M(east)(E62) 02:05 Agassiz Trawl (E63) 03:08 MSS profiling (E64) 04:55 CTD (E65) 05:32 Mooring recovery (E66) 07:24 MSS profiling (E67) 08:27 Camera Tow (E68) 10:43 CTD (E69) 11:23 MSS profiling (E70) 12:29 WP2 (E71-73) 14:01 Mooring (East) deployment aborted (E74) 15:26 WP2 (E75) 15:50 MSS profiler (E76) 17:39 Box Coring (E77-82). E79 Box didn't activate

18/06/18 Day 169	Ice Station	Very defined ice edge. Position when entered the ice 82° 31.33' N 029° 59.71' E 10:00 WP2 at Station J85 (E83-84) 09:40 CTD (E85) 12:32 WP2 (E86-87) 13:44 CTD (E88) 16:41 WP2 (E89-90) 17:40 MSS (E91) 18:53 WP2 (E92-97) 22:45 MSS profiler (E98-100)
19/06/18 Day 170	06:00 Wind: 9 knots Sea state: ice Air temp: 0.5°C Water temp: -1.7°C Pressure: 1010 hPa 18:00 Wind: 21 knots Sea state: 4 Air temp: 0°C Water temp: 0°C Pressure: 1008 hPa	00:32 WP2 (E101-104) 04:29 WP2 (E105-106) 08:32 WP2 (E107-108) 09:28 Leave ice station. Very defined ice edge boundary. DOWNTIME: 4 hours due to blown hydraulic hose on the gantry 15:35 CTD at Station JR86 (E109) 21:58 CTD at Station JR87 (E110) 23:56 Box Core (E111)
20/06/18 Day 171		01:42 Box Core (E112) 04:21 CTD at Station JR88 (E113) 07:32 Mooring Deployment at Station M(e) (E114) 09:43 Mooring anchor released 11:51 CTD at Station JR89 (E115)
21/06/18		

Day 172	06:40 Wind: 1 knots Sea state: 0 Air temp: 3°C Water temp: 1°C Pressure: 1008 hPa	02:00 Attempted lander recovery at Station LANDER. No success with release. Dragging with light gear (E116) 05:47 Attempting dragging for lander with heavier gear (E117-18) 09:20 Lander buoy on surface after successful release 12:15 WP2 nets (E119-120) 13:06 CTD (E121) 14:15 Camera Tow (E122)
22/06/18 Day 173	08:00 Wind: 7 knots Sea state: 3 Air temp: 2.5°C Water temp: 3°C Pressure: 1010 hPa	03:12 CTD at Station JR95 (E123) 06:26 CTD at Station JR96 (E124) 08:42 CTD at Station JR97 (E125) 10:43 Mooring deployment at Station M(w) (E126) 12:31 Mooring anchor released 13:51 CTD at station M(w) (E127) 21:44 MIK at "midnight" location (E128-29)
23/06/18 Day 174	04:00 Wind: 14 knots Sea state: 3-4 Air temp: 0°C Water temp: 1.5°C Pressure: 1014 hPa	05:03 Camera Tow at Station J83 (E130) 08:58 CTD at Station J90 (E131) 09:22 MIK net (E132) 10:51 CTD at Station J91 (E133) 12:23 CTD at Station M(e) (E134) 16:54 CTD at Station B27 (E135) 18:04 WP2 (E136-38) 22:30 CTD at Station J92 (E139)
24/06/18 Day 175	06:30 Wind: 11 knots Sea state: 3-4 Air temp: -1°C Water temp: 0°C Pressure: 1007 hPa	01:43 CTD at Station J93 (E140) 04:07 CTD at Station J94 (E141) 06:51 CTD at Station B28 (E142) 11:13 CTD at Station B16 (E143)

		18:20 CTD at Station J98 (E144)
25/06/18 Day 176	06:30 Wind: 6 knots Sea state: 2 Air temp: 0°C Water temp: 0°C Pressure: 996 hPa	JCR slow steaming yesterday and overnight due to thick fog. 09:08 CTD at Station B15 (E145) 10:49 CTD at Station HH51 (E146) 11:39 MSS profiler (E147) 13:26 Photo lander test (E148) 14:35 MSS profiler (E149) 15:31 Photo lander moored deployment (E150) 16:13 MSS profiler (E151) 17:43 Camera Tow (E152) 19:28 MSS profiler (E153) 20:40 MIK net (E154-55) 22:43 MSS profiler (E156)
26/06/18 Day 177	06:00 Wind: 12 knots Sea state: 3-4 Air temp: 0°C Water temp: 0°C Pressure: 994 hPa	00:23 Agassiz (E157) 01:35 MSS profiler (E158) 03:34 Camera Tow (E159) 06:24 Box Core (E160-61) 07:57 WP2 (E162-68) 11:20 Box Core (E169-71) 14:08 Photo Lander Recovery (E172) 15:20 Box Core (E173) 20:53 MIK net at Station B34 (E174) 22:08 Camera Tow (E175)
27/06/18 Day 178	19:00 Wind: 12 knots Sea state: 3-4 Air temp: 1°C Water temp: 0°C Pressure: 996 hPa	Visibility improving today. Big swell rolling in from the SW. 00:17 MSS profiler (E176) 01:00 MIK net (E177) 02:30 MSS profiler (E178) 03:31 Agassiz (E179) 04:25 MSS profiler (E180) 04:58 MIK net (E181) 05:59 MSS profiler (E182)

		07:23 Photo lander deployed (E183) 07:58 MSS profiler (E184) 08:57 MIK net (E185) 10:46 CTD (E186) 11:29 MSS profiler (E187) 12:10 Box corer (E188) no mud 12:58 MIK net (E189) 13:51 MSS profiler (E190) 14:38 Box Core (E191-92) no mud 15:52 WP2 (E193-95) 17:00 MIK net (E196) 18:20 Photo Lander recovery (E197) 19:34 Camera Tow (E198) 21:01 MIK net (E199) 21:57 WP2 net (E200) 23:10 CTD at station JR99 (E201)
28/06/18 Day 179	17:00 Wind: 20 knots Sea state: 4 Air temp: 2°C Water temp: 4°C Pressure: 996 hPa	Through the Polar Front overnight. Water temperature increased. Ship covered in kittiwakes. 01:00 CTD at station HH50 (E202) 02:41 CTD at station HH54 (E203) 04:18 Camera Tow at Station HH49 (E204) 06:52 CTD (E205) 08:20 Agassiz (E206) 09:47 CTD at Station HH55 (E207) 11:23 CTD at Station HH48 (E208) 13:07 CTD at Station JR100 (E209) 14:45 MSS Profiler at Station B14 (E210) 16:16 Camera Tow (E211) 18:26 MSS Profiler (E212) 19:35 WP2 (E213) 20:58 MSS Profiler (E214) 22:30 Agassiz Trawl (E215)
29/06/18 Day 180	18:00 Wind: 15 knots	00:06 MSS Profiler (E216-18) 04:14 Camera tow (E219)

	Sea state: 3-4 Air temp: 2°C Water temp: 4°C Pressure: 1004 hPa	06:53 WP2 (E220) 08:08 CTD (E221) 09:26 Box Coring (E222-24) 11:37 WP2 (E225-27) 12:58 Box Coring (E228-29) 15:03 Camera Tow (E230) 19:20 CTD at Station HH63 (E231) 21:28 CTD at Station HH71 (E232)
30/06/18 Day 181	16:30 Wind: 15 knots Sea state: 3-4 Air temp: 4.7°C Water temp: 6°C Pressure: 1014 hPa	06:54 Glider Recovery (E233) at position 74.88N 30.04E 07:15 CTD at glider position (E234) 10:33 CTD at Station B13 (E235) 11:30 WP2 (E236-37) 12:30 Camera Tow (E238) 14:24 MSS Profiler (E239) 15:23 WP2 (E240-41) 16:50 Agassiz Trawl (E242) 18:46 MSS Profiler (E243) 19:30 WP2 (E244-45) 20:34 Photo Lander Deployed (E246) 21:16 MSS Profiler (E247) 22:04 Camera Tow (E248) 23:27 WP2 (E249-50)
01/07/18 Day 182	17:30 Wind: 22 knots Sea state: 5 Air temp: 5.5°C Water temp: 6°C Pressure: 1012 hPa	00:18 MSS Profiler (E251-52) 03:52 WP2 (E253-54) 05:15 MSS Profiler (E255) 06:16 Box Coring (E256) 07:04 WP2 (E257-58) 08:01 Box Coring (E259-261) 11:14 WP2 (E262-263) 12:38 Photo Lander Recovery (E264) 13:59 Camera Tow (E265) 16:36 WP2 (E266-67) – curtailed due to wind
02/07/18 Day 183		04:11 Camera Tow at Station B35 (E268) 06:57 Agassiz tow (E269) 08:40 CTD (E270) 09:43 Box Coring (E271-73) 11:42 WP2 (E274-76) 13:06 Box Coring (E277-78) 15:50 Camera Tow (E279)

		22:21 CTD at Station B12 (E280)
03/07/18 Day 184		14:30 CTD at Station B7 (E281) 14:30 WP2 (282) 19:53 CTD at Station B6 (E283)
04/07/18 Day 185		04:04 CTD at Station B5 (E284) 13:10 CTD at Station B3 (E285) END of SCIENCE End of cruise party
05/07/18 Day 186		Packing and stowing. 12:00 On DP in a bay on Arnøya.
06/07/18 Day 187		Arrival in Tromsø

1.4 Station Locations

Nominal station locations and depths. Please refer to the cruise event log in Section 10 for the exact locations and depths of each activity at these stations.

B Stations: located during JR16006
HH Stations: located during Helmer Hanssen cruises in January 2018 and April 2018
JR Stations: located during JR17006 (note that these are labelled 'J' in Figure 1.2 and Figure 1.3

Station ID	Latitude (North)	Longitude (East)	Water depth (m)
B3	72.632	19.250	368
B5	74.366	18.166	123
B6	75.183	17.533	144
B7	76.000	16.832	319
B12	75.500	26.000	138
B13	74.500	30.002	358
B14	76.500	30.000	290
B15	78.250	30.000	313
B16	80.100	29.998	295
B17	81.300	30.000	157
B27	80.992	29.308	384
B28	80.670	29.292	428
B34	77.550	30.001	207
B35	75.500	30.000	360
HH48	76.733	29.999	257
HH49	77.000	30.000	236
HH50	77.300	30.000	190
H51	78.167	30.001	337
HH54	77.150	30.001	203
HH55	76.866	29.999	260
HH63	76.183	30.000	302
HH71	75.950	30.000	309
JR77	78.013	9.473	461
JR78a	80.008	11.240	205
JR78b	80.048	10.927	312
JR78c	80.064	10.792	411
JR78d	80.097	10.514	491
JR78e	80.292	8.909	600
JR79	81.915	18.496	3359
JR80	81.916	18.460	3368

JR81	81.251	28.027	100
JR82	81.262	28.464	185
JR83	81.278	29.146	317
JR85	82.592	30.144	3707
JR86	82.466	31.560	3385
JR87	81.589	30.767	1570
JR88	81.503	30.960	705
JR89	81.458	31.077	503
JR90	81.432	31.146	270
JR91	81.383	31.293	190
JR92	80.800	27.799	85
JR93	80.850	29.300	425
JR94	80.878	30.188	145
JR95	81.476	18.455	1560
JR96	81.263	18.452	549
JR97	81.145	18.408	379
JR98	79.333	30.000	299
JR99	77.450	30.000	208
JR100	76.617	30.000	287
Glider	74.884	30.040	387
MEast	81.305	31.334	197
MWest	81.034	18.385	260
Rijpfjorden (Lander)	80.293	22.320	168

1.5 Station Maps

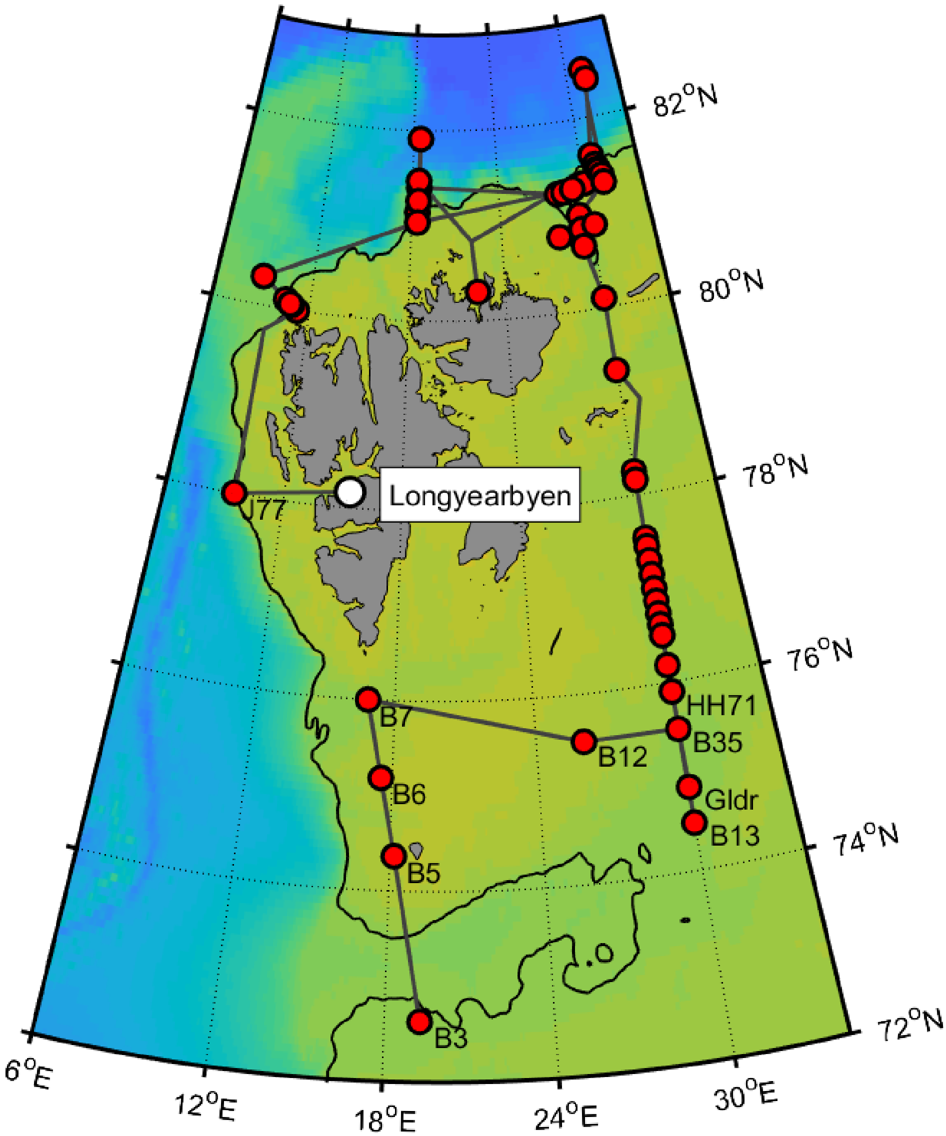


Figure 1.2: Overview of the cruise track and all Station locations, commencing in Longyearbyen and ending in Tromsø, Northern Norway. Station IDs are provided for J77 west of Longyearbyen and Stations south of 76°N. Other Station IDs are given in subsequent figures. Black contour line denotes 400 m isobath.

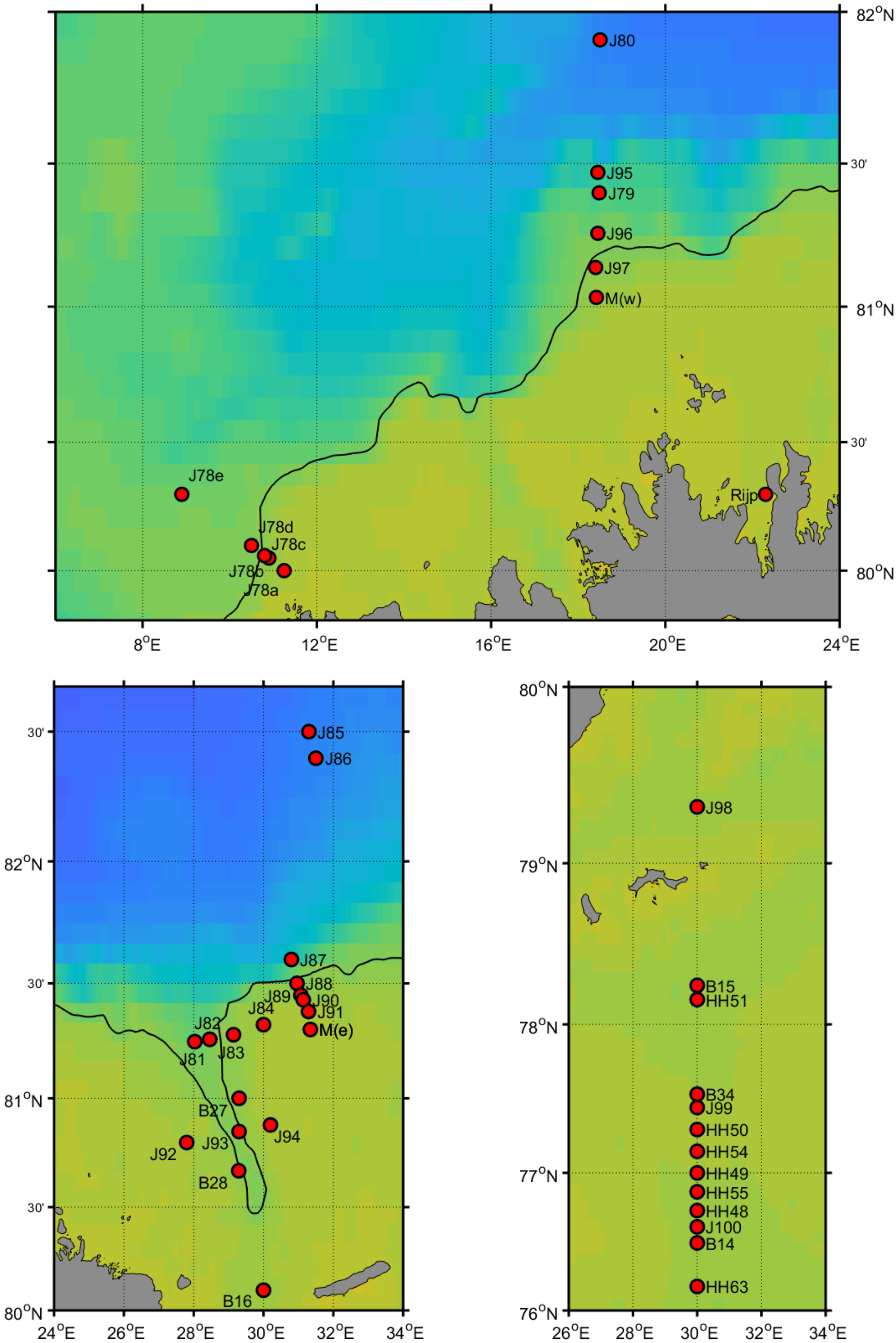
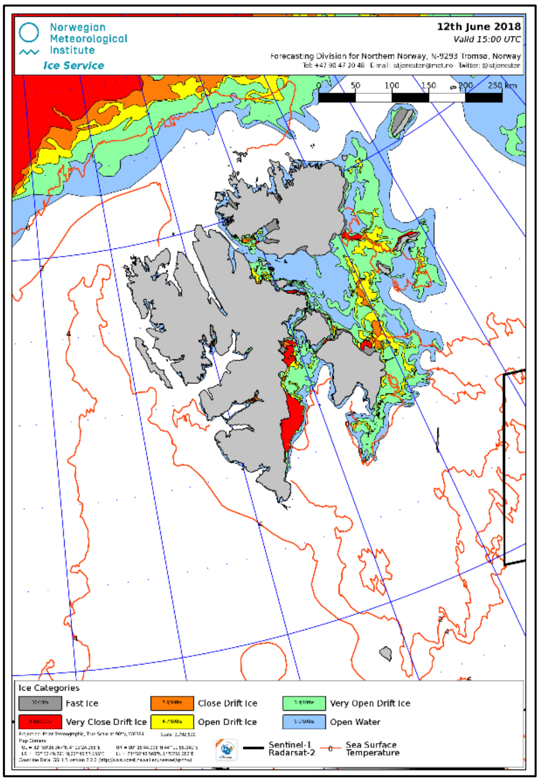


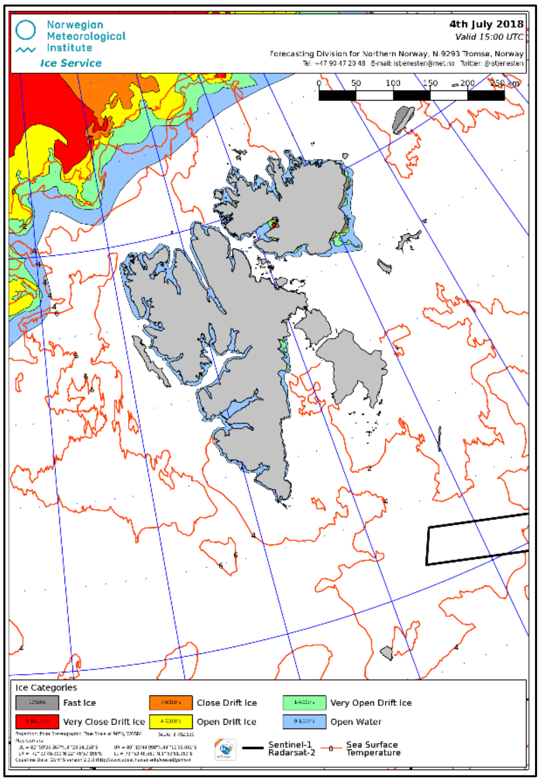
Figure 1.3: Subfigures of the Station locations covering NW Svalbard (top), NE Svalbard (lower left) and the 30°E Line (lower right).

1.6 Ice Charts

Ice Charts for the start and end dates of scientific sampling during JR17006 are given below. They can be found at http://polarview.met.no/



12th June 2018



4th July 2018

2 Computing, Hydrography and Meteorology

2.1 Computing

Andrew England and Sean Vincent (BAS)

2.1.1 Data Logging / SCS

Samba file server running on JRLB was briefly unavailable at 23:33 GMT on 2018/06/28 causing EA600, EM122, Navmet and SCS to disconnect. Although the SCS continues to log locally this situation requires a restart of Acquisition to enable other systems to resume operation. Approximately 22 seconds of data not recorded by SCS whilst Acquisition was restarted.

Time & Date (GMT)	Event
2018/06/08 19:56:07	ACQ restarted, newleg run (Leg: 20180608)
2018/06/28 00:02:13	ACQ stopped due to samba issue
2018/06/28 00:02:35	ACQ restarted
2018/07/06	ACQ restarted, end of leg

2.1.2 Other systems

EM122 workstation suffered a RAID array failure requiring reinstallation.

USBL workstation failed with an undiagnosed hardware failure, swapped over to the spare. Apart from the above samba issue on JRLB the Unix systems, SABRIS and ESX servers all worked without any serious issues.

2.2 Hydrography

2.2.1 Salinity

Billy Plat (NMF)

Salinity samples were collected by the science team and stored in the corridor lab with the BAS Guildline Autosal Sn 68959. The room temperature was controlled to approximately 23 degrees C and the bath temperature was set to 24 degrees C. The temperature of the lab was observed to fluctuate between approximately 22.8 – 23.9 degrees C.

The 8 crates of CTD and Underway samples were analysed by Billy Platt (NMF) and Jamie Rogers (SAMS) using the standard BODC method with the NMF salinity logging software. The problems experienced early on in the previous cruise (JR17-005) were not experienced this time and the software worked perfectly.

The Autosal was standardised on the 2nd July 2018 and all samples run thereafter. A standard of batch P161 was run at the start and end of every crate to allow drift to be tracked.

The naming convention of using 'CTD' for CTD crates and 'U' for Underway crates was used for every crate. Standards were numbered sequentially starting at 9000.
A data file from the analysis software was supplied for each crate as a tab separated text file that can be opened as an Excel spreadsheet. All measurements were also logged manually on paper log-sheets.

2.3 CTD

Emily Venables (SAMS) and Carson McAfee (BAS)

Table 2.1: CTD Sensor Serial Number

Instrument	Serial Number
Deck unit SBE11plus	11P15759-0458
Underwater unit SBE9plus	09P15759-0480
Temp1 sensor SBE3plus	032705
Temp2 sensor SBE3plus	03P5042
Cond1 sensor SBE 4C	042222
Cond2 sensor SBE 4C	042255
Pump1 SBE5T	054488
Pump1 SBE5T	052371
Standards Thermometer SBE35	3527735-0024
Transmissometer C-Star	1399DR
Oxygen sensor SBE43	432291
PAR sensor	70688
Fluorometer	088-216 Removed on 13/06/2018 (Cast 006)
Fluorometer	088-249 Installed on 13/06/2018 (Cast 007)
Altimeter PA200	10127.244740
CTD swivel linkage	961018
LADCP Master	14897
LADCP Slave	15060

Fluorometer:

During casts 001-006 it was noted that the fluorometer values were quite spiky. The original unit SN:088-216 was replaced with a new unit SN:088-249 on the 13/06/2018 for casts 007-064. A review of the casts showed the same spiky profile in the fluorescence. It was also noted that a number of these spikes correlated to the transmissometer values (which also had spikes). The decision was made that these are real data, and that there is nothing wrong with the fluorometer.

2.3.1 Data processing

This was kept as similar as possible to the processing on previous NERC Changing Arctic Ocean research cruises, specifically scripts developed by Jo Hopkins and Estelle Dumont on JR16006. Processing was carried out using Seabird Data Processing software version 7.26.7 and Matlab software version 2017b.

Data were converted in Seabird initially to output pressure, oxygen, temperature, conductivity and depth. These data were run through Matlab routines to check what values to use for sensor alignment, then a batch file was set up to run the following modules through Seabird:

1. <u>SBE Data conversion</u>

Run: DatCnv
Input: JR17006_NNN.hex, JR17006_NNN.XMLCON, JR17006_NNN.bl, JR17006_NNN.hdr
Output: JR17006_NNN.cnv, JR17006_NNN.ros
Variables exported to binary *.cnv files:

- scan: Scan Count
- latitude: Latitude [deg]
- longitude: Longitude [deg]
- timeJ: Julian Days
- timeS: Time, Elapsed [seconds]
- pumps: Pump Status
- prDM: Pressure, Digiquartz [db]
- depSM: Depth [salt water, m]
- t090C: Temperature [ITS-90, deg C]
- t190C: Temperature, 2 [ITS-90, deg C]
- c0mS/cm: Conductivity [mS/cm]
- c1mS/cm: Conductivity, 2 [mS/cm]
- sbeox0V: Oxygen raw, SBE 43 [V]
- sbeox0Mm/L: Oxygen, SBE 43 [umol/l]
- v1: Voltage 1
- flC: Fluorescence, Chelsea Aqua 3 Chl Con [ug/l]
- v0: Voltage 0
- CStarAt0: Beam Attenuation, WET Labs C-Star [1/m]
- CStarTr0: Beam Transmission, WET Labs C-Star [%]
- v6: Voltage 6
- par: PAR/Irradiance, Biospherical/Licor [uE/m^2.s]
- v7: Voltage 7
- altM: Altimeter [m]

Default oxygen tau and hysteresis corrections were applied.
Created *.ros files from *.bl files using a 5s scan range and a scan range offset of -2.5s

2. <u>SBE WildEdit</u>

Input and output: JR17006_NNN.cnv
Flagging of major spikes: Pass 1 removed data points over 2 standard deviations of 100 scan average and pass 2 removed spikes over 20 standard deviations of 100 scan average.

3. <u>SBE Filter</u>

Input and output: JR17006_NNN.cnv
Low pass filter (0.15, as recommended by Seabird) applied to pressure and depth data.

4. <u>SBE Align CTD</u>

Input and output: JR17006_NNN.cnv

Oxygen: The SBE43 Oxygen sensor typically has a time response of between 0 and 7 seconds according to SeaBird, generally increasing in colder temperatures. In this processing, however, the sensor was not advanced as this process appeared mostly to introduce errors.

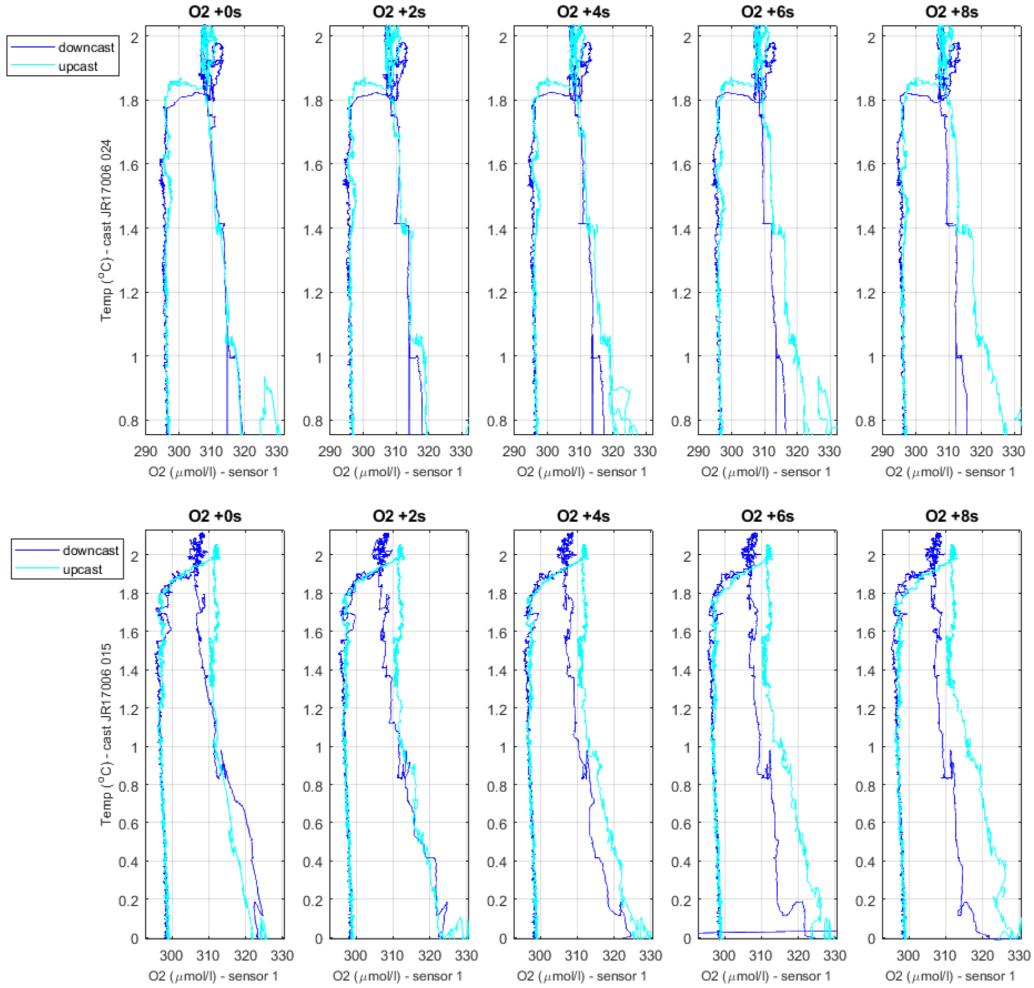


Figure 2.1: Oxygen measurements plotted against temperature to track water mass space rather than depth. Upcast and downcast data with advances from 0 to 8 seconds.

Temperature: No alignment was performed on either sensor as both seemed to be in good agreement.

Conductivity: Conductivity sensor advances were applied to compensate for sensor time lag according to Figure 2.2. The best alignment was produced by shifting the primary sensor by -1 scan and the secondary sensor by +1 scan.

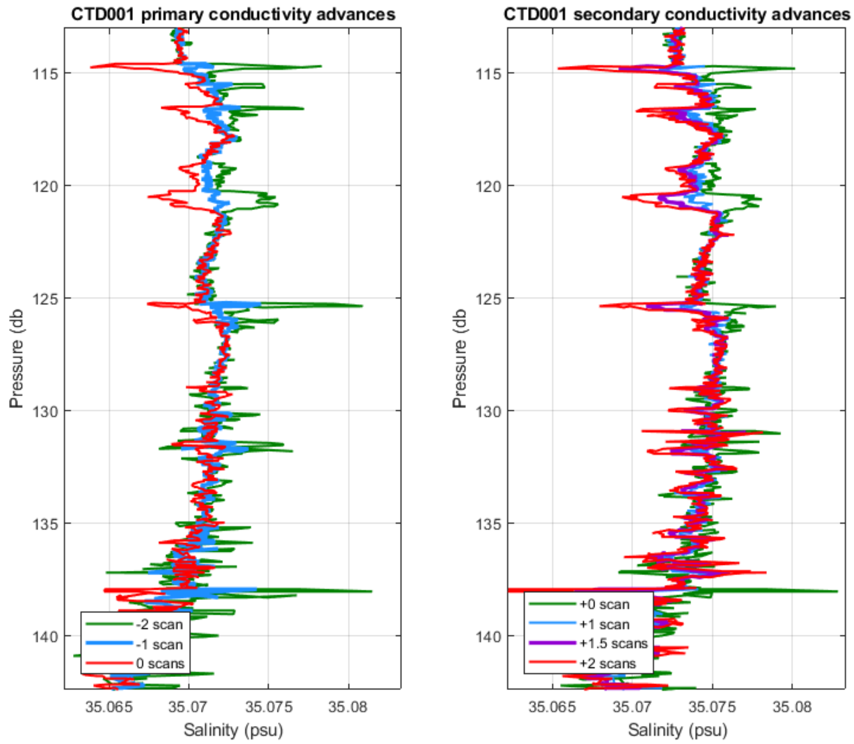


Figure 2.2: Conductivity sensor alignment test results.

5. <u>SBE CellTM</u>

Input and output: JR17006_NNN.cnv
A recursive filter run to remove conductivity cell thermal mass effects from measured conductivity.
Thermal anomaly amplitude, alpha was set to 0.03 and thermal anomaly time constant, tau was set to 7 as recommended by Seabird.

6. <u>SBE Derive:</u>

Input and output: JR17006_NNN.cnv
Variables derived from processed pressure, temperature and conductivity.

- depSM: Depth [salt water, m]
- sal00: Salinity, Practical [PSU]
- sal11: Salinity, Practical, 2 [PSU]
- sigma-é00: Density [sigma-theta, kg/m^3]
- sigma-é11: Density, 2 [sigma-theta, kg/m^3]
- svCM: Sound Velocity [Chen-Millero, m/s]
- svCM1: Sound Velocity, 2 [Chen-Millero, m/s]

7. <u>SBE Translate</u>

Input and output: JR17006_NNN.cnv
Conversion of binary data to asci. Data were kept in binary format up until this stage to avoid loss of precision.

8. SBE BottleSum

Input: JR17006_NNN.cnv, JR17006_NNN.bl
Output: JR17006_NNN.btl
Creation of *.btl bottle file using a 5s window centered around the bottle firing time. Final *.bl bottle files are produced in the Matlab processing stage.

9. SBE Strip

Input and output: JR17006_NNN.cnv
Removal of depth variable produced by DatCnv.

10. SBE Binavg

Input: JR17006_NNN.cnv
Output: JR17006_NNN_2hz.cnv

11. SBE Binavg

Input: JR17006_NNN.cnv
Output: JR17006_NNN_LADCP.cnv
1 second bins for LADCP

12. SBE AsciiOut

Input: JR17006_NNN_LADCP.cnv
Output: JR17006_NNN_LADCP.asc
Generate files for LADCP processing

Data were processed further in Matlab (R2017b) using the CAO processing routines developed by Estelle Dumont on JR16006. The following steps were taken:

13. MATLAB - Reading and plotting of *.cnv files produced by Seabird modules.

Inputs: JR17006_NNN.cnv, JR17006_NNN_2hz.cnv, JR17006_CTDcnv_24Hz_driver.csv, JR17006_CTDcnv_2Hz_driver.csv
Outputs: JR17006_NNN.mat, JR17006_NNN_2hz.mat
Driver files for JR17006 set up with variable lists as per cruise setup.

14. MATLAB - Creation of bottle files

Inputs: JR17006_NNN.cnv, JR17006_NNN.bl
Outputs: JR17006_NNN_BTL.mat, JR17006_NNN_BTL.csv
Data extracted according to scan numbers from bl files. Averages, standard deviations, minimum and maximum values over each 5 second window were saved. SBE35 temperature data added if present.

15. MATLAB - Manual removal of surface soak and post-cast data

Inputs: JR17006_NNN_2hz.mat, JR17006_NNN.mat
Outputs: JR17006_castcrop_times.mat, JR17006_NNN_cropped.mat
Plots of pressure, pump status and oxygen were produced, and the start and end of each cast manually selected. Start and end times were saved in a master file and used to crop the 24 Hz data.

16. <u>MATLAB - Splitting of upcast and downcast data</u>

Input: JR17006_NNN_cropped.mat
Outputs: JR17006_NNN_cropped_down.mat, JR17006_NNN_cropped_up.mat
The 24Hz data were split into up and down casts using the maximum pressure extracted from the data.

17. <u>MATLAB - Manual removal of temperature spikes and anomalies</u>

Input: JR17006_NNN_cropped_down.mat
Output: JR17006_NNN_cropped_down_despiked.mat
Primary and secondary temperature and salinity, Oxygen, fluorometer and PAR data were plotted.

A graphical user interface (Figure 2.3) within the Matlab toolbox was used to manually flag bad temperature data. Derived parameters, salinity and density were also flagged for those indices, along with oxygen as the measurement would have been made from the same (usually displaced) parcel of water.

18. <u>MATLAB - Automatic removal of salinity spikes</u>

A filter was applied to the salinity data to flag outliers. In this case a moving window with a length of 48 points (2 seconds). Points outside of the threshold of 0.005 psu were flagged and marked as NaN.
Input: JR17006_NNN_cropped_down_despiked.mat
Output: JR17006_NNN_cropped_down_despiked.mat

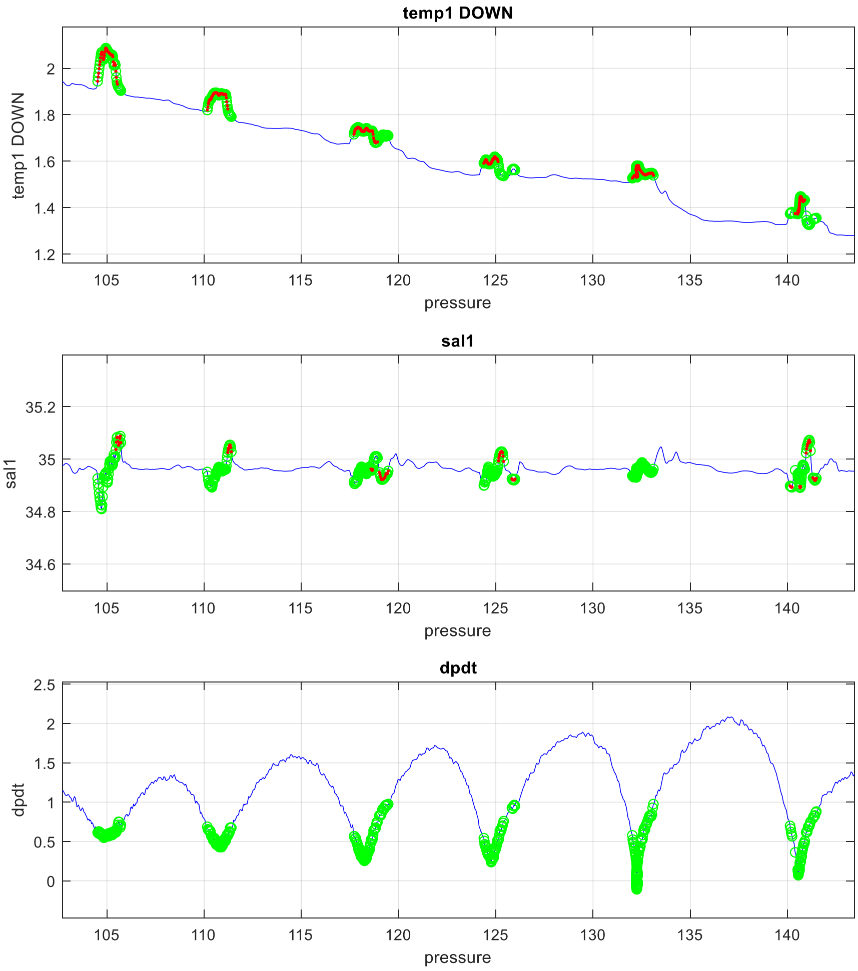


Figure 2.3: Example of flagged temperature anomalies from water recirculating within CTD package as veer rate changes.

2.3.2 Calibration of Conductivity and Oxygen Sensors

Calibrations for oxygen and conductivity were calculated from bottle samples and entered in to the cruise_setup file.

2.3.2.1 Salinity

106 discrete salinity samples were taken from the CTD Niskins, covering a wide range of salinity values. For each sample the bottle was rinsed 3 times with the Niskin seawater, filled, plastic insert fitted, bottle neck wiped, and lid put on.

Once a crate of 24 samples was full, it was placed in the Autosal laboratory to acclimatise to temperature for at least one day prior to analysis. At the start and end of each crate a standard seawater (SSW) sample was analysed, in order to monitor the drift of the instrument. No clear drift pattern was visible, and the readings showed little difference from the theoretical value (less than 0.001psu). For each crate, the average of the two SSW offsets was used as the offset to correct the Autosal readings.

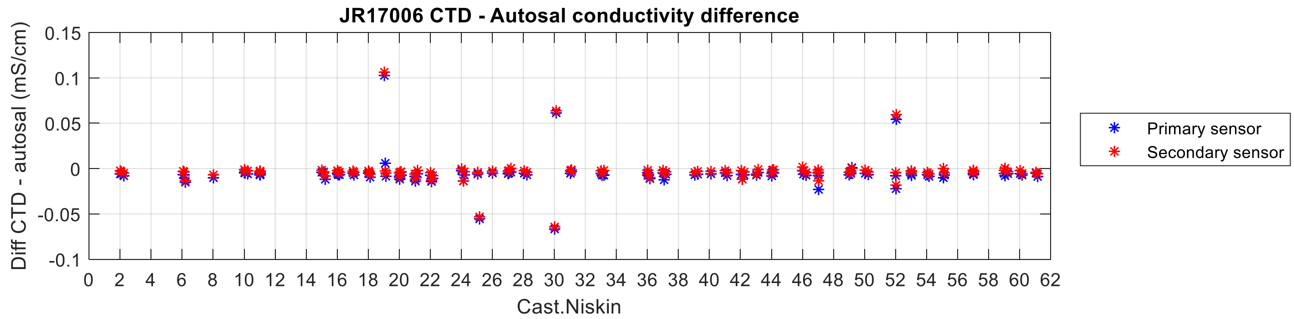


Figure 2.4: Difference between the raw CTD and Autosal conductivity readings in time, all values.

There did not appear to be any temporal drift in the sensors, or a drift relative to pressure, so a constant offset was used to correct the data of both sensors. The median and standard deviation of the differences between the raw CTD and the Autosal readings were calculated, and all readings with a difference larger than 0.2 standard deviations of the median were excluded from the dataset. The median offset of each subset of selected points was then calculated and used as the correction offset.

Table 2.2: Summary of sample calibrations for each of the conductivity sensors

	Sensor 1	**Sensor 2**
Total numbers of samples	106	106
Number of samples rejected	24 (22.6%)	22 (20.8%)
Conductivity sensor offset ($cond_{calib}$ =$cond_{raw}$ - offset)	-0.0063 mS/cm	-0.0035 mS/cm

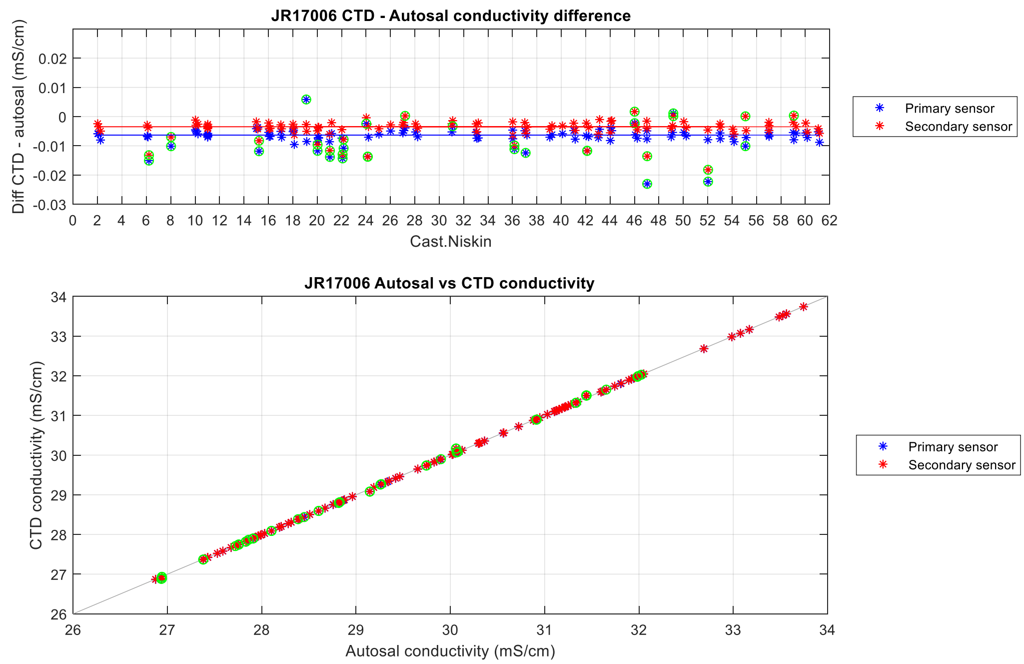


Figure 2.5: Top: difference between the raw CTD and Autosal conductivity readings in time, close-up. Bottom: raw CTD vs Autosal conductivity readings. Green circles indicate outliers, removed from dataset before calculating the final sensor offsets. The offsets are the lines shown on the top plot.

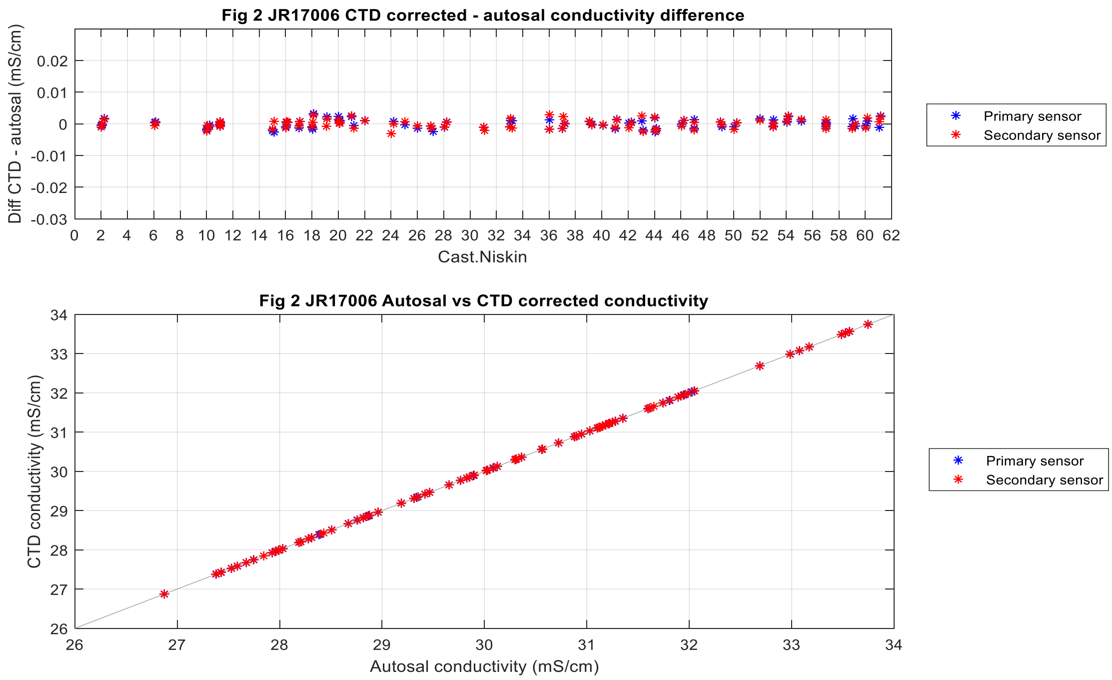


Figure 2.6: Top: difference between the corrected CTD and Autosal conductivity readings in time. Bottom: corrected CTD vs Autosal conductivity readings.

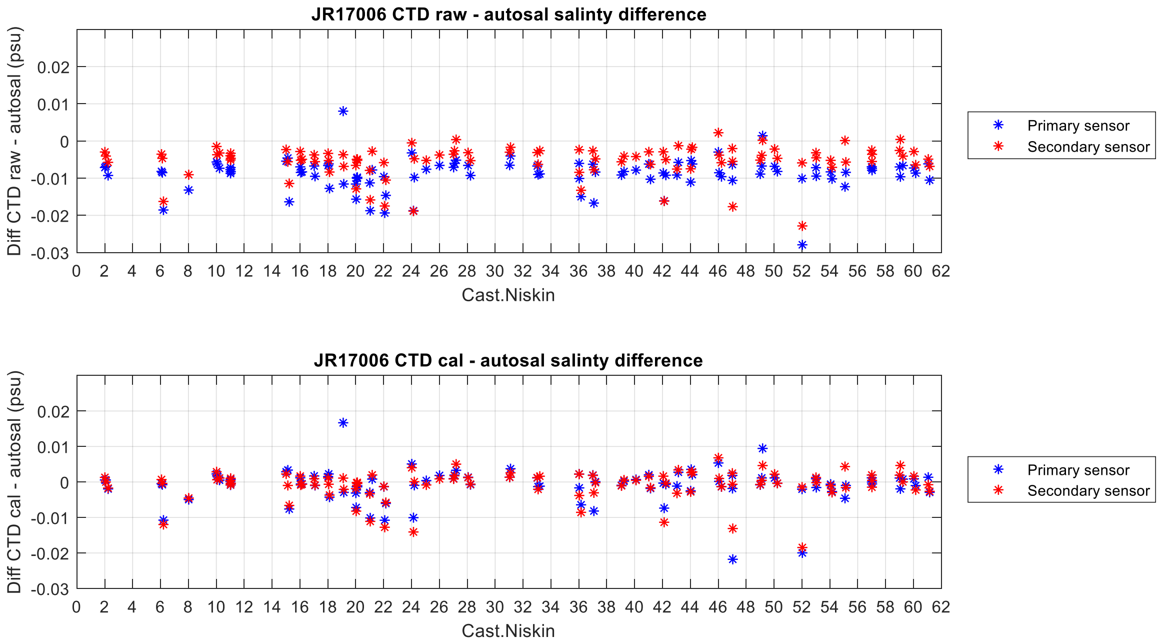


Figure 2.7: Top: difference between the raw CTD and Autosal salinity sample readings. Bottom: re-calculated CTD vs Autosal salinity sample readings using the corrected conductivities.

2.3.2.2 Oxygen

See Section 4 for full report, but the following calibration was applied to the oxygen sensor:

$$O2\_cal = (O2\_raw - O2\_int) / O2\_gra$$
$$O2\_cal = (O2\_raw - 24.032) / 0.8942$$

Input: JR17006_NNN_cropped_down_despiked.mat
Output: JR17006_NNN_cropped_down_despiked_calib.mat

20. <u>MATLAB - Averaging into 1db bins</u>

Input: JR17006_NNN_cropped_down_despiked_calib.mat
Output: JR17006_NNN_ cal_1dbd.mat

21. <u>Export to Ascii</u>

Inputs: JR17006_NNN_cropped_down_despiked_calib.mat, JR17006_NNN_ cal_1dbd.mat
Outputs: JR17006_NNN_final_24Hz_down.csv, JR17006_NNN_final_1db_down.csv

Table 2.3: List of CTD casts on JR17006

Event #	Cast #	Station name	Latitude (North)	Longitude (East)	Water depth (m)	Cast depth (m)	Start date and time (UTC)	Bottom time (UTC)	End time (UTC)
2	001	JR77	78.01318	9.47312	461	457	12/06/2018 06:41	06:53	07:06
5	002	JR77	78.01297	9.47385	475	453	12/06/2018 10:08	10:21	10:54
7	003	JR77	78.01264	9.47242	481	460	12/06/2018 14:16	14:29	14:49
10	004	JR78a	80.00837	11.24038	205	195	13/06/2018 06:04	06:14	06:27
11	005	JR78b	80.04805	10.92698	312	310	13/06/2018 07:20	07:33	07:44
12	006	JR78c	80.06438	10.79241	411	391	13/06/2018 08:29	08:42	09:17
15	007	JR78d	80.09749	10.51446	491	473	13/06/2018 11:22	11:36	11:53
16	008	JR78e	80.29195	8.90858	600	593	13/06/2018 14:06	14:24	14:37
18	009	MWest	81.03374	18.38546	260	245	14/06/2018 02:33	02:43	03:10
26	010	MWest	81.03386	18.41356	237	225	14/06/2018 08:30	08:42	09:04
46	011	MWest	81.03396	18.41343	236	222	15/06/2018 04:31	04:43	05:26
47	012	JR79	81.91471	18.49587	3359	200	15/06/2018 11:55	12:05	12:24
48	013	JR80	81.91604	18.46036	3368	0	15/06/2018 13:14	Aborted	13:21
53	014	JR80	81.91787	18.42212	3358	0	15/06/2018 15:08	Aborted	15:23
55	015	JR80	81.92197	18.38232	3347	2293	15/06/2018 17:15	18:21	19:35
56	016	JR79	81.39763	18.48581	760	728	16/06/2018 00:12	00:30	01:00
57	017	JR81	81.25058	28.02685	100	92.5	16/06/2018 13:49	13:58	14:15
58	018	JR82	81.26216	28.4637	185	176	16/06/2018 15:19	15:28	15:46
59	019	JR83	81.27798	29.14627	317	303	16/06/2018 17:04	17:12	17:30
61	020	B17	81.29997	30.00014	157	151	16/06/2018 21:21	21:27	21:41
65	021	MEast	81.30537	31.3339	197	185	17/06/2018 04:55	05:06	05:25
69	022	MEast	81.30255	31.34287	183	170	17/06/2018 10:43	10:51	11:11
85	023	JR85	82.59166	30.14443	3707	208	18/06/2018 09:53	10:05	10:26
88	024	JR85	82.59601	30.58092	3659	3588	18/06/2018 13:44	14:49	16:12
109	025	JR86	82.46579	31.55966	3385	1000	19/06/2018 15:35	15:59	16:32
110	026	JR87	81.58946	30.76686	1570	1555	19/06/2018 21:58	22:29	23:11
113	027	JR88	81.50314	30.9603	705	688	20/06/2018 04:21	04:43	05:16
115	028	JR89	81.45836	31.07706	503	484	20/06/2018 11:51	12:05	12:30
121	029	Lander	80.29297	22.32005	168	167	21/06/2018 13:06	13:20	13:49
123	030	JR95	81.47576	18.45464	1560	1549	22/06/2018 03:12	03:45	04:37
124	031	JR96	81.26324	18.45155	549	536	22/06/2018 06:26	06:45	07:16
125	032	JR97	81.14466	18.40827	379	362	22/06/2018 08:42	08:54	09:16
127	033	MWest	81.03863	18.41146	257	245	22/06/2018 13:51	14:03	14:26
131	034	JR90	81.43179	31.14564	270	254	23/06/2018 08:58	09:08	09:16
133	035	JR91	81.38338	31.29346	190	176	23/06/2018 10:51	10:59	11:17
134	036	MEast	81.30279	31.31536	184	180	23/06/2018 12:23	12:34	12:54
135	037	B27	80.99211	29.30787	384	379	23/06/2018 17:03	17:16	17:42
139	038	JR92	80.79998	27.79884	85	72	23/06/2018 22:30	22:36	22:48
140	039	JR93	80.85011	29.29974	425	410	24/06/2018 01:43	01:57	02:19

141	040	JR94	80.87774	30.18806	145	135	24/06/2018 04:07	04:18	04:37
142	041	B28	80.67004	29.2921	428	412	24/06/2018 06:51	07:09	07:31
143	042	B16	80.10027	29.99826	295	279	24/06/2018 11:13	11:24	11:47
144	043	JR98	79.33328	29.99977	299	286	24/06/2018 18:20	18:30	18:45
145	044	B15	78.25001	29.9997	313	298	25/06/2018 09:08	09:19	09:38
146	045	H51	78.1668	30.00139	337	321	25/06/2018 10:49	11:00	11:24
186	046	B34	77.54955	30.00149	207	192	27/06/2018 10:46	10:55	11:16
201	047	JR99	77.44994	30.00036	208	196	27/06/2018 23:10	23:22	23:30
202	048	HH50	77.30027	29.99962	190	175	28/06/2018 01:00	01:07	01:20
203	049	HH54	77.14984	30.00136	203	189	28/06/2018 02:41	02:50	02:59
205	050	HH49	77.00004	30.00013	236	223	28/06/2018 06:52	07:08	07:33
207	051	HH55	76.86622	29.999	260	247	28/06/2018 09:47	09:56	10:11
208	052	HH48	76.73265	29.99927	257	245	28/06/2018 11:23	11:32	11:51
209	053	JR100	76.61663	30.0002	287	272	28/06/2018 13:07	13:16	13:28
221	054	B14	76.50004	29.99991	290	277	29/06/2018 08:08	08:21	08:50
231	055	HH63	76.18335	29.99988	302	289	29/06/2018 19:20	19:29	19:46
232	056	HH71	75.95003	30.00001	309	296	29/06/2018 21:39	21:50	22:09
234	057	Glider	74.88428	30.03979	387	370	30/06/2018 07:15	07:29	07:44
235	058	B13	74.50004	30.00157	358	345	30/06/2018 10:33	10:44	11:17
270	059	B35	75.49999	29.9998	360	349	02/07/2018 08:40	08:45	09:15
280	060	B12	75.4998	25.9997	138	125	02/07/2018 22:22	22:29	22:40
281	061	B7	75.99986	16.83209	319	306	03/07/2018 14:30	14:40	15:05
283	062	B6	75.1833	17.53348	144	134	03/07/2018 19:53	19:58	20:13
284	063	B5	74.36641	18.16642	123	110	04/07/2018 04:04	04:19	04:35
285	064	B3	72.6318	19.24952	368	353	04/07/2018 13:10	13:22	13:58

2.3.3 CTD Results

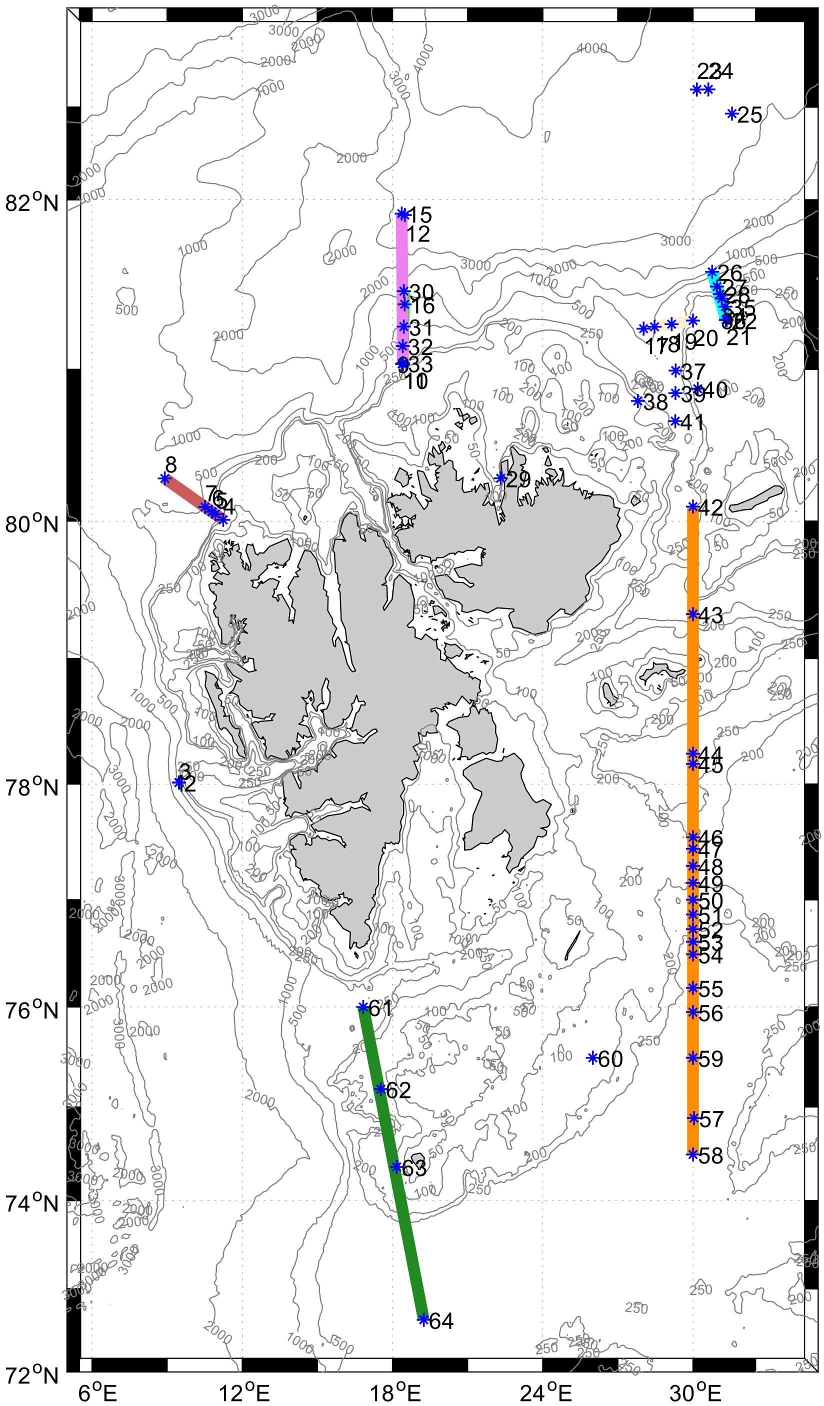


Figure 2.8: Location of all CTD profiles acquired during JR17006 denoted by their CTD cast number (refer to Table 2.3)

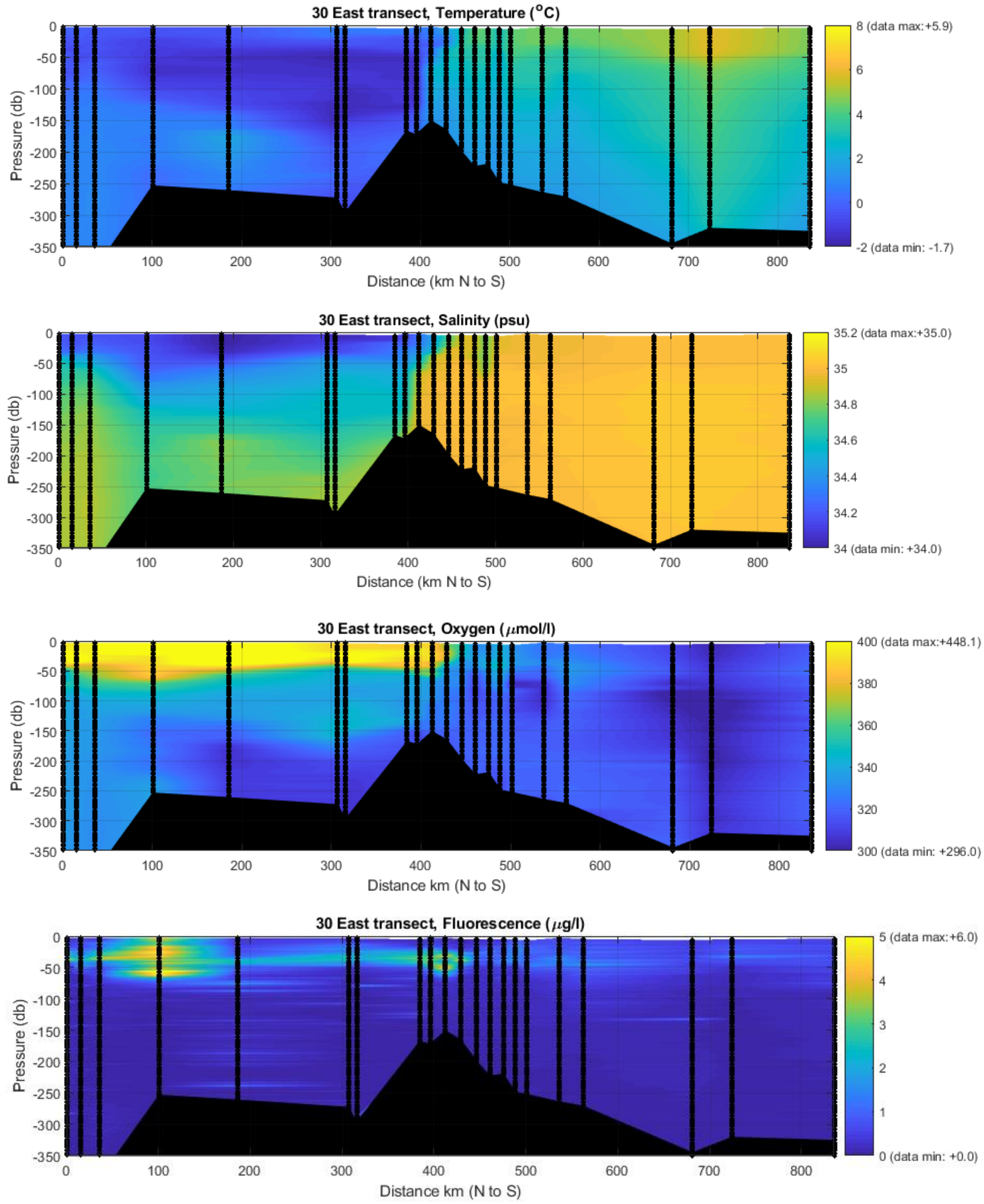


Figure 2.9: Temperature, salinity, oxygen and chlorophyll data from the 30°E transect – Black vertical lines indicate CTD cast numbers 37, 39 and 41 to 58 depicted in Figure 2.8.

2.4 Underway Data

Emily Venables (SAMS)

2.4.1 Overview

This section describes the underway data acquisition and processing during JR17006, bringing together navigation data with echo sounder depth, meteorological data and sea surface hydrographic parameters.

Table 2.4: Underway instrument channels processed and used in this report.

Instrument	Parameter	Unit
Oceanlogger	airtemp1	celsius
	humidity1	%RH
	par1	Umol/S.m2
	tir1	W/m2
	airtemp2	celsius
	humidity2	%RH
	par2	Umol/S.m2
	tir2	W/m2
	baro1	hPa
	baro2	hPa
	tstemp	celsius
	conductivity	S/ma
	salinity	psu
	sound velocity	m/sa
	transmittance	0<Tr<1
	flowrate	l/min
	sstemp1	celsius
	sstemp2	celsius
	fluorescence	ug/l
Anemometer	Wind direction	degrees
	Wind speed	m/s
	Wind speed	knots
Echosounder EA600	Depth	metres
Seatex GPS	Latitude	degrees
	Longitude	degrees

2.4.2 Instrument set-up

The Oceanlogger system recorded the sea surface and most meteorological parameters. Anemometer, echosounder and position data came in from separate streams. Table 2.4 lists all those that have been extracted and processed. In all cases, data were received in csv format as *.ACO files. Column headings and units were listed in a corresponding .TPL file, each timestamped at time of recording in the format 'YYY DDD HH:MM:SS'.

Data have been processed for the entire science time of the cruise: 8th June 2018, day 159, until 5th August 2018, day 186. Pumps were switched off in sea ice, so periods of no flow and a lag of 60 data points after restart have been removed from the data.

2.4.3 Navigation

The Seatex navigation system worked smoothly and there was no need to process data from backup systems. Figure 2.10 shows the cruise track, with bathymetry from the echo sounder.

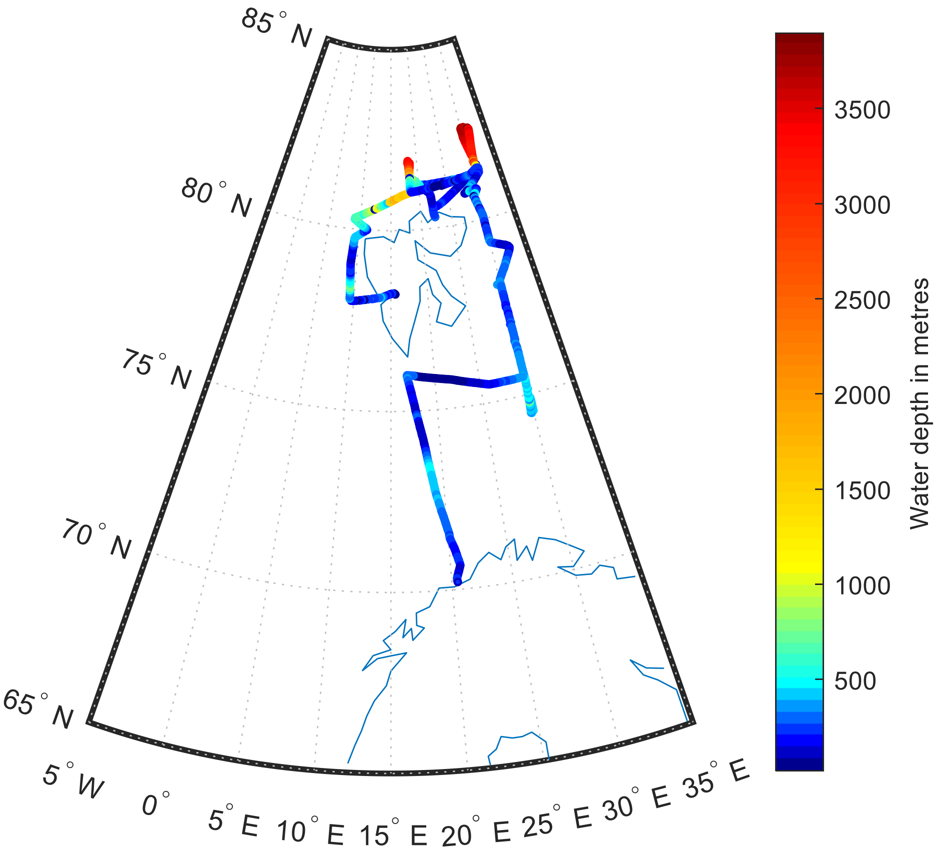


Figure 2.10: Cruise track showing EA600 echosounder bathymetry

2.4.4 Bathymetry

Echo sounder EA600

The Bathymetric data were often very noisy, with spurious dropouts and artefacts. A moving median and standard deviation filter was applied in order to clean the data before applying minute averaging.

- First pass window size 1000 points, disregard data outside median +/- 1.1 SD.
- Second pass window size 120 points, disregard data outside median +/- 1.5 SD
- Third pass window size 60 points, disregard data outside median +/- 1.5 SD

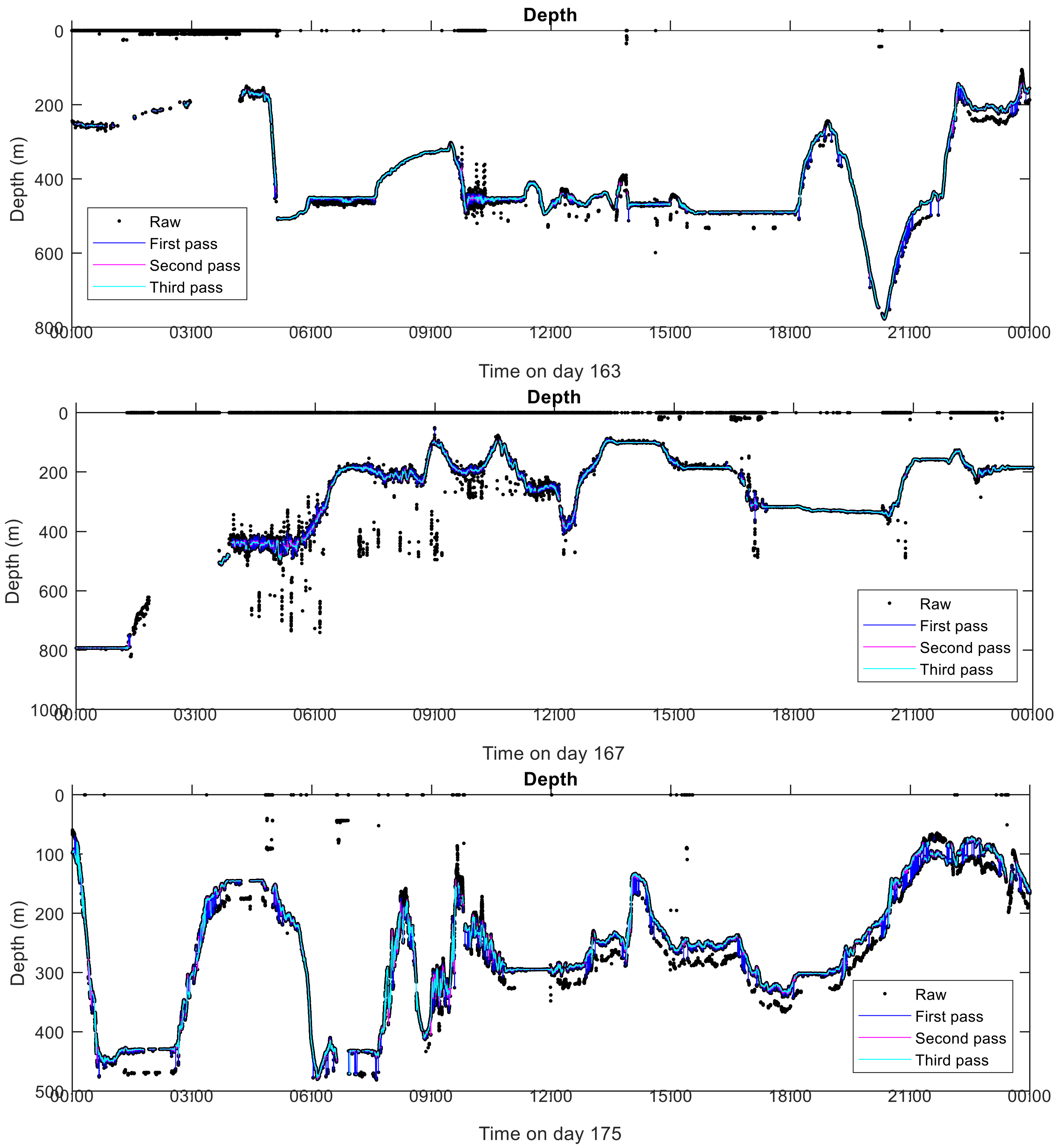


Figure 2.11: 3 days of raw and filtered echosounder data

2.4.5 Oceanlogger Data

Surface water parameters from the oceanlogger system were saved as daily raw files and as a minute-averaged time series. Data from times of no flow (when pumps were switched off), and from a lag time of 5 minutes (60 data points) afterwards were removed. No filtering was applied to these data, but a conductivity calibration was applied from salinometer sample results as described in the next section. Figure 2.12 shows the hydrographic time series from the cruise along with chlorophyll and turbidity.

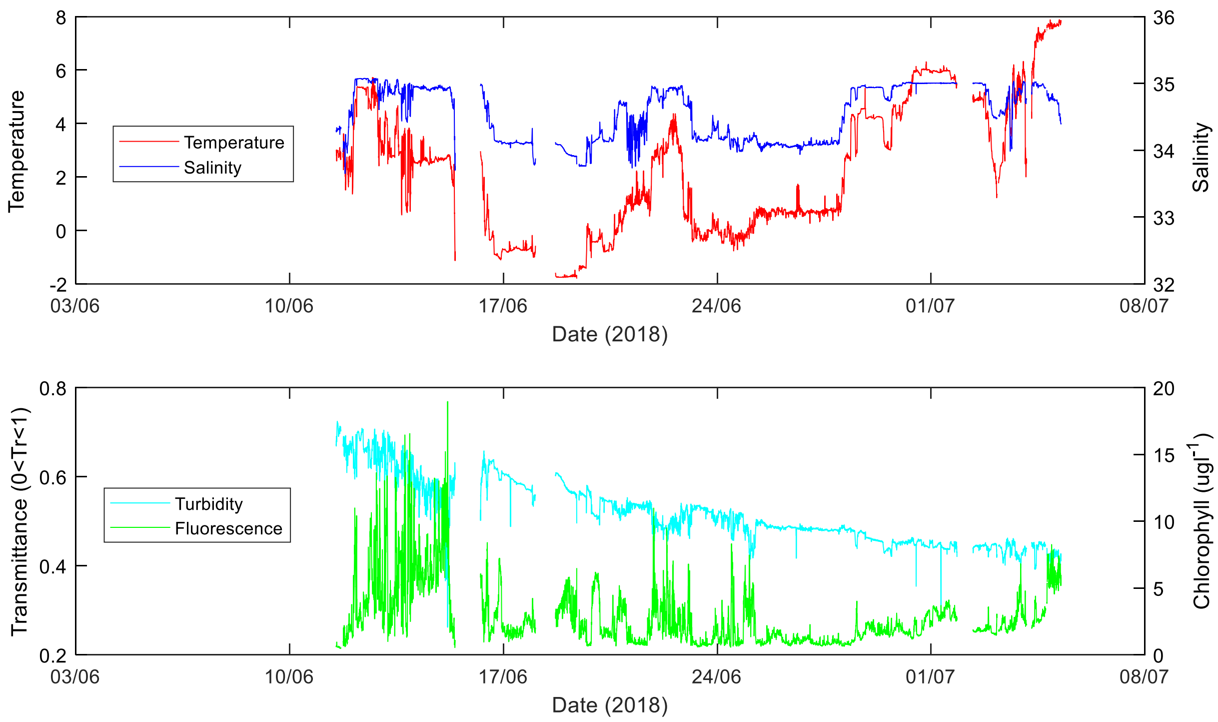


Figure 2.12: Surface Temperature, salinity, turbidity and fluorescence from the pumped underway surface water supply. Gaps where pumps were turned off in sea ice.

2.4.5.1 Underway conductivity calibration

56 discrete salinity samples were taken from the underway system during the cruise. When the pumps were running, these were taken at 0600, 1200 and 1800 each day. For each sample the bottle was rinsed 3 times with the running seawater, filled, plastic insert fitted, bottle neck wiped, and lid put on.

Once a crate of 24 samples was full, it was placed in the Autosal laboratory to acclimatise to temperature for at least one day prior to analysis (see Autosal operations Section 2.2.1 for more details). At the start and end of each crate a standard seawater (SSW) sample was analysed, to monitor the drift of the instrument.

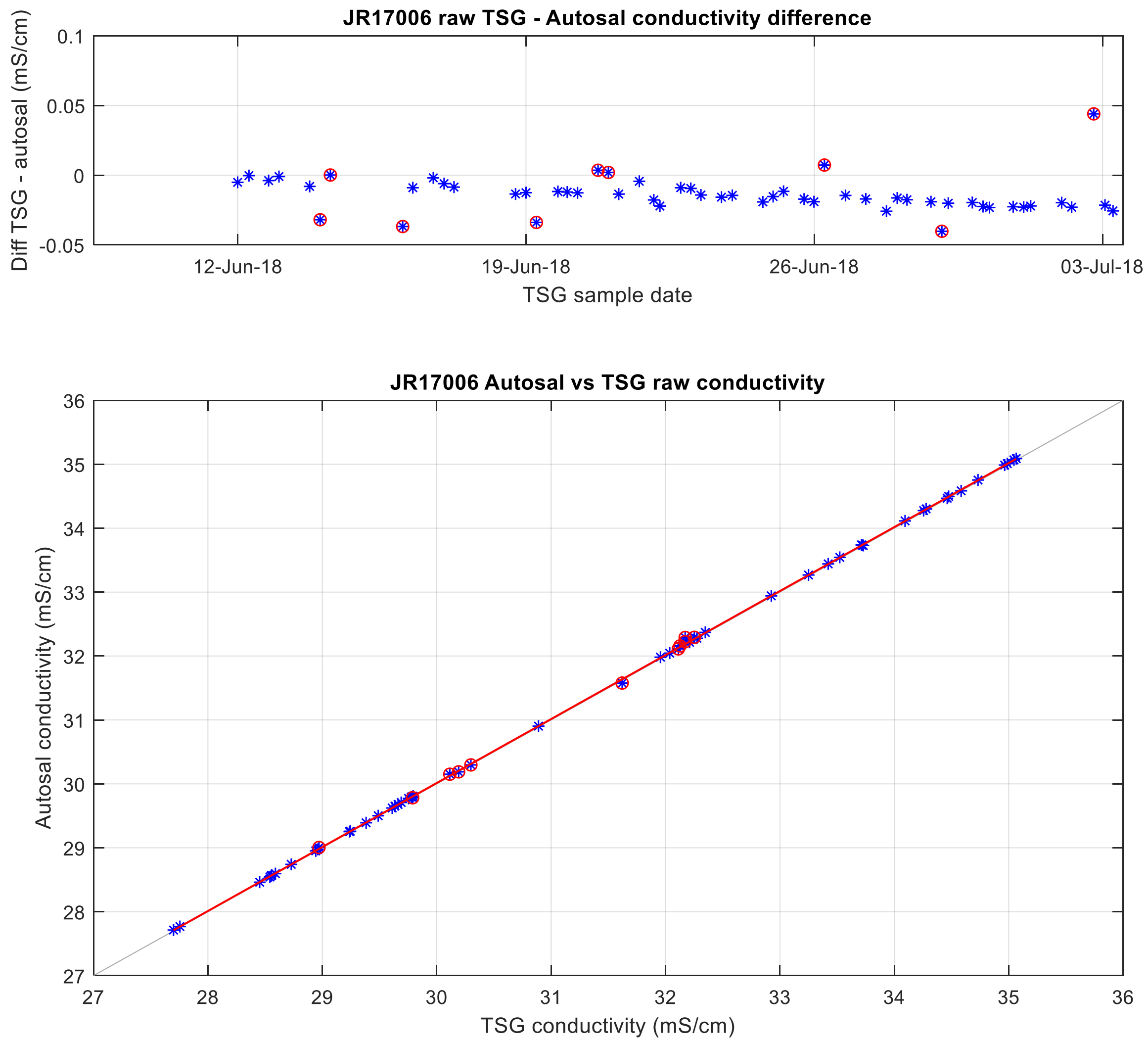


Figure 2.13: (Top) difference between the raw TSG and Autosal conductivity readings in time. (Bottom) raw TSG vs Autosal conductivity readings. Outliers indicated by red circles.

All calibration data, including outliers are shown in Figure 2.13. The median and standard deviation of the differences between the raw TSG and the Autosal readings were calculated, and all readings with a difference larger than 1 standard deviation of the median were excluded from the dataset (16 points, or 29%). A linear regression was run on the remaining data points (Figure 2.14), and the final calibration equation was determined to be:

$$\mathbf{cond_{calib} = 1.0011 * cond_{raw} - 0.0187}$$

(R^2 = 1)

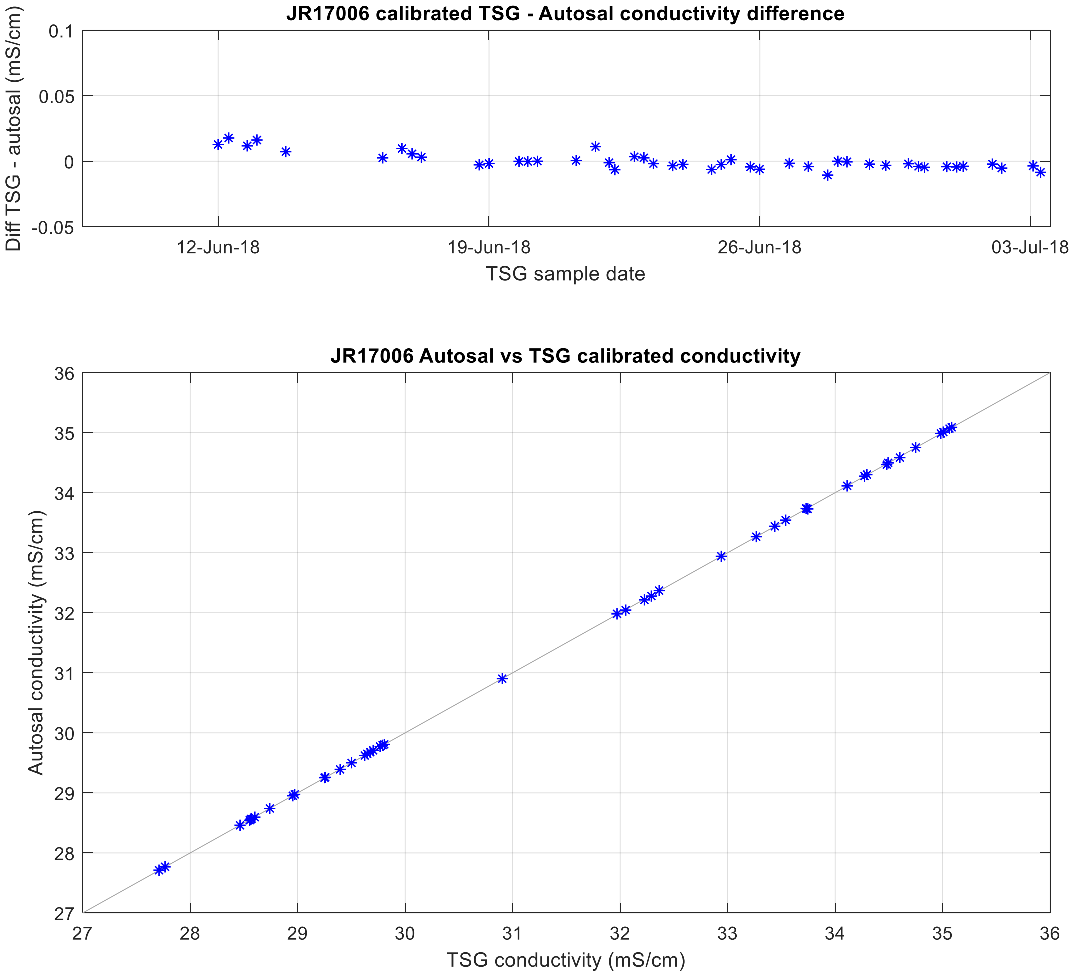


Figure 2.14: (Top) difference between the corrected TSG and Autosal conductivity readings in time. (Bottom) corrected TSG vs Autosal conductivity readings.

2.4.6 Meteorological Data

Meteorological data were recorded throughout the cruise, saved as daily raw files and as a minute-average for the entire dataset. Figure 2.15 shows time series of some of the routinely measured parameters.

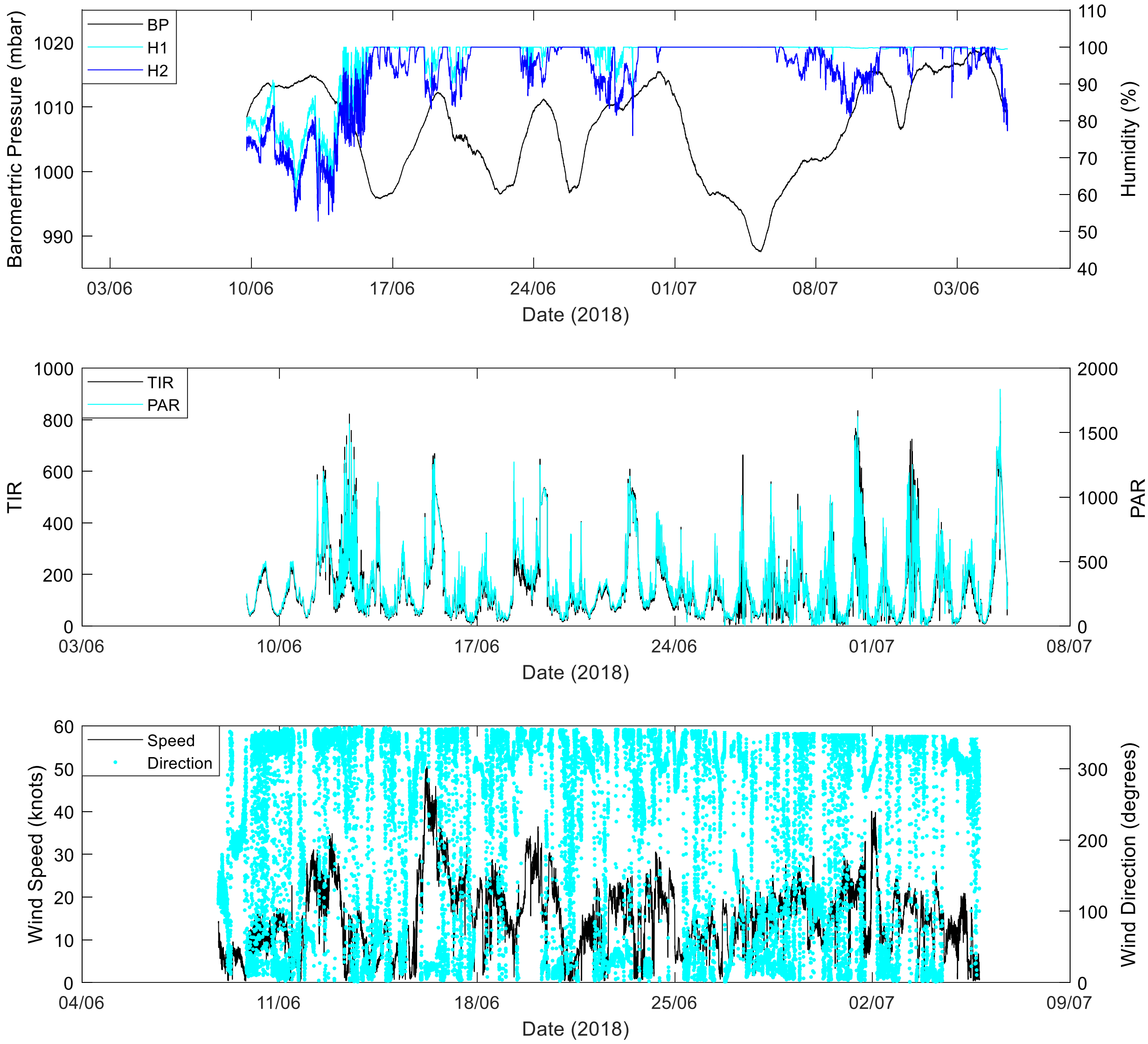


Figure 2.15: Meteorological data for the cruise duration.

2.5 Vessel-Mounted Acoustic Doppler Current Profiler (VMADCP)

Marie Porter (SAMS)

2.5.1 Instrument description

The 75 kHz RD Ocean Surveyor (model 71A-1029-00) fitted into the ship's hull was used to collect water current velocities over a range of depths. It transmits high frequency acoustic signals which are backscattered from plankton, suspended sediment, and bubbles, all of which are assumed to be travelling with the mean speed of the water. The ADCP estimates horizontal and vertical velocity as a function of depth by using the Doppler effect to measure the radial relative velocity between the instrument and scatterers in the ocean.

The transducer head is mounted 6.3 m below the waterline and beam 3 is rotated 60.08° relative to the ships centreline. A nominal rotation of 60.08° (misalignment angle) is therefore necessary to remove the ships velocity from the data. Fine tuning of this misalignment is performed in Matlab post-processing routines.

2.5.2 Data Acquisition and configuration

The ADCP was controlled using the proprietary RD VmDas software, version 1.42.

The VmDas software creates a series of raw files needed for processing:

- .ENR binary file of beam coordinate, single ping data
- .N1R ascii file with the NMEA telegram and ADCP time stamp
- .VMO ascii file with VmDas configuration

Additional files output are:

- .ENS binary file with beam coordinate single ping data and NMEA data
- .NMS binary file of navigation and attitude
- .ENX binary file of earth coordinate, single ping data
- .STA binary file of earth coordinate, short time average data
- .LTA binary file of earth coordinate, long time average data
- .LOG ascii file with record of ADCP communication and VmDas errors

.ENX, .STA and .LTA files can be read by the WinADCP software.

NMEA strings were fed to the VMDas software from the *Navigation Repeater* and output in the .N1R files. There were:

$PADCP,9754,20180510,013551.53,0.21

Time stamp from the VmDas software every time the ADCP pings
Ensemble number, PC date, PC time, PC clock offset in seconds*

$PRDID,0.58,0.38,338.39

Ships, pitch, roll and heading from SeaTex, the primary navigation and attitude feed on the ship

$INGGA,013551.90,5517.075263,N,00032.064867,W,1,12,0.7,-1.08,M,47.58,M,,*43

Time, position and fix from SeaTex, the primary navigation and attitude feed on the ship

$INVTG,338.09,T,339.09,M,9.8,N,18.1,K,A*0B
Track made good and ground speed (relative to the ground)

These raw files were written directly to a networked drive (U:\Data).

The cruise track during JR17006 was primarily planned to be in shallow water, but with deeper troughs and features we therefore ran a broadband water tracking command file for the majority of the cruise (saved as *JR800mBottomTrack 16mBins ThruSSU.txt*). We used the Kongsberg K-Sync system to trigger the transducers. Since this does not tend to work well when bottom tracking is enabled we maintained the water tracking command file even whilst in shallow water. Profiling was set to 50 x 16 m bins, with a blanking distance of 8 m. The time between ensembles in the command file was set to 2 seconds, but this was over ridden by the VmDas software options where 'set to ping as fast as possible' was selected.

When spending a large amount of time in the deep water, north of the continental shelf we switched to using the water tracking mode (*JR800mWaterTrack 16mBins ThruSSU.txt).*

Filename	**Date-Time (UTC)**	**Notes**
JR17006001	12-6-18 08:33	Initial start of ADCP without K-Sync synchronisation.
JR17006002	12-6-18 08:40	
JR17006003	12-6-18 10:19	
JR17006004	12-6-18 11:12	Changed configuration from C:\ADCP\Command files\JR17005\bottom_track\JR 500m BottomTrack 8mBins NotThruSSU.txt to C:\ADCP\Command files\SetModes\JR 500m BottomTrack 16mBins ThruSSU.txt to use K-Sync synchronisation.
JR17006005	13-6-18 18:02	Change to JR 800m WaterTrack 16mBins ThruSSU for the deep water transect coming up
JR17006006	16-6-18 10:30	Change to JR 800m BottomTrack 16mBins ThruSSU
JR17006007	16-6-18 16:49	
JR17006008	18-6-18 19:38	ADCP crashed now running 16m bins 800m THRUSSU but have turned off swath, they won't run together
JR17006009	18-6-18 19:41	
JR17006010	18-6-18 19:44	
JR17006011	18-6-18 19:47	
JR17006012	18-6-18 19:52	
JR17006013	18-6-18 19:59	
JR17006014	18-6-18 20:00	
JR17006015	18-6-18 20:03	
JR17006016	18-6-18 20:08	
JR17006017	18-6-18 20:10	
JR17006018	18-6-18 20:21	ADCP restarted to allow it to run alongside the

		Swath
JR17006019	22-6-18 12:42	Turned off for mooring triangulation
JR17006020	22-6-18 13:50	
JR17006021	22-6-18 15:13	Restarted after K-sync failure
JR17006022	28-6-18 00:20	Restarted after U drive failure
JR17006023	02-7-18 06:10	
JR17006024	02-7-18 06:29	
JR17006025	02-7-18 06:29	
JR17006026	02-7-18 06:30	

Table 2.5: The non-labelled events suggest times that the stream was restarted due to computing needs rather than a change in location or file format.

2.5.3 Matlab Processing Routines

A suite of Matlab routines was used to perform data screening and transformation into absolute velocities in Earth coordinates. The routines were first obtained from IfM Kiel by Mark Inall and adapted for use on the RRS James Clark Ross by Deb Shoosmith in 2005. Since then numerous bug fixes and refinements have been added by various users: Angelika Renner, Mark Brandon, Hugh Venables and Sam Jones. Minor tweaks were made on this cruise.

The Matlab post processing uses the $PRDID string in the .N1R files and the binary .ENX file from VMDAS that contains single ping, bin mapped, earth coordinate data (transformed within the software using the heading and tilt sources specified). A detailed description of all the routines can be found in the JR030 cruise report.

Continued over page …..

In short, the following processing takes place:

1. RDI binary file with extension .ENX (single-ping ADCP ship referenced data from VMDAS) and ascii file with extension .N1R (ascii NMEA output from Seapath saved by VMDAS) are read into the MATLAB environment. The N1R file consists of ADCP single ping time stamps ($PADCP string) and pitch, roll and heading information ($PRDID string) from the Seapath.
2. Ensembles with no ADCP data, bad or missing heading information are removed
3. Attitude information time merged with single ping ADCP data
4. Heading data used to rotate single ping ADCP velocities from vessel centreline reference to True North reference
5. Transducer mis-alignment error corrected for (derived from the mis-alignment determination)
6. Ship velocity derived from SeaTex positional information
7. Further data screening performed to remove data where:
   - The correlation in any bin is below 128 (i.e. more noise than signal)
   - There is more than 1 bad beam in the bin
   - The percentage good 4 beam solution = 0
   - Max heading change between pings > 10 degrees per ping
   - Max ship velocity change between pings >0.5514 $ms^{-1}pingrate^{-1}$
   - Error velocity greater than twice STD of error velocities of single ping profile
8. All data averaged into 120-second super-ensembles
9. Determine absolute water velocities from either bottom track derived ship velocity or SeaTex GPS derived ship velocity, dependent on depth.
10. Data below 86% of the bottom depth (determined either from the bottom tracking or from the EA600) were removed.

2.6 MSS90 Microstructure Profiler

Jamie Rodgers, Emily Venables & Marie Porter (SAMS)

2.6.1 Narrative

A Sea and Sun Technology MSS90 shear and temperature microstructure profiler was deployed for 2 test casts to train crew and then opportunistically at 7 stations: M West, M East, JR85, HH51, B34, B14, and B13. The locations of these stations are shown in Figure 2.16, and the timing of each cast, relative to the first deployment at each station is shown in Figure 2.17. 196 successful full profiles were completed, along with 3 partial profiles from test runs or due to the line snagging and causing the profile to be interrupted and aborted. Two casts were lost due to software crashes or computer operator error. Each profile consists of measurements of velocity shear from two probes mounted perpendicularly to each other in the horizontal plane, temperature from slow and fast response sensors, conductivity and pressure. The shear measurements allow the turbulent kinetic energy (TKE) to be estimated.

The profiler was deployed on a Kevlar cored cable from an electric winch mounted on the bulwark towards the port side of the stern, with data and power connections to a power supply and laptop inside a shipping container on the deck nearby. Once a data connection had been established and recording commenced the profiler was allowed to fall at its terminal velocity in water, which was adjusted to be around 0.8 ms^{-1} by adding and removing ballast and floatation rings. The cable was paid out at a speed that allowed it to remain slack, judged by allowing one spare loop of cable to remain on the surface of the water. While one person controlled the speed of the winch another used a wooden pole to ensure that the cable came off the winch drum freely and without catching or tangling.

At open water stations (all stations except JR85), the ship steamed ahead at 0.5 knots through the water into to wind using thrusters alone to reduce the depth of increased turbulence in the water and to remove the risk of snagging the cable on a turning propeller if the line was to be swept under the ship. At the ice station, this method was adapted to reduce the risk of ice building up on around the stern and cutting the cable or snagging the profiler. As the ice was drifting downwind, the ship was positioned stern to the wind at the windward side of the small area of open water that it was occupying. The profiler was deployed as normal but with the ship steaming at 0.5 knots through the water downwind and hauled back in without the ship drifting, to increase the length of time taken to reach the far side of the open water where the profiler had to be recovered and the ship repositioned.

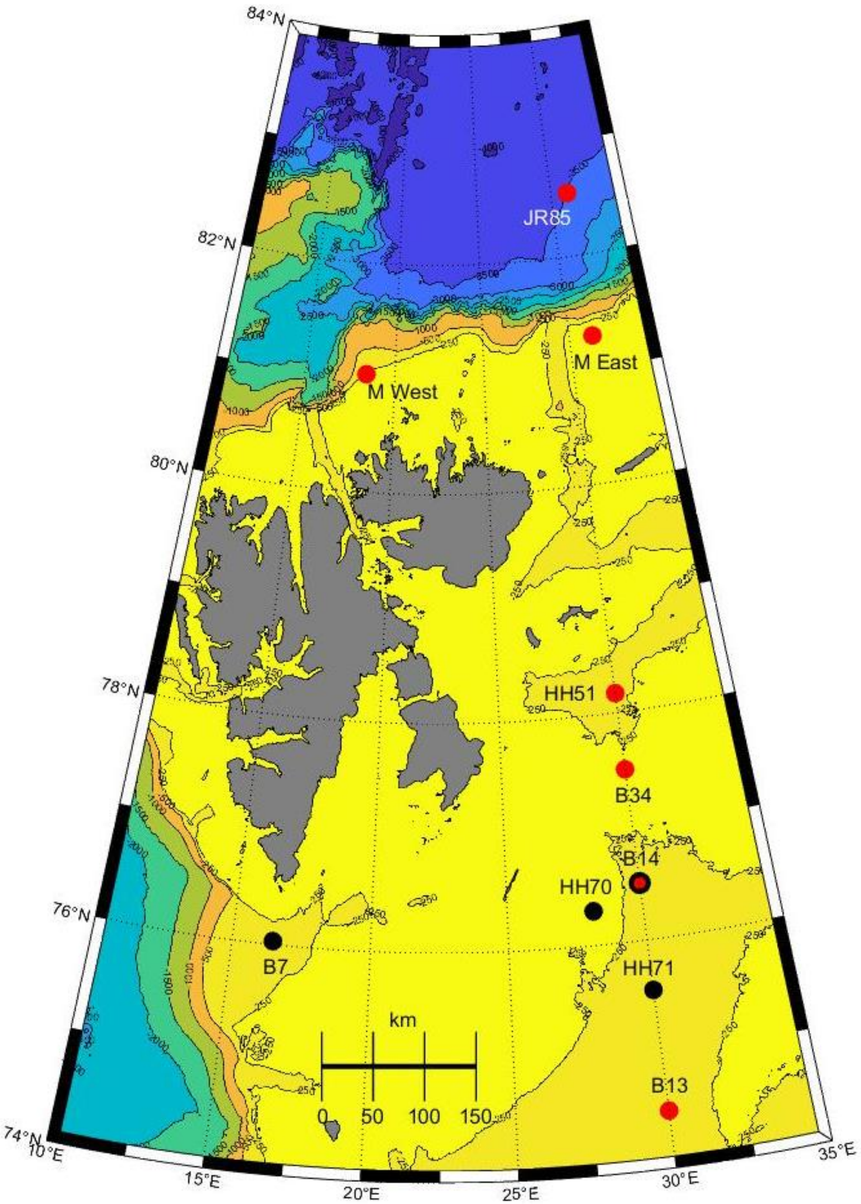


Figure 2.16 - Stations where MSS profiling was completed during JR17006 in red. Stations visited on the previous Arctic PRIZE cruise (HH23042018) are shown in black, Station B14 was visited during both cruises. Note extra contour at 250m.

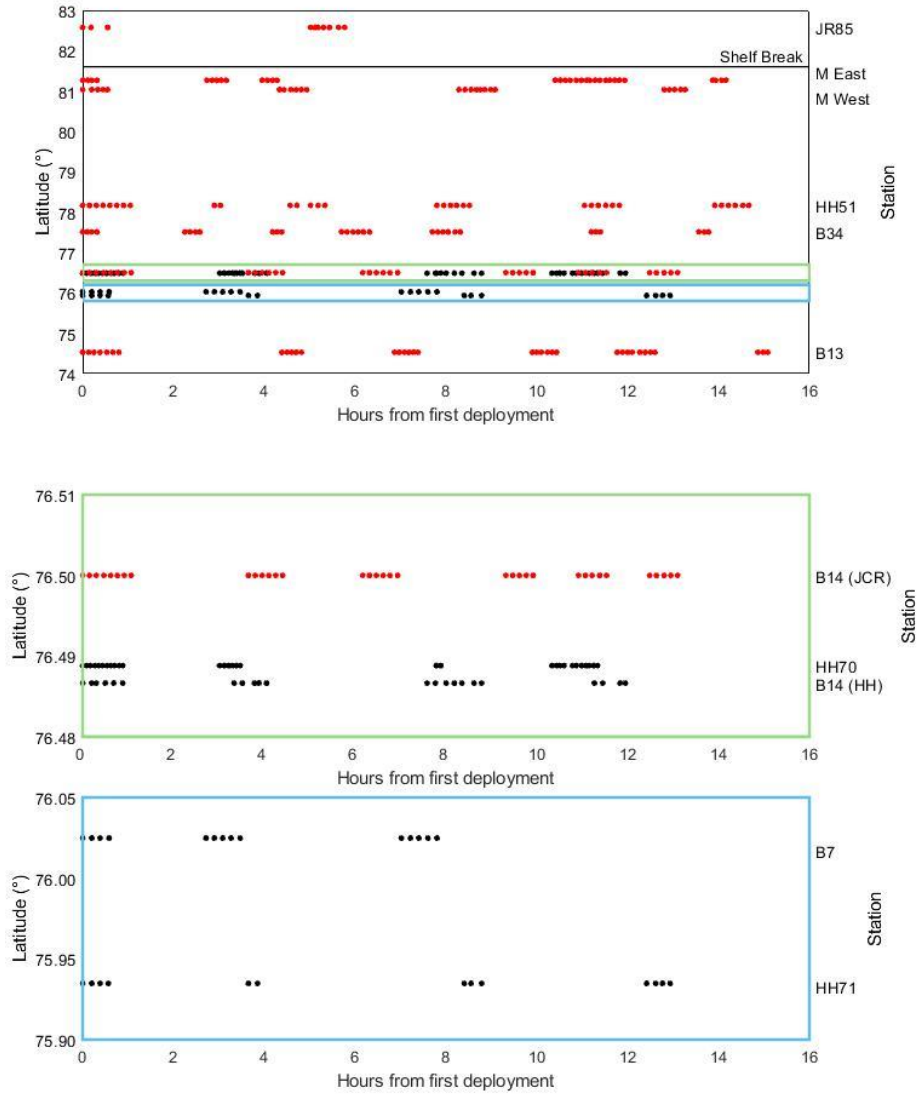


Figure 2.17 - Deployments of the MSS profiler at each station, with each point representing one deployment. Red represents stations from RRS James Clark Ross during the June/July 2018 cruise, and black from RV Helmer Hanssen during the April/May 2018 cruise.

Figure 2.18 - the line being payed out over the stern of the ship (left) and reeled in using the boom on the winch to guide the line onto the drum equally

The laptop provided a live feed of raw data from the shear probes, temperature sensor, and salinity sensor. This data stream was monitored to decide upon an appropriate stop depth for the station in question. At the chosen depth the winch was stopped and the profiler continued to descend until its fall was arrested by the cable becoming taut. Thus two depths are recorded in the log – the stop depth, where the winch stopped, and the maximum depth, where the profiler stopped falling. The data from the profile must be monitored to ensure that the profiler was indeed free-falling and that shear spikes are not caused by it being decelerated by the cable becoming taut. The profiler is designed to allow contact with the seabed however previous cruises have discovered that this greatly increases the risk to damaging the extremely delicate shear probes with the ensuing expense and loss of data collection time. On this cruise it was decided that the best approach balancing data collection from as much of the water column as possible with cost and missing data from changing broken probes, was to stop the profiler once it had passed the final picnocline but before it got close enough to the seabed that it was at risk of hitting it.

The data files were partially processed onboard into useable files and further processing has been taking place since the end of the cruise. Measurements of epsilon, the dissipation rate of turbulent kinetic energy, and the associated mixing rate will be available as profiles in the near future.

2.6.2 Sensor Configuration

Shear Probes: ISW PNS02 SN: 104 & 105
Fast Response Temperature: Thermometrics FP07
Temperature: ISW Pt100
Conductivity: ADM 7polig
Pressure: Keller PA8-50
Acceleration: ADXL203

2.6.3 Deployment Details

Station (Name Depth Date)	Bridge Log Event No	Date (start of event)	First Profile Start Time (UTC)	Final Profile Start Time (UTC)	Target Stop Depth (complete profiles) (m)	Data Files (JCR…)	Comments
Trial	8	12/06/18	1520	1528	200	0001 - 0002	Trial station to train crew
M West	29	14/06/18	1051	1110	130	0003 - 0006	0022 scrapped due to snagging
	33		1335	1401		0007 - 0011	
	35		1448	1508		0012 - 0015	
	40		2115	2247		0016 - 0030	
	43	15/06/18	0043	0101		0031 - 0034	
M East	64	17/06/18	0305	0338	135	0035 - 0039	0041 no data file due to software crash
	67		0725	0801		0040 - 0045	
	70		1122	1210		0046 - 0053	
	76		1553	1621		0054 - 0058	
JR85	91	18/06/18	1744	1817	135 (trail at 100 & 200m)	0059 - 0061	Ice station, not full tidal cycle. 0063 abandoned due to repositioning.
	98		2245	2310		0062 - 0066	
	100		2322	2330		0067 - 0068	
HH51	147	25/06/18	1140	1243	200	0069 - 0076	
	149		1434	1442		0077 - 0078	
	151		1614	1700		0079 - 0083	
	153		1928	2011		0084 - 0089	
	156		2243	2329		0090 - 0095	
	158	26/06/18	0135	0220		0096 - 0101	
B34	176	27/06/18	0018	0037	140	0102 - 0105	Some deeper starts to profiles due to large waves
	178		0233	0253		0106 - 0109	
	180		0429	0441		0110 - 0112	
	182		0600	0637		0113 - 0118	
	184		0800	0837		0119 - 0124	
	187		1130	1142		0125 - 0127	
	190		1352	1405		0128 - 0130	
B14	210	28/06/18	1448	1552	200	0131 - 0138	
	212		1827	1912		0139 - 0144	
	214		2058	2144		0145 - 0150	
	216	29/06/18	0007	0043		0151 - 0155	
	217		0143	0220		0156 - 0160	
	218		0317	0354		0161 - 0165	
B13	239	30/06/18	1425	1513	160	0166 - 0172	0190 recording failed so no usable data
	243		1848	1914	135	0173 - 0177	
	247		2117	2148		0178 - 0183	
	251	01/07/18	0019	0051		0184 - 0189	
	252		0211	0301		0190 - 0197	
	255		0517	0530		0198 - 0200	

Table 2.6: MSS Deployment details

2.7 Glider Mission PRIZE3 (unit 306 '*Zephyr*')

Marie Porter, Emily Venables & Estelle Dumont (SAMS)

2.7.1 Narrative

This glider was a shallow G2 Slocum supplied by MARS and equipped with a pumped CTD sensor, oxygen optode, triplet Eco-Puck measuring backscatter, chlorophyll fluorescence and CDOM (coloured dissolved organic matter) and PAR (Photosynthetically Active Radiation) sensor.

Zephyr was deployed on the 26th April 2018 during cruise number 18042018 aboard R/V Helmer Hanssen (University of Tromsø), in position 74° 37.019' N, 29° 50.161' E at 17:15 UTC. The standard functional checks were carried out successfully on deck prior to deployment. Before launch the glider was craned into the Polarcirkel small boat, then personnel joined the small boat from the trawl deck level. Standard small boat launch procedure was followed, using the cradle over the fold-down section of the Polarcirkel to slide the glider into the water. The glider was launched without a float and tag line, so as to reduce risk of damage when trying to remove it knowing that it had been ballasted the same as the successful 400 on PRIZE2. Once in the water remote control was handed over to the pilot via Iridium.

A CTD cast was conducted from the vessel near the time of deployment. The CTD and the glider temperature, conductivity, oxygen and fluorescence sensors appeared to be in good agreement.

After a few test dives Zephyr was sent North (T1) along the 30°E meridian. All the sensors data looked fine except for the CDOM which appeared suspiciously low (compared to the data from Raleigh and the previously deployed glider Drake). The calibration coefficients were initially suspected but seemed correct, and the cause for the low values remained undetermined. This will be investigated further in the lab post-recovery. When Zephyr got to within 20 to 30km of the ice edge it was sent South (T2). Once it reached Atlantic waters it was sent back North (T3). On the 1st June the science logger started recording an increasing number of oddities, and a higher power consumption became observable. Pilots carried out a series of tests, switching sensors on and off in turn, and reducing sampling rates. They came to the conclusion that the oxygen optode was the likely culprit, the suspected reason being water ingress inside the sensor's cable or connector. The optode was therefore turned off for the remainder of the mission. Unfortunately this appeared to have a knock-on effect on the WetLabs sensor, which also had to be turned off. The CTD and PAR sensors remained active. By that time the sea ice had receded a lot, and scientists decided to not go up to the ice edge but instead to turn the glider around (T4) once it had crossed the polar front and entered Arctic waters . A final South to North transect was performed, only up to 75°N in order to meet up with the recovery ship.

Zephyr was recovered on the 30th June 2018 during cruise JR17006 aboard RRS James Clark Ross (UK), in position 74° 53.076'N, 30° 02.623' E at 06:50 UTC. The glider was recovered using a cargo net assembly. It was then returned to the UK aboard the vessel.

Table 2.7: Transects summary

#	Direction	Start date	Start dive	End date	End dive	Duration (days)	Distance (km, direct line)	Min latitude	Max latitude
1	S→N	26/04/18	1	12/05/18	443	15.8	236	74.6	76.7
2	N→S	12/05/18	443	22/05/18	709	9.9	145	75.4	76.7
3	S→N	22/05/18	709	11/06/18	1257	20.0	219	75.4	77.4
4	N→S	11/06/18	1257	29/06/18	1754	18.2	285	74.8	77.4
5	S→N	29/06/18	1754	30/06/18	1765	0.5	8	74.8	74.9

Table 2.8: Sensor information

Sensor type	Parameters	Model	Serial number	Calibration date
CTD	Temperature, conductivity	SeaBird Slocum CTD	9099	30-Jan-2018
Oxygen optode	Dissolved oxygen	Aanderaa 4831	243	25-Oct-2017
Eco-puck	Fluorescence (chl-a), CDOM, backscatter 700nm	WetLabs FLBBCDSLC	3288	09-Jan-2018
PAR	PAR	Biospherical QSP2155	50252	12-Feb-2016

Table 2.9: Sampling summary

Dates	CTD	Optode	WetLabs	PAR	Reason for change
26/04 –02/06	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	"Short" mission, should have enough battery to have all sensors on at full resolution
02/06 – 05/06	Various	Various	Various	Various	Optode data and energy usage issues, various sampling regimes tested
06/06 – 30/06	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Off	Off	Optode not working, and high power draw from WetLabs, both turned off.

2.7.2 Technical data (whole mission)

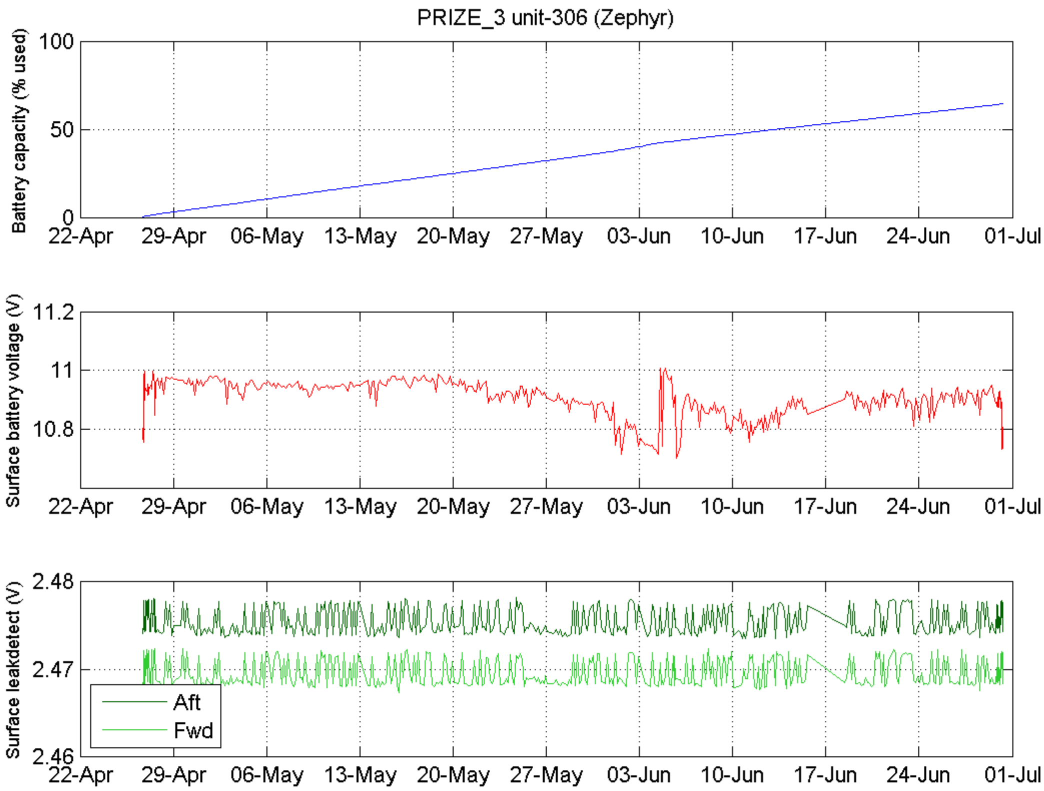


Figure 2.19: engineering readings for unit-306's mission. Total energy used: 64.5% in 65 days.

2.7.3 Overview of Preliminary Data

Figure 2.20 and Figure 2.21 below are an overview of the raw data collected by the gliders between January and June 2018 (data from unit-400 and unit-306 only). The datasets need to undergo further post-processing which could include: applying sensors offsets following inter-comparison with CTD casts or other shipborne measurements and/or inter-glider comparisons, sensors post-cruise calibrations, temporal alignment of sensors, correction of conductivity cell thermal lag effect, correction of pressure and salinity effects on the dissolved oxygen data, correction of quenching effect on the fluorometer data. This work will be carried out in late 2018 and 2019, and a full analysis of the datasets is expected to be published soon afterwards.

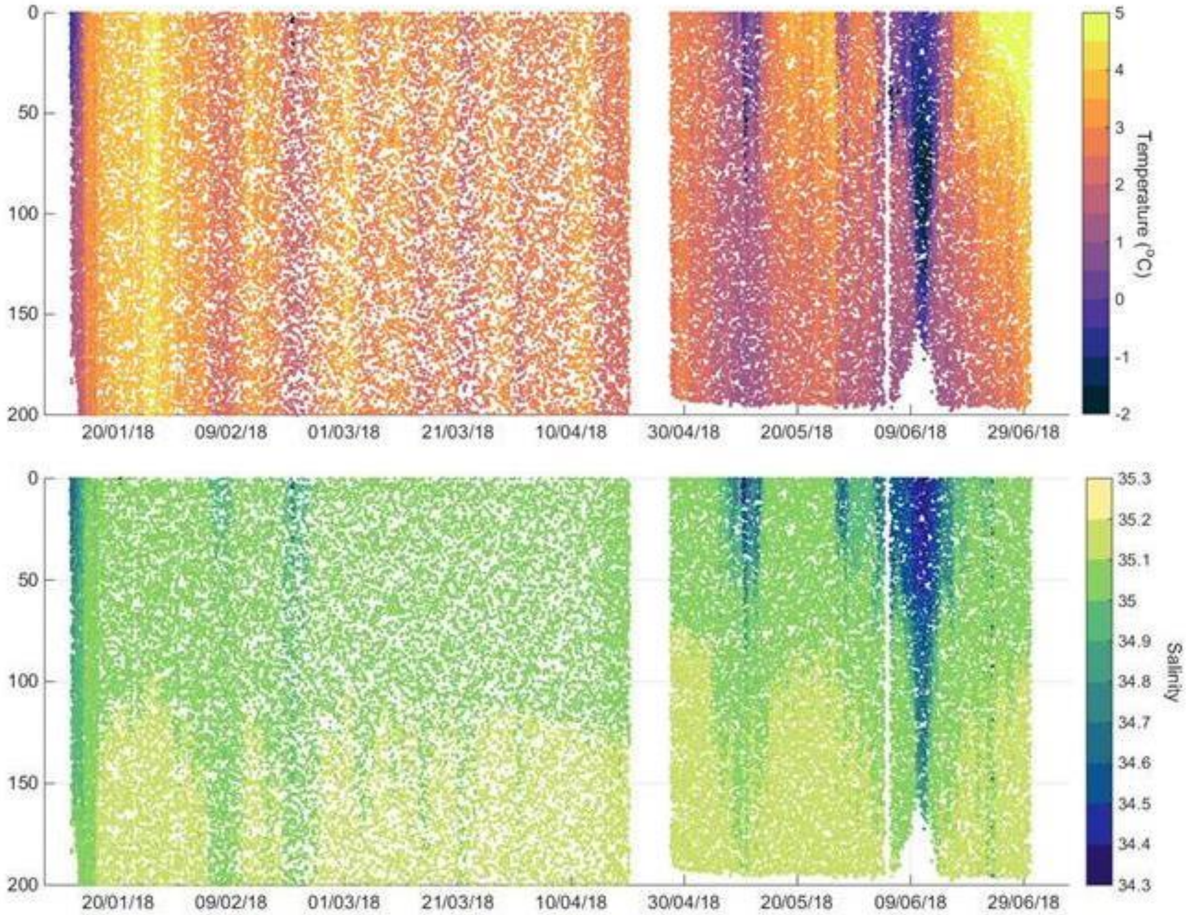


Figure 2.20: Raw temperature and salinity time series from January to July 2018, from the surface down to 200m.

The periods of lower temperature (<0°C) and lower salinity (<34.7psu) throughout the water column in Figure 2.20 indicate the Northern end of the transects after the gliders crossed the polar front. Conversely, periods of higher temperature (>3°C) and salinity (>34.8psu) show the presence of Atlantic water towards the southern end of the transects.

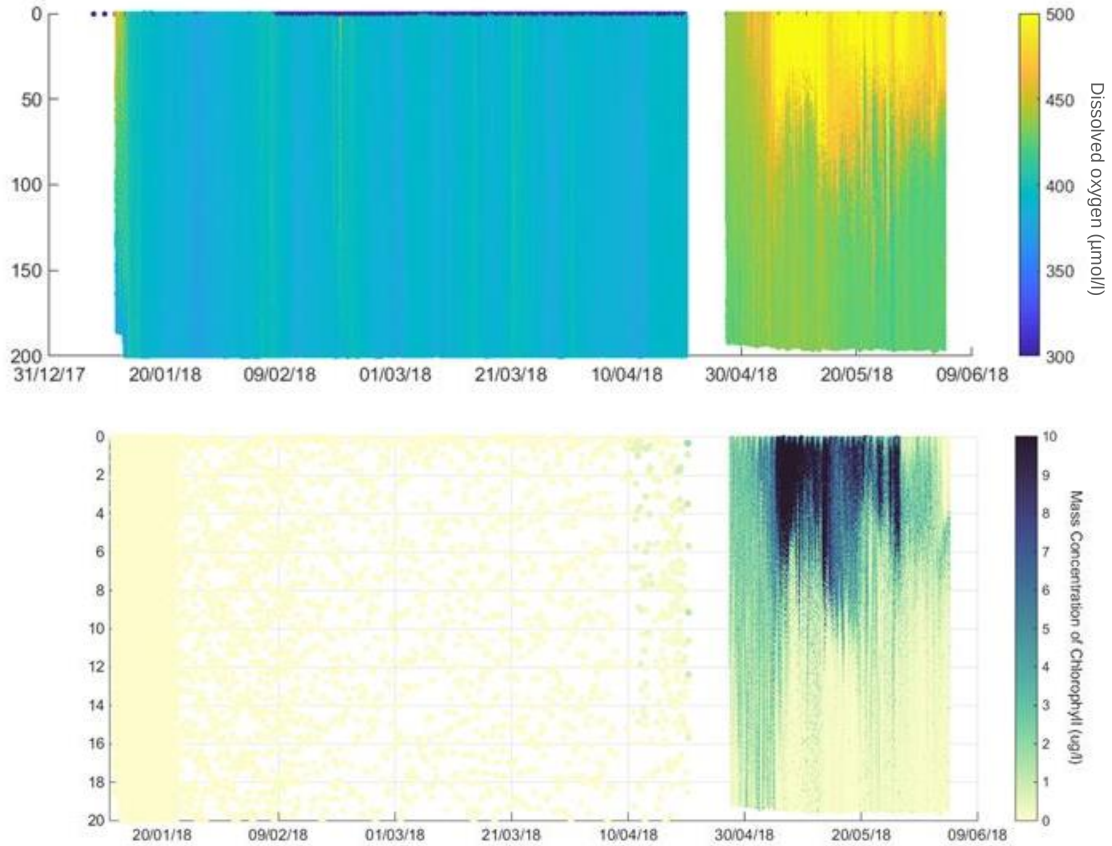


Figure 2.21: Raw dissolved oxygen and chlorophyll-a time series from January to June 2018, from the surface down to 200m for O2, and zoomed in to the top 30m for chl-a.

The O2 values in Figure 2.21 are raw and need correcting for pressure and salinity effect, this will have a significant effect on the values (lowering them by about 20 to 30%). Both variables remained low during winter until the onset of the spring bloom in early May. Faulty sensors on unit-306 in early June meant no data were collected for the last 4 weeks of the mission.

2.8 Mooring Report

Billy Platt (NMF), Finlo Cottier (SAMS), Estelle Dumont (SAMS), Laura Hobbs (SAMS), Emily Venables (SAMS), Sian Henley (University of Edinburgh)

2.8.1 Summary

WEST Mooring

	Event #	Datetime (UTC)	Latitude*	Longitude*	Depth
Recovered	21	14-Jun-18 04:30	81° 02.0349' N	18° 24.7977' E	234m
Deployed	126	22-Jun-18 10:45	81° 02.0400' N	18° 24.8400' E	246m **

EAST Mooring

	Event #	Datetime (UTC)	Latitude*	Longitude*	Depth
Recovered	66	17-Jun-18 05:30	81° 18.1528' N	31° 20.5652' E	183m
Deployed	114	20-Jun-18 07:30	81° 18.1442' N	31° 20.4941' E	209m **

Table 2.10: Summary of mooring recovery and deployment during JR17006

* All positions indicate the most accurate seabed location available, obtained from deployment location, echosounder survey or trilateration.
** Deployment depths noted here are depths measured by the ship's swath at the mooring release location, the actual mooring seabed depths will be different due to fallback.

2.8.2 Mooring Recoveries

An Ixsea TT801 deck unit was used to communicate with the release unit for both moorings. This was connected to the ships transducer and the other acoustic instruments, EA600 and EM122, were turned off during communications. Diagnostic commands showed both units to be communicating fine and in the vertical position. A recovery pellet was not on either mooring only a coil of rope with a metre or so tail. In both cases the coil was initially grappled from the starboard side before using another grapple to hook the tail end and by pulling hard break the cable ties holding the coil of rope. The top rope was then connected to the winch rope which had been run around the aft end of the ship and up the starboard side to the midships position. This was allowed to pass aft and stream behind the vessel before being hauled in. Both moorings were recovered top first over the aft end of the JCR using the ships deck winch, deck mounted block and the aft gantry.

The west mooring was recovered on the 14th June 2018 and the East mooring recovered on the 17st June 2018.

2.8.2.1 West mooring recovery

Iridium sensor S/N J123QI shows signs of internal corrosion/slight flooding when the end cap was removed.
ADCP S/N 2666 has corrosion on the pins of the bulkhead connector resulting in one of the power pins breaking off. The instrument was still able to communicate fine and showed no signs of internal flooding when opened and inspected. The data were recovered ok.

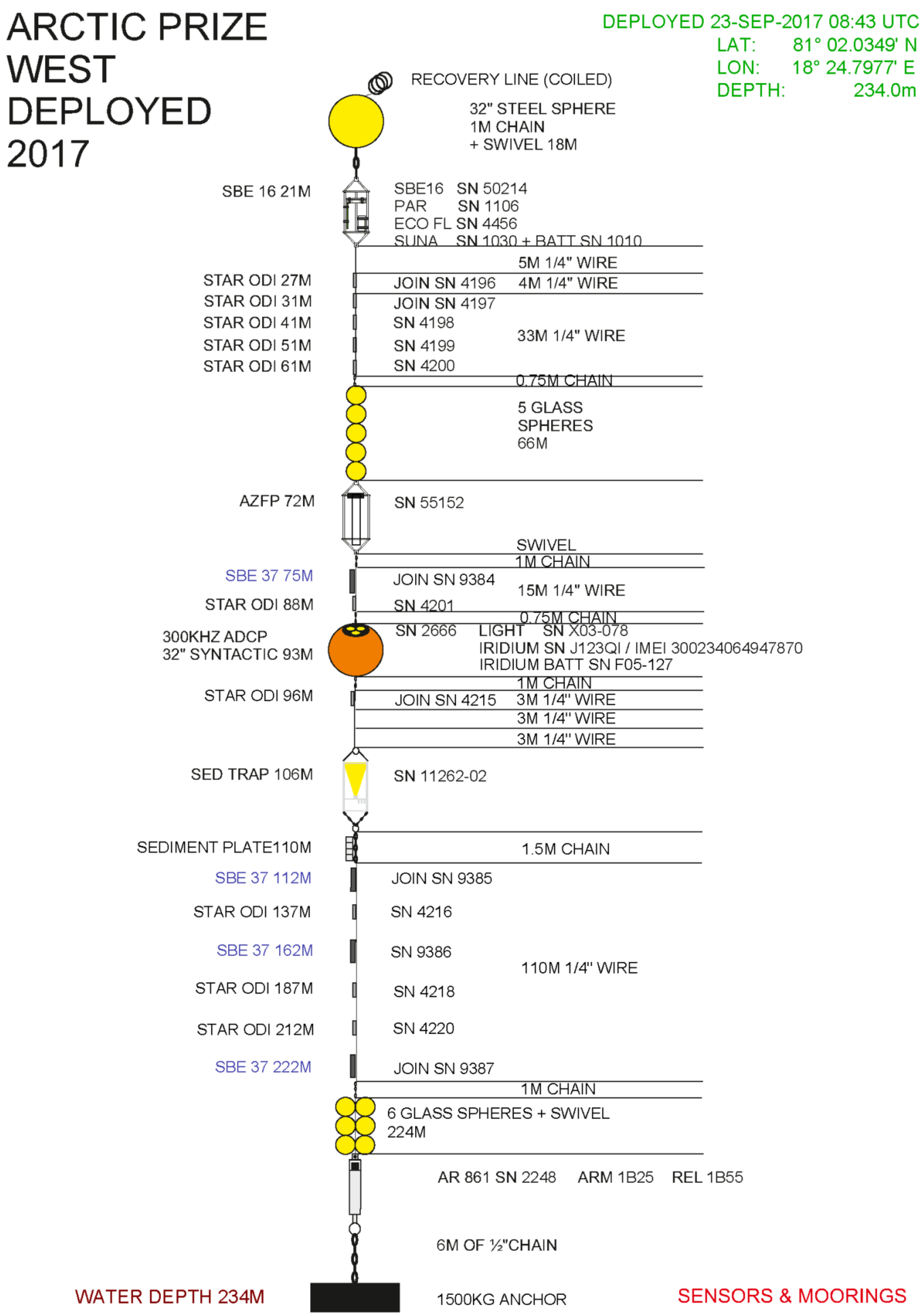


Figure 2.22: WEST mooring diagram deployed in 2017 and recovered during this cruise. Note: instrument depths on diagram are approximate.

2.8.2.2 East mooring recovery

Recovered on the 17th June 2018. The bottom section of the mooring was tangled which meant the lowest set of glass buoyancy came on board with the top set of glass buoyancy. This was stopped off and untangled and allowed to stream back out behind the vessel before continuing to recover. Communication was not possible with the SBE16 S/N 50215. On later inspection it was found that it had flooded badly and was corroded inside. See attached pictures. This meant that there was also no data recovered from the PAR, S/N 1115, or the Fluorometer, S/N 4737, as these were powered through the SBE16. Star Odi S/N T4302 was also flooded and no data recovered from this.

2.8.3 Data overview

After recovery the depths recorded by various instruments (SBE16, SBE37 and ADCPs) were checked and the final instrument depths adjusted accordingly. Final depths and data status are summarised in the Table 2.11 (West mooring) and Table 2.12 (East mooring) below.

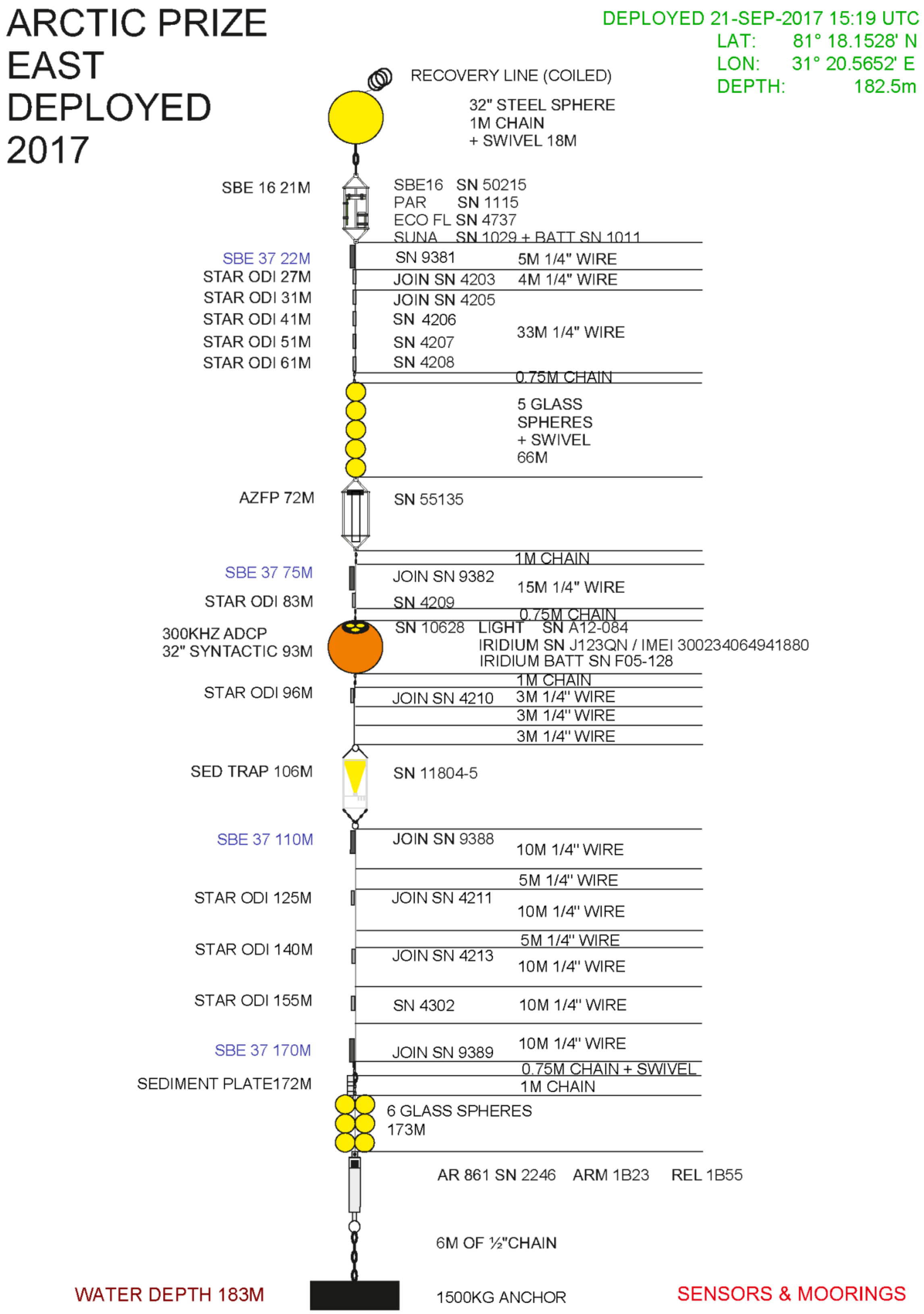


Figure 2.23: EAST mooring diagram deployed in 2017 and recovered during this cruise. Note: instrument depths on diagram are approximate.

Table 2.11: Summary of data recovery from the WEST mooring

Depth (m)	Instrument	S/N	Parameters					Interval (HH:MM:SS)	Data ok?	Comments
			Temp	Press	Cond	Fluo	PAR			
21	SBE16	50214	X	X	X	X	X	2 hours	Yes	
21	SUNA	1030	nitrate					2 hours	Yes	
27	SO	4196	X					6 minutes	Yes	
31	SO	4197	X					6 minutes	Yes	
41	SO	4198	X					6 minutes	Yes	
51	SO	4199	X					6 minutes	Yes	
61	SO	4200	X					6 minutes	Yes	
71	AZFP	55152						7 seconds	Yes	
74	SBE37	9384	X	X	X			12 minutes	TBC	Suspected offset on conductivity sensor, TBC in post-processing
86	SO	4201						6 minutes	Yes	
91	ADCP	2666						20 minutes	Yes	
94	SO	4215	X					6 minutes	No	Lost or damaged?
106	Sed trap	11262-02						variable	Yes	
108	Sed plate	N/A						6 minutes	Yes	
110	SBE37	9385	X	X	X			12 minutes	Yes	
135	SO	4216	X					6 minutes	Yes	
160	SBE37	9386	X	X	X			12 minutes	Yes	
185	SO	4218	X					6 minutes	Yes	
210	SO	4220	X					6 minutes	Yes	
220	SBE37	9387	X	X	X			12 minutes	Yes	

Table 2.12: Summary of data recovery from the EAST mooring

Depth (m)	Instrument	S/N	Parameters					Interval (HH:MM:SS)	Data ok?	Comments
			Temp	Press	Cond	Fluo	PAR			
22	SBE16	50215	X	X	X	X	X	2 hours	No	Flooded
22	SUNA	1029	Nitrate					2 hours	Yes	
23	SBE37	9381	X	X	X			12 minutes	Yes	
28	SO	4203	X					6 minutes	No	Flooded
32	SO	4205	X					6 minutes	Yes	
42	SO	4206	X					6 minutes	Yes	
52	SO	4207	X					6 minutes	Yes	
62	SO	4208	X					6 minutes	Yes	
72	AZFP	55135						7 seconds	Yes	
75	SBE37	9382	X	X	X			12 minutes	Yes	
83	SO	4209	X					6 minutes	Yes	
92	ADCP	10628						20 minutes	Yes	
95	SO	4210	X					6 minutes	Yes	
107	Sed trap	11804-5	X					variable	Yes	
109	SBE37	9388	X	X	X			12 minutes	Yes	
124	SO	4211	X					6 minutes	Yes	
139	SO	4213	X					6 minutes	Yes	
154	SO	4302	X					6 minutes	Yes	
169	SBE37	9389	X	X	X			12 minutes	Yes	
171	Sed plate	N/A						N/A	Yes	

The plots below are preliminary plots of the raw data from the instruments. Most of these datasets have undergone further post-processing.

2.8.3.1 CTDs

Post-cruise the SBE37s offsets in temperature and conductivity will be checked against the calibrated shipboard CTD readings during calibration dips. The instruments will also undergo a post-deployment calibration at NOC (in 2019, or 2020 for the instruments re-deployed during this cruise).

The Star-Odis temperature sensor offsets will be checked with data from the bucket tests done pre and post-deployments.

On the Eastern mooring the onset of sea ice can be observed in the surface CTD data in early November. The ice break-up is visible by the sudden increase in the surface temperature and salinity values in early February, as well as a homogenisation of the water column. This matches the time of sea-ice onset and retreat at the mooring location obtained from satellite imagery.

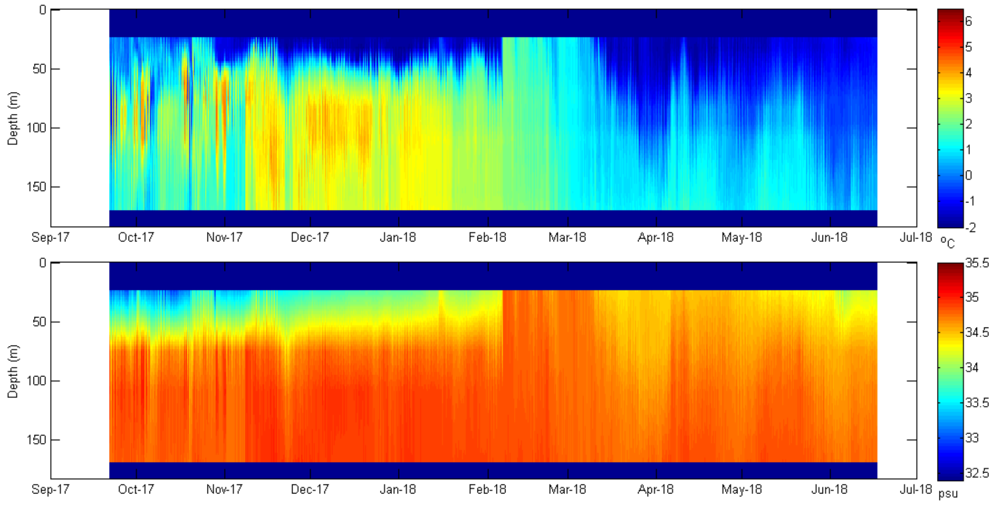


Figure 2.24: EAST mooring CTD contour time series, Sep-17 to Jun-18. Temperature data is from the SBE37s and Star-Odis, salinity from the SBE37s.

At the Western mooring, ice-free year round, the water column appears a lot less stratified than at the Eastern site. The spring bloom is detected in the fluorometer data in early May. The PAR data show the gradual return of the light from March to mid-April followed by a reduction in values. This is most likely due to a combination of sensor bio-fouling, more matter in the water column at spring bloom time reducing light penetration, and possibly higher cloud cover.

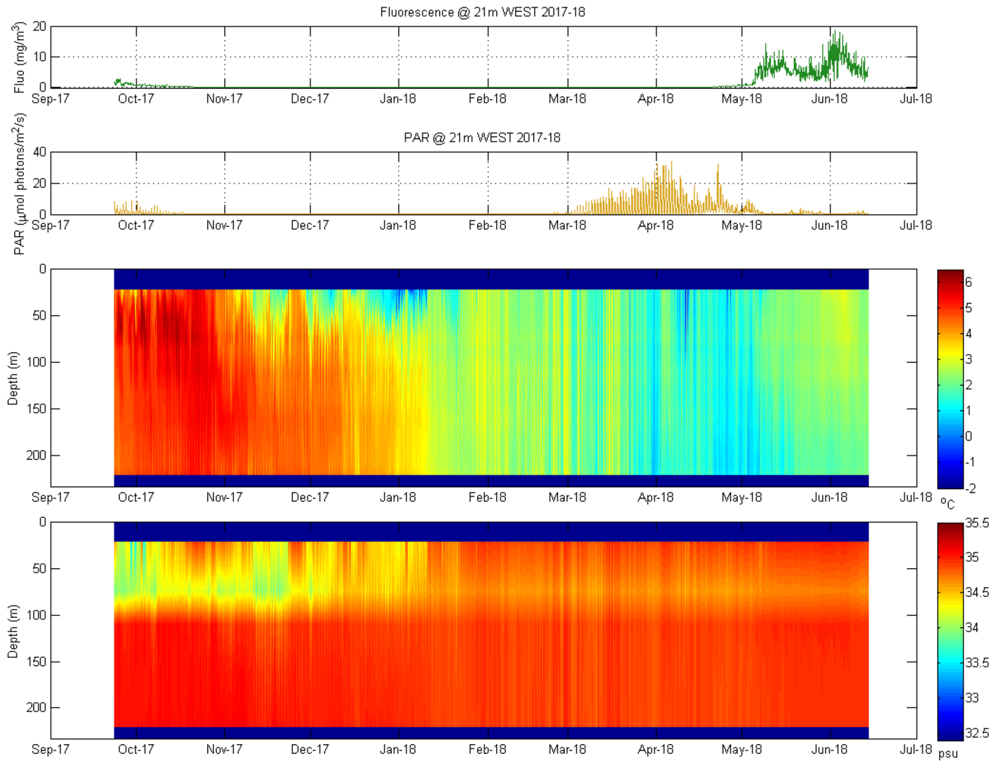


Figure 2.25: WEST mooring CTD contour time series with Chl-a fluorescence and PAR, Sep-17 to Jun-18. Temperature data are from the SBE16, SBE37s and Star-Odis, salinity from the SBE16 and SBE37s. An offset in conductivity is suspected on the ~75m SBE37.

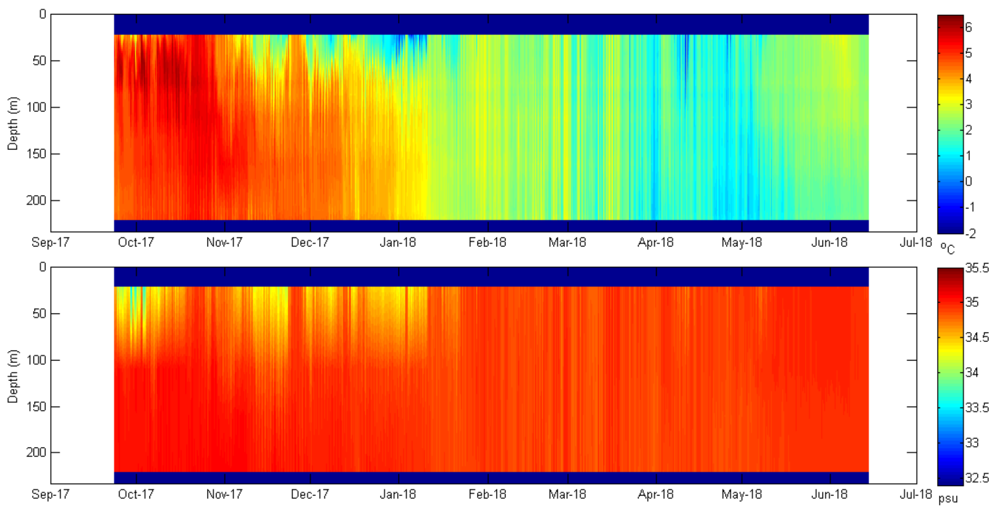


Figure 2.26: WEST mooring CTD contour timeseries, Sep-17 to Jun-18. Temperature data are from the SBE16, SBE37s and Star-Odis, salinity from the SBE16 and SBE37s. Salinity data from 75m SBE37 excluded.

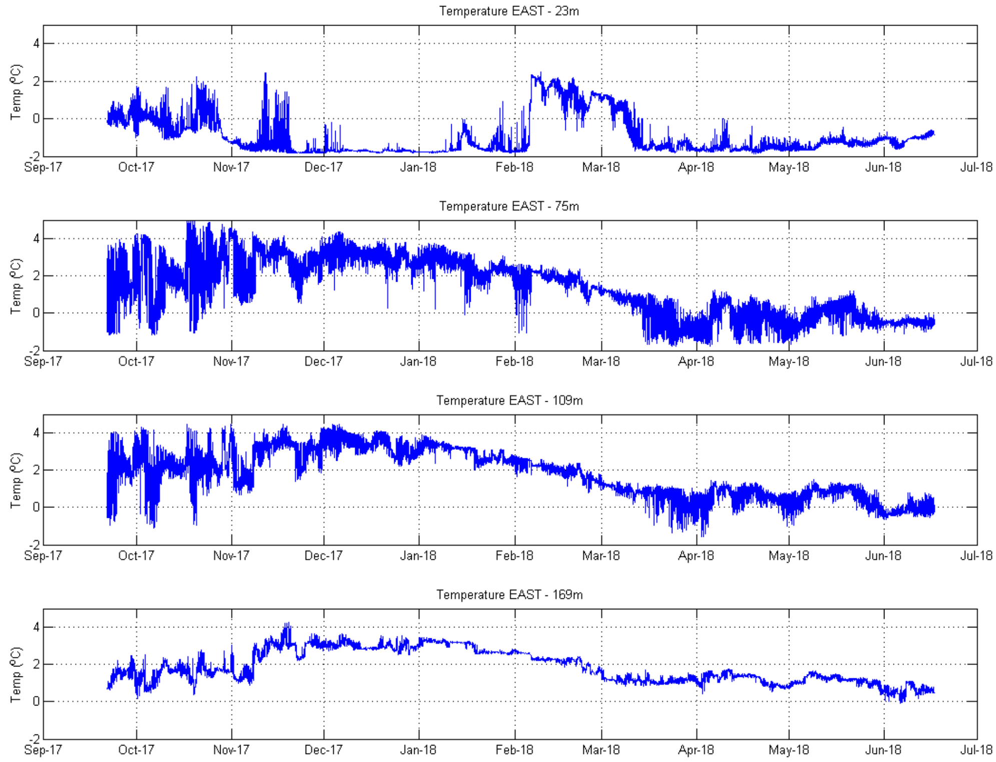


Figure 2.27: EAST mooring temperature time series, Sep-17 to Jun-18 at 23m, 75m, 109m and 169m.

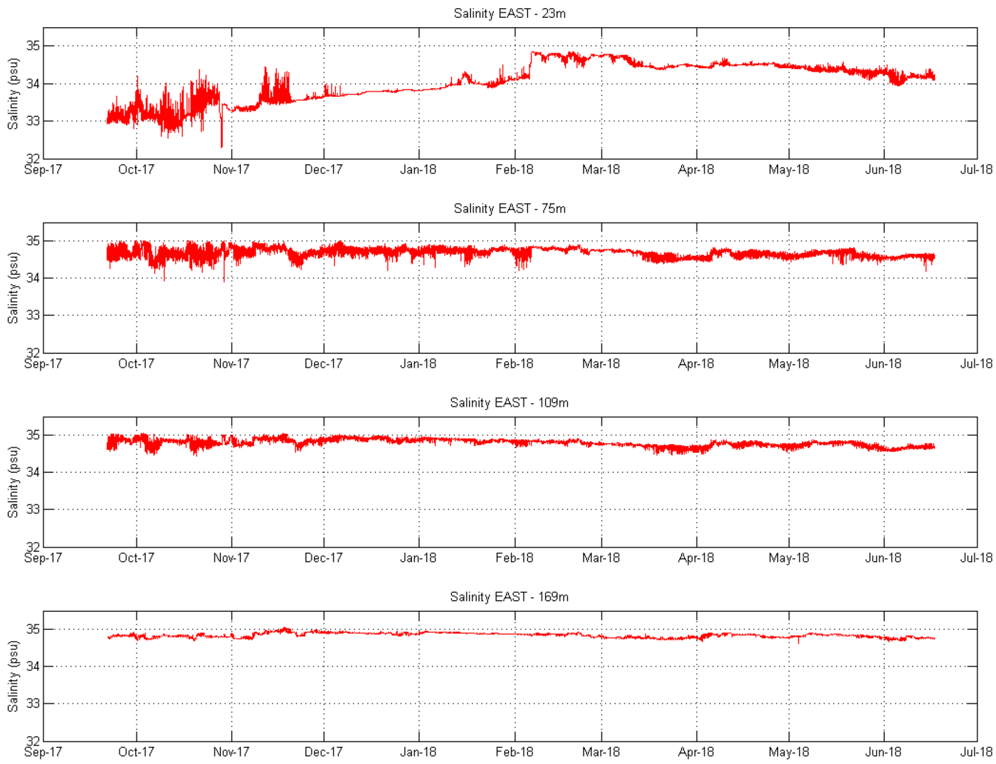


Figure 2.28: EAST mooring salinity timeseries, Sep-17 to Jun-18 at 23m, 75m, 109m and 169m.

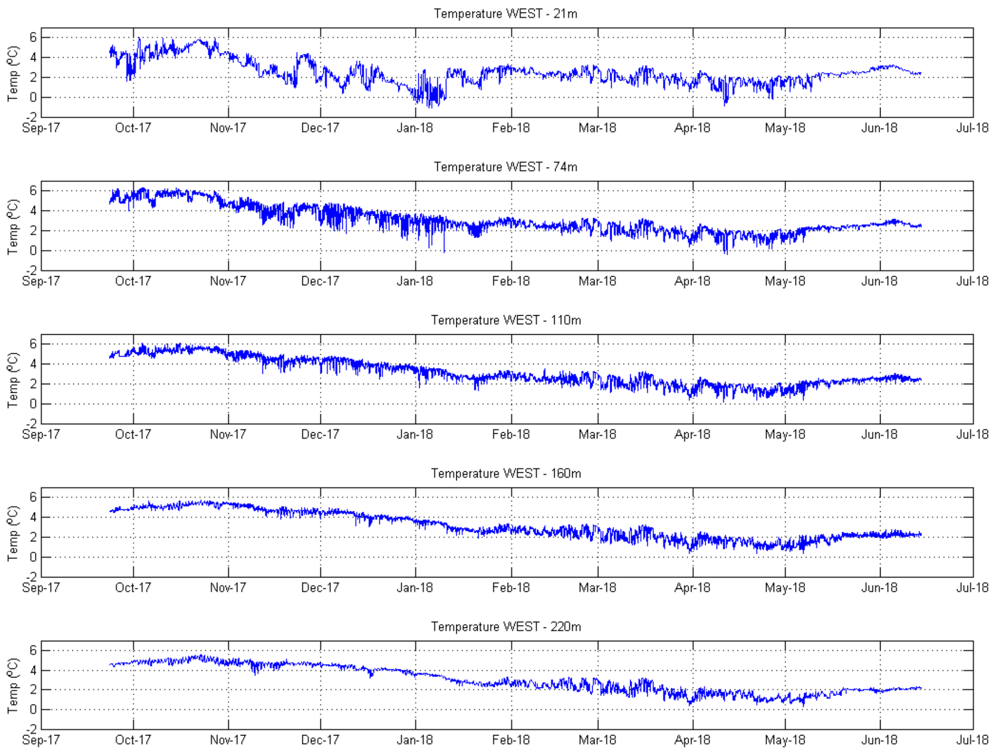


Figure 2.29: WEST mooring temperature timeseries, Sep-17 to Jun-18 at 21m, 74m, 110m, 160m and 220m.

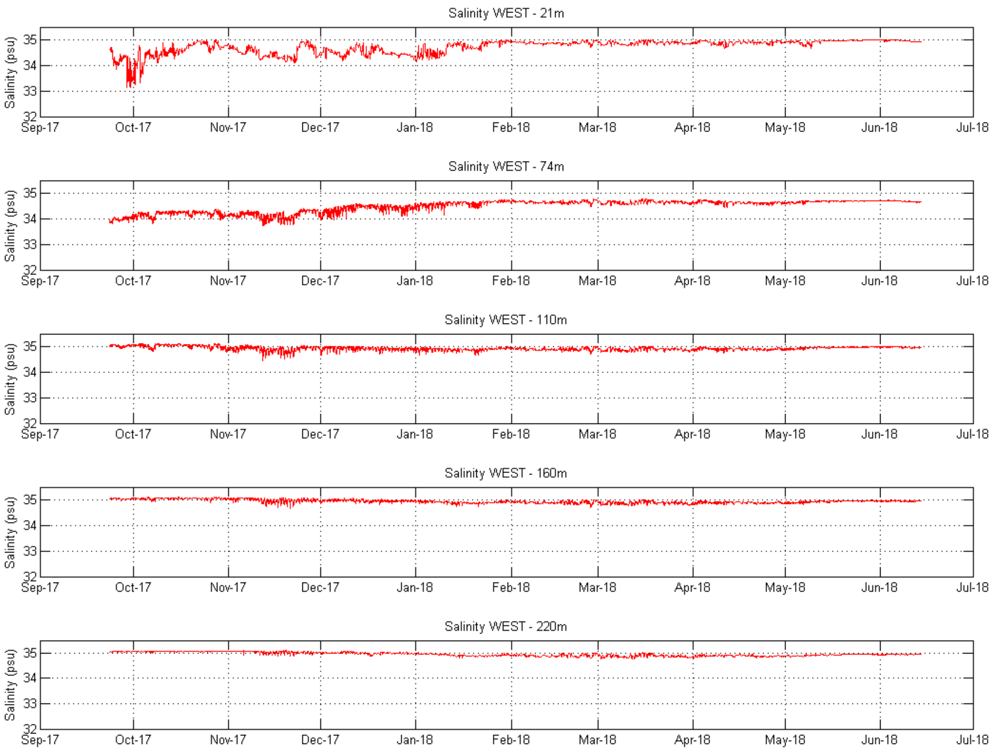


Figure 2.30: WEST mooring salinity timeseries, Sep-17 to Jun-18 at 21m, 74m (suspect), 110m, 160m and 220m.

2.8.3.2 ADCPs

Data were recovered from the ADCPs on both moorings for the duration of the deployment. The data will be post-processed and used for oceanographic analysis (currents) and zooplankton DVM analysis (vertical velocity and backscatter).

A constant interference over ~12m (3 bins width) is visible in Figure 2.31 and Figure 2.32 a few meters above each ADCP. The AZFP frame was located around that depth on each mooring (~75m) and is likely to be the source of the interference.

Significant drops in range are observable from early February to early April (East) and early February to late May (West). These first appear as daily dips centred on midday, from the surface down to 20 to 60m, progressively increasing in depth and duration (see Figure 2.33). The data are particularly bad on the Western mooring where the ADCP range is barely 30m for 6 weeks (from early April until mid-May). The daily range drop pattern is also visible at the start of the deployment on the Western mooring throughout September and October, although at a smaller scale. The suspected cause for this poor data quality is the lack of matter in the surface layer caused by zooplankton DVM patterns.

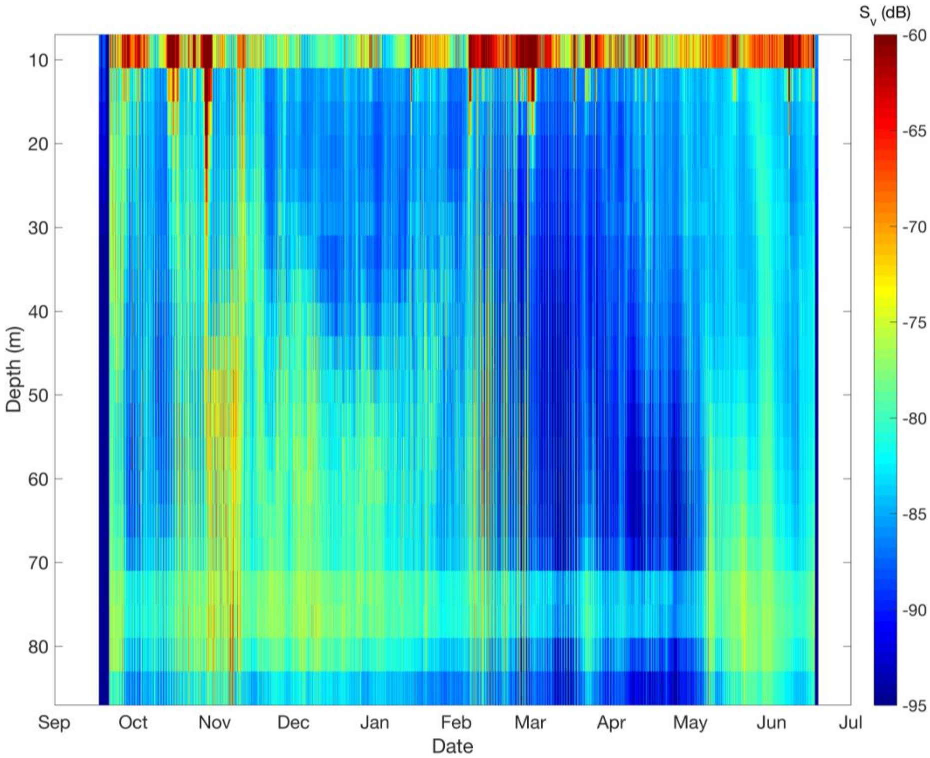


Figure 2.31: Eastern mooring backscatter data, Sep-17 to Jun-18

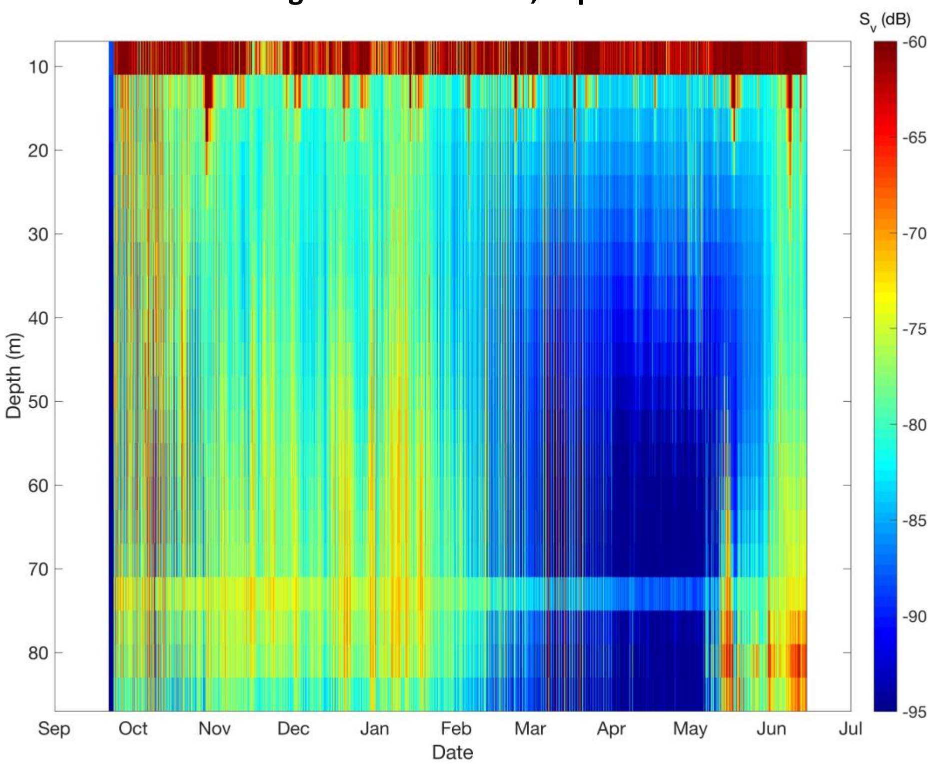


Figure 2.32: Western mooring backscatter data, Sep-17 to Jun-18

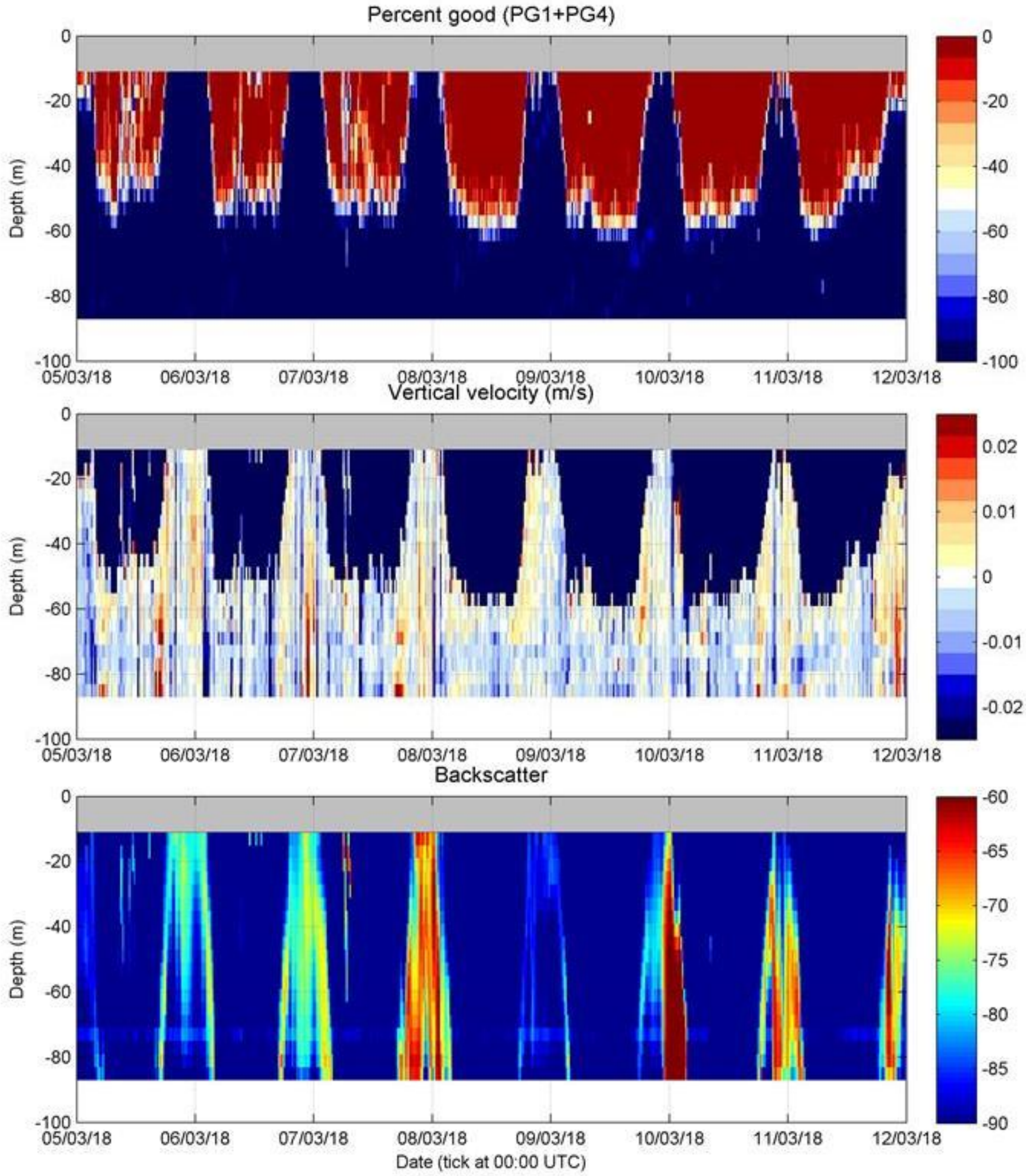


Figure 2.33: example of ADCP backscatter (middle) and vertical velocity (bottom) data over one week on the West mooring. The top plot shows the data quality percentage (sum of PG1 = 3-beams solution and PG4=4-beams solution). Data where the PG sum is less than 50% have been masked in the bottom plots (dark blue).

2.8.3.3 AZFPs

Data were recorded on both instruments, these will be post-processed, quality-checked and analysed after the cruise.

2.8.3.4 Submersible ultraviolet nitrate analyser (SUNA V2)

Deployed at a nominal depth of 21 m on PRIZE mooring west and PRIZE mooring east

Instrument recovery and post-deployment calibration

Both SUNA instruments were calibrated within 24 hours of recovery by standard addition of 10 mM potassium nitrate stock solution to seawater samples collected at each mooring location at the time of recovery. For SUNA 1030 deployed at mooring west, this calibration was conducted in a clean plastic drum using seawater from the ship's non-contaminated underway supply. Sub-samples were also taken at each standard addition for measurements of CDOM interference by Ina Lefering. For SUNA 1029 deployed at mooring east, the calibration by standard addition was carried out using parafilm wrap to create a sample reservoir in the instrument's measurement compartment, and using water from 7 m collected during CTD 23 at station JR85. The end-of-deployment reference spectrum of SUNA 1029 was assessed using ultrapure water (18.2 MΩ).

Reference spectra updates

Reference spectra were updated on both instruments within 24 hours of recovery and the change in reference spectra recorded. These updates were repeated several times over the following 24-48 hours to monitor the stability of reference spectra. Prior to redeployment, final reference spectra were uploaded: SNA1029D.cal for SUNA 1029 and SNA1030D.cal for SUNA 1030. Instrument performance was assessed with repeat measurements of ultrapure water and standard additions of 10 mM potassium nitrate stock solution to seawater samples collected from the ship's non-contaminated underway supply.

Data retrieval and processing

Raw data were downloaded from both instruments in ASCII format, as per the deployment set-up, and backed-up on an external hard drive and the legwork drive. Initial data processing is carried out using SeaBird UCI software version 1.2.5, and includes correcting nitrate concentration data for shifts in the reference spectra over the one-year deployments and corrections for temperature and salinity measured contemporaneously by a SeaBird SBE16 mounted on the same mooring frame at the same depth (SUNA 1030, mooring west) or a SeaBird SBE37 mounted 1 metre below (SUNA 1029, mooring east). Subsequent data processing includes calibration of instrument data to nitrate concentration data from standard additions measured onboard using a Lachat Quikchem 8500 flow injection nutrient analyser standardised using international certified reference materials for nutrients in seawater from KANSO Limited, Japan.

2.8.3.5 Sediment traps

The sampling bottles were removed from the traps and visually inspected. It was determined that each bottle had been open (1-20) and that there was material in each. The samples were then stored at 4°C and transferred to collaborators at UiT, Tromsø for analysis post-cruise.

2.8.4 Mooring Deployments

Both moorings were deployed top first over the aft end of the JCR using the ships deck winch, the aft gantry and the Gilson winch. The wire was run through a deck block at the start of the red-zone before running up to the block on the gantry.
The moorings were deployed largely as designed with the exception of no Iridium beacon on the East mooring and no SBE 16, PAR or Fluorometer on the West mooring due to the instruments being flooded on the previous deployments as well as a last minute adjustment to the position of some Star Odis and SBE 37s.
Instrument clocks were synched to UTC before deployment.

2.8.4.1 East mooring deployment

The East mooring was deployed on the 20th June 2018. It was released at position 81° 18.1468' N 31° 20.6175' E. After trilateration of the mooring a cocked hat was produced with the centre being at position 81° 18.1442' N 31° 20.4941' E. This position is within approximately 25m of the planned deployment location.

The instruments were started over several days as there were two false starts to the deployment. Instruments were all originally programmed to start at 12:00 UTC on the 16th June but bad weather on the morning of the 16th delayed deployment. The Star Odi's were left on from this point onwards as was the ADCP as it was already installed in the ADCP sphere and the PSO was happy to leave it as it was.

Deployment was again attempted on the 18th June and the remaining instruments were all programmed to start on the 18th. However, deployment had to be postponed for further testing of the SUNA. After this short postponement (~2 hours), there was insufficient time to complete the deployment before the day shift on the crew side and the mooring tech were out of hours.

On the 20th June the mooring was deployed and the remaining instruments, SBE16, SBE 37s, SUNA and AZFP, were set to start at 12:00 UTC on the 20th June 2018.

2.8.4.2 West mooring deployment

The west mooring was deployed on the 22nd June 2018 between 08:30-10:30 UTC. With the exception of the SUNA which was already started all the instruments were setup to start logging at 12:00 UTC on the 22nd June 2018.

Trilateration of the mooring was attempted but communication with the release after deployment was very difficult. Several positions were taken up by the ship with all the acoustics turned off and other than a couple of very wild readings (8000m or 15m) no response was received from the release unit. An over-the-side hydrophone was used as well as the ships transducer but to no avail. The master decided to slowly manoeuvre the ship over the mooring with the EA600 on and this highlighted several sections of the subsurface buoyancy at position 81° 02.04' N 18° 24.84' E.

Once deployment had started the location of some SBE 37's and Star Odis was changed by the PSO so there is one 'mark' near the bottom of the mooring without a sensor on it. This is intentional. The 1.5m length of chain underneath the sediment trap was missed off the mooring so all instruments above this point will be 1.5m deeper than planned.

Due to the earlier flooding of the SBE 16 this, along with the PAR and ECO FL were not redeployed on the mooring. An SBE 37 was put in its place inside the frame.

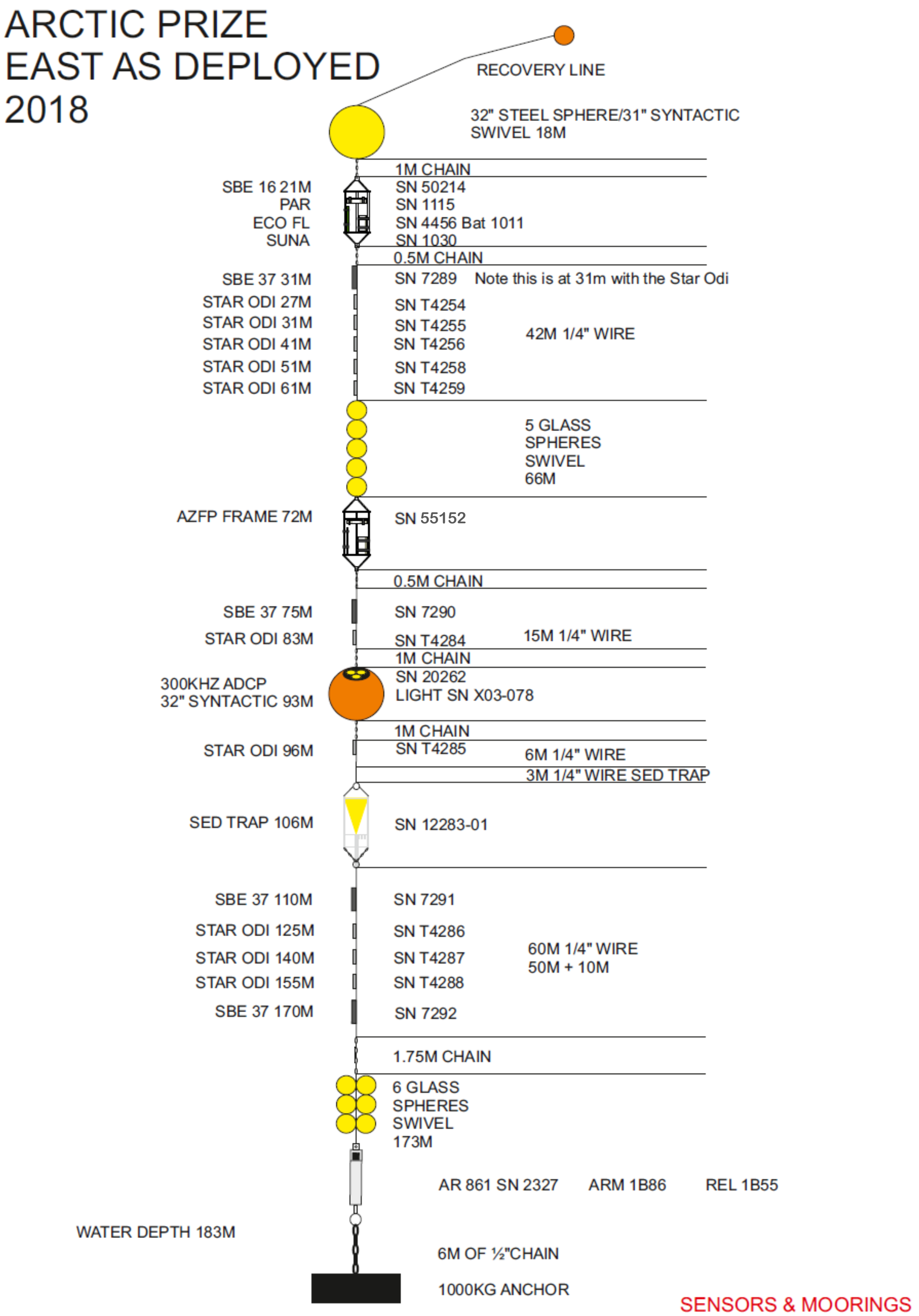


Figure 2.34: EAST mooring diagram, deployed on 20-Jun-18.

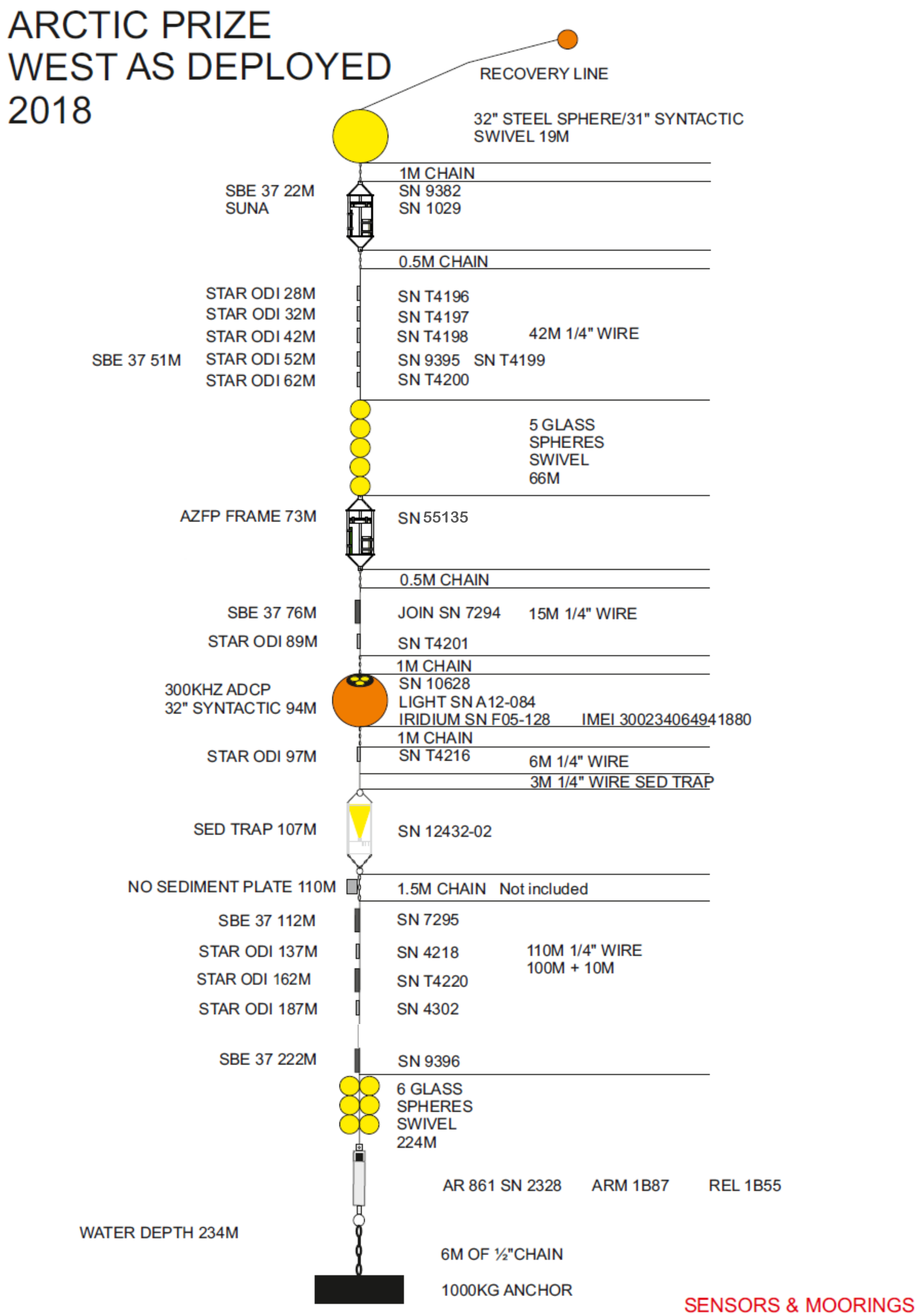


Figure 2.35: WEST mooring diagram, deployed on 22-Jun-18.

2.8.5 Instrument setup

2.8.5.1 SBE37

The SBE 37's were re-batteried and attached to the CTD for a test dip to ensure that they were working fine. The data was checked by the science party and deemed to be good. All were setup for deployment using the following commands.

```
datetime=MMDDYYYYHHMMSS
outputformat=3
txrealtime=n
outputsal=y
sampleinterval=720
samplenumber=0
samplenumber=0
startdatetime=06202018120000          (EAST)          or
startdatetime=22062018120000 (WEST)
startlater
qs
```

This is the same as the setup used for the recovered moorings and the science party were happy with this setup.

2.8.5.2 SBE16

S/N 50214 was re-batteried and positioned in the frame the same as it had been for the previous deployment. It was setup using the following commands.

```
DateTime=MMDDYYYYHHMMSS
OutputSal=1
TxRealTime=1
SampleInterval=7200
InitLogging
InitLogging
StartDateTime=06202018000000 (EAST)
StarLater
qs
```

This is the same as the setup used for the recovered moorings and the science party were happy with this setup.

2.8.5.3 SUNA

Prior to redeployment, both instruments were tested successfully for operation of the bio-fouling wiper, and data collection and transfer using an external power supply and then the SUNA battery packs. Instrument settings uploaded for deployment were exactly the same as for the previous year's deployments, and summarised in SUNA-1029-Summary-20180621T152945 for SUNA 1029 and SUNA-1030-Summary-20180620T042739 for SUNA 1030. Measurements will be taken by both instruments for 30 seconds every two hours on the even hour (i.e. 0000, 0200, 0400 etc.). These will be matched by CTD measurements every two hours. Both instruments were checked for operation with the correct timings prior to deployment.

As a result of failure of the SBE16 deployed with SUNA 1029 on mooring east during deployment year 1, SUNA 1030 and the working SBE16 recovered from mooring west were redeployed on mooring east. SUNA 1030, its battery pack and the SBE16 were mounted on the same frame and deployed at the nominal depth of 21 m on mooring east at 0730 UTC on 20/6/2018. For mooring west, SUNA 1029 and its battery pack were mounted on the same frame as a SBE37 to provide contemporaneous measurements of temperature and salinity. This instrument package was deployed at a nominal depth of 21 m on mooring west at 1100 UTC on 22/6/2018

2.8.5.4 Star Odi

The Star Odi's for the East mooring were tested in a bucket of seawater for several hours before being setup for deployment. The data and response rates from this were checked by the science party and were deemed perfectly acceptable.
The Star Odis for the West mooring were all ones that had been recovered as there weren't enough 'fresh' sensors for both moorings. The response rates and readings of all the Star Odis recovered were checked and then the best 10 were selected for redeployment.

2.8.5.5 ADCP

East mooring - Spare instrument S/N 20262 was batteried in the container and deployed on the East mooring. WinSC was used by the PSO and mooring tech to programme the instrument
Although a delayed start had been programmed, due to the abandoned deployment attempt it was later confirmed by listening that the unit was pinging at the correct times.
West mooring instrument S/N 10628 had new batteries installed and was setup by the PSO and mooring tech using WinSC and programmed the same as the East mooring ADCP.

2.8.5.6 AZFP

The AZFP's (S/N 55135 and 55152) were rebatteried and the old anodes replaced. The instruments clocks were synchronised to UTC and the flash cards formatted prior to deployment. Setup parameters were:

- Burst interval 10s
- Ping Period 10s
- Pings/burst 1
- Average Burst = No
- Beams setup: pulse length 500micro sec, digitization 40KS/s, max range 93.14m, 0.5m bin average, lock 0.0m

These parameters gave an estimated battery usage of 161.8Ah (main power) and 30.65Ah (Tx power) for a 470-days deployment (or about 90% and 77% respectively, which is accepatbel as the deployment should only be ~390 days).

2.8.5.7 Sediment traps

East mooring S/N ML12283-01
West mooring S/N Ml12432-02
The units were both batteried at NOC before the cruise. The collection bottles were filled and fitted by the science party the evening before the East mooring and on the morning of deployment for the West mooring.
The traps were set to rotate on the following schedules.

Table 2.13: Event schedule for the East mooring sediment trap

Event 1 of 22 = 06/21/2018 00:00:00	Event 12 of 22 = 03/29/2019 00:00:00
Event 2 of 22 = 07/05/2018 00:00:00	Event 13 of 22 = 04/12/2019 00:00:00
Event 3 of 22 = 07/19/2018 00:00:00	Event 14 of 22 = 04/26/2019 00:00:00
Event 4 of 22 = 08/02/2018 00:00:00	Event 15 of 22 = 05/10/2019 00:00:00
Event 5 of 22 = 08/16/2018 00:00:00	Event 16 of 22 = 05/24/2019 00:00:00
Event 6 of 22 = 09/01/2018 00:00:00	Event 17 of 22 = 06/07/2019 00:00:00
Event 7 of 22 = 10/01/2018 00:00:00	Event 18 of 22 = 06/21/2019 00:00:00
Event 8 of 22 = 12/01/2018 00:00:00	Event 19 of 22 = 07/05/2019 00:00:00
Event 9 of 22 = 02/01/2019 00:00:00	Event 20 of 22 = 07/19/2019 00:00:00
Event 10 of 22 = 03/01/2019 00:00:00	Event 21 of 22 = 08/02/2019 00:00:00
Event 11 of 22 = 03/15/2019 00:00:00	Event 22 of 22 = 09/01/2019 00:00:00

Table 2.14: Event schedule for the West mooring sediment trap

Event 1 of 22 = 06/28/2018 00:00:00	Event 12 of 22 = 03/29/2019 00:00:00
Event 2 of 22 = 07/05/2018 00:00:00	Event 13 of 22 = 04/12/2019 00:00:00
Event 3 of 22 = 07/19/2018 00:00:00	Event 14 of 22 = 04/26/2019 00:00:00
Event 4 of 22 = 08/02/2018 00:00:0	Event 15 of 22 = 05/10/2019 00:00:00
Event 5 of 22 = 08/16/2018 00:00:00	Event 16 of 22 = 05/24/2019 00:00:00
Event 6 of 22 = 09/01/2018 00:00:00	Event 17 of 22 = 06/07/2019 00:00:00
Event 7 of 22 = 10/01/2018 00:00:00	Event 18 of 22 = 06/21/2019 00:00:00
Event 8 of 22 = 12/01/2018 00:00:00	Event 19 of 22 = 07/05/2019 00:00:00
Event 9 of 22 = 02/01/2019 00:00:00	Event 20 of 22 = 07/19/2019 00:00:00
Event 10 of 22 = 03/01/2019 00:00:00	Event 21 of 22 = 08/02/2019 00:00:00
Event 11 of 22 = 03/15/2019 00:00:00	Event 22 of 22 = 09/01/2019 00:00:00

3 Marine Optics

Katharina Lefering (U Strathclyde)

3.1 Background

Observing and understanding the impact of extreme seasonality of light availability in the Barents Sea is a key aim of the Arctic Prize project. Light availability directly influences primary productivity and animal behaviour, both of which are the subject of research effort in PRIZE. Having completed 2 cruises in winter and spring, we will characterise the absorption properties of water column on this third summer cruise with the aim to monitor seasonal changes. Absorption spectra will be partitioned to identify contributions of each optically relevant component, i.e. dissolved organic matter (CDOM), phytoplankton and detritus. Our major objective for this cruise it to support WP3 and sampling efforts will therefore be coordinated with Andrew Orkney, Sharon McNeill and Callum Whyte.

3.2 Aims

- Characterisation of absorption properties of different optically relevant components at 2 depths, just below the surface and at the subsurface chlorophyll maximum (SCM)

3.3 Methods

The optics work concentrated efforts on measuring absorption spectra of water samples collected just below the surface and at the sub-surface chlorophyll maximum (SCM), with particular interest in characterising differences / similarities between Atlantic and Polar water masses. Exceptions were made at ST35 (B7) where we sampled 2 SCMs (at 5 and 30 m) as the first one was observed very close to the surface, and ST36 (B5) where the surface layer was well mixed and only a single sample was collected (Table 3.1).

Water samples were analysed for total non-water absorption (PSICAM), for non-water absorption of all constituents smaller than 5um (PSICAM), and for CDOM absorption, i.e. after filtration through 0.2 um pore size membrane filter (LWCC). Absorption by particulate matter only was measured by filtering onto GF/F filters and measuring both total particulate and detrital absorption after bleaching with sodium hypochlorite solution. Phytoplankton absorption (or the absorption of bleached material) is obtained by subtraction. PSICAM absorption is particularly accurate and immune to scattering effects and will be used to correct filter pad absorption data for a variety of systematic issues that would otherwise limit data accuracy during post-cruise processing.
Total suspended matter (TSM) concentration of each sample was determined by filtering as much sample as possible onto a pre-weighed GF/F filter. Filters were rinsed with purified water (Milli-Q) before and after sample filtration to reduce salt retention (with exception of 6 filters, highlighted in grey in Table 3.1).

3.4 Results

Most stations exhibited some vertical structure with SCM depths varying from 10 m up to 40 m. At some stations, we observed additional chlorophyll maxima below the euphotic zone. These maxima were not samples because phytoplankton at these depths are assumed to have negligible contribution to primary productivity. A summary of sampling metadata and data availability can be found in Table 3.1.

Absorption data will have to be processed and analysed post-cruise but first observations could be made on a relative basis. Absorption signatures were dominated by phytoplankton absorption both at the surface and the SCM across all stations, as we would expect from predominantly case 1 waters. The magnitude of absorption, however, varied across different sample sites with generally higher absorption at the northern stations and decreasing absorption towards the southern stations, most likely indicating post-bloom conditions at southern stations with more productive waters in the North. SCM absorption was typically stronger than the absorption just below surface, again suggesting that we sampled after the peak of the spring bloom.

Observed spectral characteristics of absorption and varying filtering speed suggested variations in the taxonomic composition of dominating phytoplankton species across the study area. Optical microscopy confirmed the presence of phaeocystis, diatoms and dinoflagellate species. More in-depth analysis of spatial distribution will be done by Andrew Orkney and Rafaelle Descoteaux.

Additional CDOM spectra were measured from samples collected from the calibration CTD at the Mooring West site for Sian Henley for subsequent correction of SUNA measurements for CDOM fluorescence.

Table 3.1: Summary of Optics sampling metadata and SPM concentrations.

The last 5 columns indicate which absorption data have been collected: *x* (data available) or – (no data available).

Station	PRIZE station name	Lat	Lon	date [YYMMDD]	day of year	CTD time [UTC]	ship log/event no. CTD	water depth [m]	sample depth [m]	Temp [C]	Sal [ppm]	TSM* [mg/l]	a_total	a_<5µm	a_CDOM	a_part	a_det
ST19	JR77	78.013	9.474	180612	163	10:07	5	450	**surface**			7.725	x	x	x	x	x
ST19	JR77	78.013	9.474	180612	163	10:07	5	450	**15.0**			7.125	x	x	x	x	x
ST20	JR78C	80.064	10.793	180613	164	08:29	12	407	**3.2**	2.8	34.8	15.200	x	x	x	x	x
ST20	JR78C	80.064	10.793	180613	164	08:29	12	407	**40.0**	3.0	34.9	5.800	x	x	x	x	x
ST21	Mooring west	81.034	18.414	180614	165	08:30	26	263	**1.7**	2.5	34.9	1.200	x	x	x	x	x
ST21	Mooring west	81.034	18.414	180614	165	08:30	26	263	**25.0**	2.5	34.9	1.050	x	x	x	x	x
ST22	JR80	81.916	18.488	180615	166	11:54	47	3368	**2.1**	-0.9	33.9	7.525	x	x	x	x	x
ST22	JR80	81.916	18.488	180615	166	11:54	47	3368	**27.0**	-0.8	34.3	8.600	x	x	x	x	x
ST23	Mooring east	81.303	31.344	180617	168	10:43	69	183	**3.0**	-0.8	34.1	1.204	x	x	x	x	x
ST23	Mooring east	81.303	31.344	180617	168	10:43	69	183	**18.0**	-0.8	34.1	0.740	x	x	x	x	x
ST24	JR85	82.592	30.136	180618	169	09:45	85	3710	**1.7**	-1.8	34.0	1.275	x	x	x	x	x
ST24	JR85	82.592	30.136	180618	169	09:45	85	3710	**10.0**	-1.8	34.0	1.600	x	x	x	x	x
ST25	JR89	81.458	31.077	180620	171	11:53		502	**surface**	-0.6	34.2	0.800	x	x	x	x	x
ST25	JR89	81.458	31.077	180620	171	11:53		502	**22.0**	-0.8	34.2	0.675	x	x	x	x	x
ST26	Lander	80.293	22.320	180621	172	13:10	121	161	**0.9**	1.5	34.5	1.400	x	-	x	x	x
ST26	Lander	80.293	22.320	180621	172	13:10	121	161	**20.0**	0.5	34.6	1.200	x	-	x	x	x
ST27	JR96	81.263	18.451	180622	173	06:39	124	594	**2.0**	2.8	34.8	1.520	x	x	x	x	x
ST27	JR96	81.263	18.451	180622	173	06:39	124	594	**12.0**	2.7	34.8	0.920	x	x	x	x	x
ST28	B16	80.100	30.000	180624	175	11:26	143	295	**2.0**	-0.5	34.1	1.200	x	x	x	x	x
ST28	B16	80.100	30.000	180624	175	11:26	143	295	**25.0**	-1.0	34.2	1.375	x	x	x	x	x
ST29	H51	78.167	30.002	180625	176	10:45	146	340	**1.7**	0.7	34.0	0.650	x	x	-	x	x
ST29	H51	78.167	30.002	180625	176	10:45	146	340	**30.0**	-0.3	34.1	1.633	x	x	x	x	x
ST30	B34	77.550	30.001	180627	178	10:54	186	237	**2.0**	0.8	34.0	0.975	x	x	x	x	x
ST30	B34	77.550	30.001	180627	178	10:54	186	237	**35.0**	-0.5	34.3	2.150	x	x	x	x	x

ST31	HH49	77.000	30.000	180628	179	07:02	205	238	**2.4**	2.7	34.7	1.020	x	x	x	x	x
ST31	HH49	77.000	30.000	180628	179	07:02	205	238	**27.0**	3.5	34.9	0.860	x	x	x	x	x
ST32	B14	76.500	30.000	180629	180	08:15	221	293	**2.5**	4.1	34.9	1.067	x	x	x	x	x
ST32	B14	76.500	30.000	180629	180	08:15	221	293	**20.0**	4.1	34.9	1.333	x	x	x	x	x
ST33	B13	74.500	30.000	180630	181	10:40	235	393	**1.5**			0.483	x	x	x	x	x
ST33	B13	74.500	30.000	180630	181	10:40	235	393	**29.0**	5.9	35.0	0.650	x	x	x	x	x
ST34	B35	79.500	30.000	18702	183	08:40	280	360	**2.5**	4.7	35.0	0.767	x	x	x	x	x
ST34	B35	79.500	30.000	18702	183	08:40	280	360	**20.0**	4.7	35.0	0.750	x	x	x	x	x
ST35	B7			180703	184	14:36	281	321	**5.0**	3.6	34.1	0.400	x	x	x	x	x
ST35	B7			180703	184	14:36	281	321	**30.0**	4.9	34.8	0.300	x	x	x	x	x
ST36	B5	74.366	18.166	180704	185	04:02	284	121	**1.6**	3.7	34.8	0.387	x	x	x	x	x

* Values in grey - flagged to indicate potential issues due to salt retention in filter paper.

4 Oxygen Calibration

Tim Brand, Emily Venables (SAMS)

4.1.1 Introduction

A selected number of Winkler titration samples collected using the CTD rosette were used for calibration purposes of the Seabird™ polarographic dissolved oxygen probes which formed part of the CTD instrument package. Methodologies followed those documented in 'Go-Ships' protocols (Langdon, 2010) and based on the standard methodologies of Carpenter 1965 adapted for large scale hydrographic studies (e.g. Culbertson, 1991 and Dickson, 1995).

4.1.2 Methods

Winkler titration analysis was performed using a Metrohm 848 plus with a 5ml burette and an amperometric probe.

In total 60 water samples were collected in triplicate (180 individual samples) of which data from 47 was used for the calibration (Table 4.1). Samples were collected in 110ml glass bottles with gas tight ground glass lids and volume calibrated to 3dp. The sample was collected using a length of silicon rubber tube which connected to the CTD bottle spigot and which allowed the sample to gently overflow the bottle for approximately 3 bottle volumes to ensure no air was contained within the bottle and that the bottle had attained the same temperature as the water. Care was also taken to ensure that no bubbles remained in the length of rubber tubing during this filling process. Once the bottle had been filled, 1ml each of Winkler solutions A and B (manganese chloride tetra chloride and a sodium hydroxide-sodium iodide mix) were carefully and promptly injected into the sample and the glass ground lid replaced. Reagents were dispensed below the surface of the sample so as not to introduce air bubbles and ensure all reacting species were contained within the sample. Care was also taken to ensure that no air bubbles were trapped under the lid during the capping process. The sample was then inverting 3 times. The temperature of the sample during fixing was recorded using a digital thermometer (±0.1°C) in a separate sample bottle. The samples were then allowed to sit for between 2 and 6 hours at room temperature before titration. Prior to titration 1 ml of 5M H_2SO_4 was added to samples followed by a Teflon coated magnetic stirrer. Titration end points reached by the auto burette were recorded.

Standardisation of the sodium thiosulphate titrant (approx. 0.1M) was carried out daily with a commercially purchased OSIL 0.001667M KIO_3 standard.

The calibration of the oxygen probe is shown in Figure 1.

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.

Table 4.1: CTD Samples analyzed and Winkler titration results

Date	CTD	Station	Depth (m)	CTD bottle	CTD Probe (uM/l)	Winkler oxygen (uM/l)	Winkler error (1sd) (uM/l)	Winkler error (rsd) (%)
12/06/2018	2	JR77	301	5	304.4	312.9	4.3	1.4
12/06/2018	2	JR77	162	7	302.1	312.3	ND	ND
13/06/2018	6	JR78c	231	7	307.2	304.4	ND	ND
13/06/2018	6	JR78c	142	10	324.0	342.2	0.9	0.3
13/06/2018	6	JR78c	72	13	348.9	361.0	0.5	0.2
14/06/2018	9	MW	152	4	323.6	322.0	5.4	1.7
15/06/2018	15	JR80	2297	3	290.7	304.1	2.9	1.0
15/06/2018	15	JR80	751	7	298.8	301.4	14.1	4.7
16/06/2018	19	JR83	303	1	318.9	328.4	8.6	2.6
16/06/2018	19	JR83	40	11	355.8	369.3	1.4	0.4
16/06/2018	19	JR83	20	13	400.7	422.1	0.1	0.0
17/06/2018	22	Moor. East	171	1	321.5	333.5	1.4	0.4
17/06/2018	22	Moor. East	51	5	333.3	333.9	10.9	3.3
18/06/2018	24	JR85	1982	6	290.9	305.4	1.2	0.4
18/06/2018	24	JR85	1095	8	295.9	307.0	2.6	0.8
18/06/2018	24	JR85	801	9	297.9	312.2	ND	ND
18/06/2018	24	JR85	324	10	309.1	317.6	3.2	1.0
18/06/2018	24	JR85	161	12	308.6	316.1	0.9	0.3
20/06/2018	25	JR86	701	4	298.1	307.8	ND	ND
20/06/2018	25	JR86	153	9	307.4	317.6	0.0	0.0
20/06/2018	25	JR86	70	11	346.4	343.1	12.4	3.6
20/06/2018	28	JR89	485	1	322.2	332.9	2.7	0.8
20/06/2018	28	JR89	227	5	315.8	311.9	11.6	3.7
20/06/2018	28	JR89	2	21	386.0	386.5	16.7	4.3
21/06/2018	29	RIP Moor	5	15	355.0	352.9	6.2	1.8
22/06/2018	31	JR96	450	3	315.4	326.6	7.4	2.3
22/06/2018	31	JR96	180	9	307.0	307.0	11.9	3.9
22/06/2018	31	JR96	25	16	354.7	373.8	0.0	0.0
23/06/2018	36	Moor E	66	5	354.2	368.1	1.0	0.3
24/06/2018	42	B16	241	3	326.0	337.2	3.0	0.9
24/06/2018	42	B16	152	7	313.9	325.1	0.5	0.2
24/06/2018	42	B16	10	18	413.6	434.1	4.0	0.9
25/06/2018	44	B15	298	1	299.2	311.2	1.2	0.4
25/06/2018	44	B15	140	5	333.3	344.4	0.7	0.2
25/06/2018	44	B15	5	13	373.7	400.1	0.1	0.0
27/06/2018	46	B34	192	1	304.3	317.7	1.4	0.4
27/06/2018	46	B34	101	6	324.1	335.9	0.2	0.1
27/06/2018	46	B34	4	19	372.4	398.5	0.6	0.1
28/06/2018	50	HH49	126	3	310.7	324.8	0.9	0.3

28/06/2018	50	HH49	10	17	344.3	368.1	1.2	0.3
29/06/2018	54	B14	173	3	309.2	322.8	3.0	0.9
29/06/2018	54	B14	70	7	296.1	311.0	0.7	0.2
29/06/2018	54	B14	10	15	324.1	350.1	0.2	0.1
30/06/2018	58	B13	182	3	292.8	308.8	0.6	0.2
30/06/2018	58	B13	102	5	289.7	303.9	0.8	0.3
02/07/2018	59	B35	350	1	297.9	313.4	0.5	0.2
02/07/2018	59	B35	35	9	314.1	332.5	0.8	0.2

Calibration of the Seabird oxygen probe is shown in Figure 1 below.

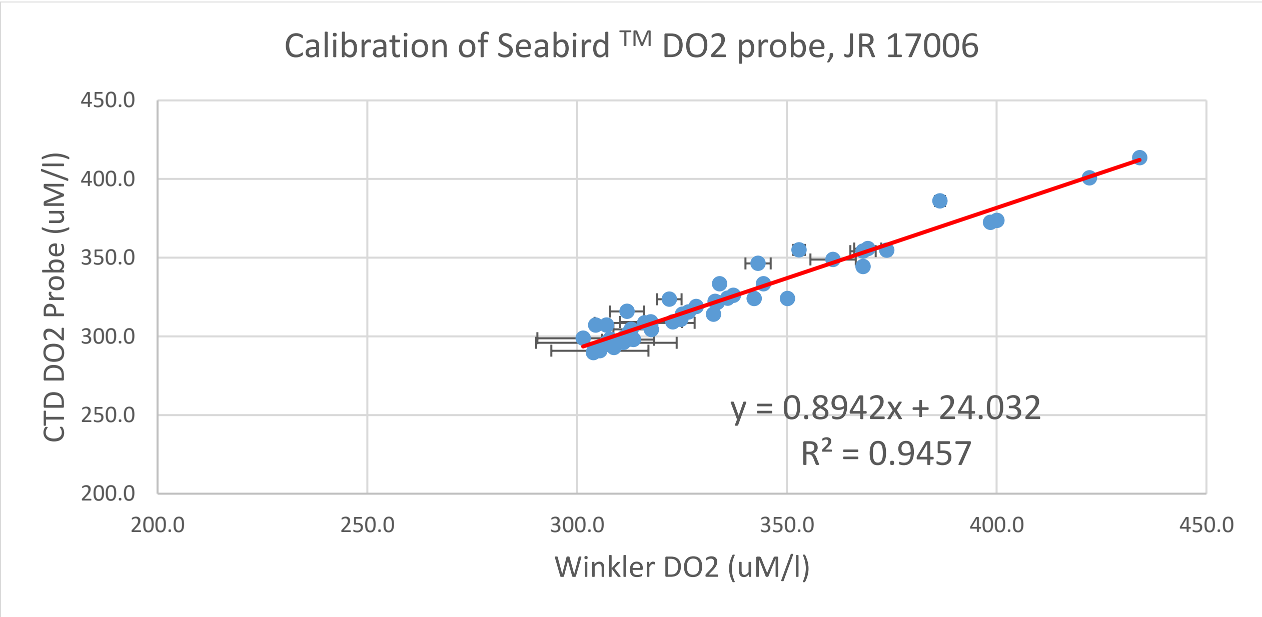


Figure 4.1: Calibration of Seabird oxygen probe

Calibration results: Gradient 0.8942, intercept 24.032, Cor. Coef. 0.9457

5 Water column chemistry

Sian Henley (University of Edinburgh), Judith Braun & Tim Brand (SAMS)

5.1 Objectives

Water column nutrient chemistry is central to the objectives of work package 2 of the Arctic PRIZE project and one of the Arctic PRIZE PhD studentships. Cruise JR17006 is the third core cruise of the Arctic PRIZE field program conducted in 2018. Measurements of organic and inorganic nutrient concentrations, fluxes, isotopic signatures and uptake by microorganisms during summer will complement a similar suite of measurements made during winter and spring cruises onboard the Norwegian research vessel R/V Helmer Hanssen. Together, these three cruises will provide seasonally-resolved insight into the nutrient biogeochemical processes regulating primary productivity in the marginal ice zone of the Barents Sea and the mechanisms by which nutrient supply, uptake and cycling are controlled by sea ice dynamics over the full seasonal transition from ice-covered in winter to ice-free during the late summer. The specific objective of cruise JR17006 was to examine these nutrient biogeochemical processes and their physical and biological controls and consequences during Arctic summer.

5.2 Sample collection

Water samples were taken from 20 L niskin bottles mounted on the ship's CTD rosette over the full water column depth during CTD casts. Samples were analysed onboard for the concentration of nitrate+nitrite, nitrite, phosphate, silicate and ammonium using a Lachat Quikchem 8500 flow injection analyser standardised using international certified reference materials for nutrients in seawater (see Section 5.4 for further details).

Samples for analysis of the stable nitrogen and oxygen isotope composition of dissolved nitrate ($\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$) were filtered within four hours of collection using sterile acrodisc supor 0.2 µm pore size filters with a membrane prefilter and acid-clean plastic syringes. All sample storage bottles were acid-clean HDPE. Samples were snap-frozen at -80 °C for ~12 hours and stored at -20 °C for transport to the home laboratory.

Samples for analysis of the concentration of dissolved organic carbon (DOC) and nitrogen (DON) were filtered within four hours of collection using precombusted (450°C for 6 hours) 25 mm GF/F filters (nominal pore size 0.7 µm) and an acid-washed glass syringe. Samples were spiked with 50 µL 85 % orthophosphoric acid and stored in acid-cleaned and muffle-furnaced (450°C for 6 hours) glass vials at +4 °C for transport to the home laboratory.

Samples for analysis of urea and dissolved free amino acid (DFAA) concentrations were filtered within four hours of collection using sterile polyethersulfone 0.2 µm pore size filters and acid-clean plastic syringes. Urea and DFAA samples were stored at -20 °C for transport to the home laboratory.

Samples for analysis of the stable oxygen isotope composition of seawater ($\delta^{18}O_{sw}$) were taken directly from the niskin bottles into HDPE bottles and stored at room temperature in the dark until analysis.

Inorganic nutrient and $\delta^{18}O_{sw}$ samples were taken over the full water column depth at the majority of stations and $\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$ samples were taken over the full water column depth at stations JR80, JR83, JR85, JR93, JR96, B16, HH51, B34, B14, B13, B35, B7 and B3. DOC, DON, urea and DFAA samples were taken over the full water column depth at stations JR80, Mooring East, JR85, JR96, B16, HH51, B34, B14, B13, B35, B7 and B3. Additional DOC and DON samples were taken over the full water column depth at stations JR81, JR83, JR86, JR Ripfjorden, JR92, JR93, JR94 and HH49.

Nitrogen uptake experiments using ^{15}N-labelled potassium nitrate, ammonium chloride, urea and DFAA were conducted at stations JR80, JR85, JR96, B16, HH51, B34, B14, B13, B35, B7 and B3 to quantify new and regenerated production, and the uptake of organic and inorganic nitrogen sources. Samples from two to three depths (surface, chlorophyll maximum and bottom of the euphotic layer) were spiked immediately after collection and incubated for 6 hours in on-deck incubators modified to ambient light levels using neutral density filters. Incubations were terminated after 6 hours by filtration onto precombusted 25 mm GF/F filters, which were stored at -20 °C until analysis. Unspiked samples from each depth were also filtered onto precombusted GF/F filters and stored at -20 °C to obtain the initial concentration and $\delta^{15}N$ of particulate organic material (POM).

5.3 Sample analysis

$\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$ samples will be analysed at the University of Edinburgh using the denitrifier method and gas chromatography isotope ratio mass spectrometry (Henley et al., 2018; Sigman et al., 2001; Casciotti et al., 2002). DOC and DON samples will be analysed at (SAMS) using high-temperature combustion and elemental analysis (Grasshoff et al., 1999). Urea samples will be analysed at SAMS using spectrophotometry (Revilla et al., 2005). DFAA concentrations will be determined at SAMS by fluorescence using the fluorogenic compound o-phthaldialdehyde (OPA) (Parsons et al., 1984, Aminot and Kérouel, 2006). Natural and labelled POM samples from nitrogen uptake experiments will be analysed for the concentration and $\delta^{15}N$ of particulate organic nitrogen at SAMS using isotope ratio mass spectrometry coupled to an elemental analyser (Lipschultz, 2008). $\delta^{18}O_{sw}$ samples will be analysed at the British Geological Survey, Keyworth, using the equilibrium method for oxygen and isotope ratio mass spectrometry (Ostlund and Hut, 1984; Meredith et al., 2017).

5.4 Macronutrients

Tim Brand (SAMS)

The principle water column dissolved nutrients, ammonium, phosphate, silicate (reactive silica), total oxidised nitrogen (TON) and nitrite were measured in 455 samples collected from 50 CTD casts.

5.4.1 Methodology

Samples were collected in 50ml acid cleaned polythene vials from the CTD rosette spigots using a short section of silicon tubing (10cm) with a 200 µm nylon filter end to remove large phytoplankton and zooplankton. Samples were always analysed within 12 hours of collection and stored in a refrigerator if they were not being analysed upon collection. All samples were allowed to equilibrate to room temperature for an hour before analysis.

Measurement was conducted using a Lachat QuikChem 8500 flow injection autoanalyser (Hach Lange) using the manufacturers recommended methods: Ammonium, 31-107-06-1-B; Orthophosphate, 31-115-01-1-G; Silicate, 31-114-27-1-A and Nitrate/Nitrite, 31-107-04-1-A.

Individual stock standard solutions of nitrate, nitrite, ammonium, phosphate and silicate were prepared at the SAMS in deionised water immediately prior to the cruise from oven dried (60C) salts. A primary mixed working standard solution was prepared each day from the stock solutions using the ship's DI water and the 5 calibration standard solutions were prepared in Grade A glass volumetric flasks using OSIL Low Nutrient Sea Water as a dilution matrix, (OSIL, http://www.osil.co.uk, Batch LNS 26, Salinity 35 psu).

All samples were measured in triplicate. The first analysis measured ammonium, phosphate, silicate and total oxidised nitrogen (NO_3+NO_2) and then nitrite was measured in a separate run. An OSIL LNSW seawater blank and five calibration standards were prepared daily to encompass the sample concentration range, with the top standard targeted to be 20-30% greater than the highest concentration sample. Calibration was followed by a KANSO seawater reference material run in triplicate (Batch CD, Pacific water) and then a drift standard using calibration standard No.5 (80% of standard range) measured after 7 samples (later changed to 10 samples) throughout the sequence of samples. A final drift standard run in either duplicate or triplicate was run at the end of the sample sequence. Analytical drift of the calibration was typically <5% and was accounted for in the data processing in MS Excel. Recovery of the KANSO standard showed good precision for the 3 accredited nutrients: PO_4 (Figure 5.1), SiO_2 (Figure 5.2) & NO_3 (Figure 5.3) summarised in Table 5.1 Recovery of nitrate was generally 0.4µM higher than the 'True' and will be adjusted in data processing. Periodically a second standard reference material was made up using OSIL nutrient standards and using concentrations different to the KANSO standard but within the normal calibration range.

Table 5.1: Nutrient analysis performance

	Ammonium	Phosphate	Silicate	Nitrate
Precision (%)	16.9	6.0	4.4	2.0
Accuracy (%)	No KANSO data	95.9	99.1	93.3

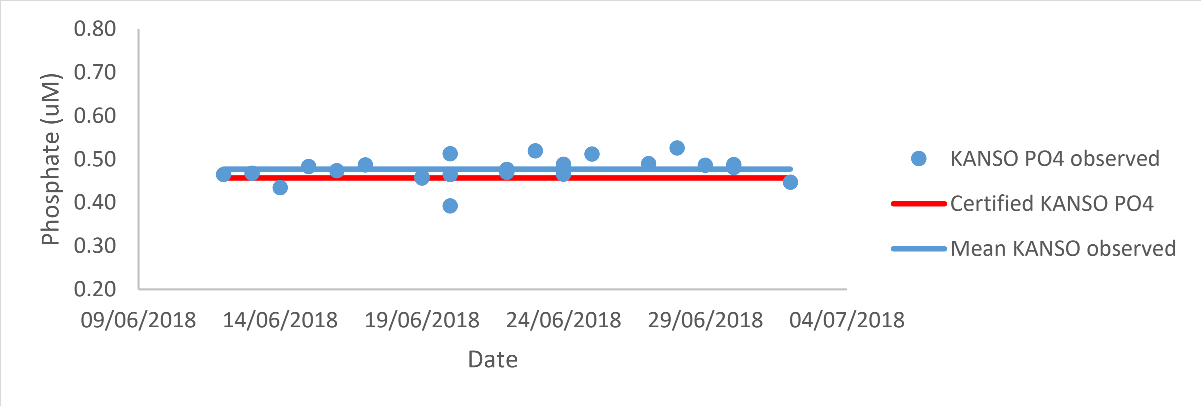


Figure 5.1: Analysis of KANSO Pacific water (Batch CD) Standard Reference material, phosphate results

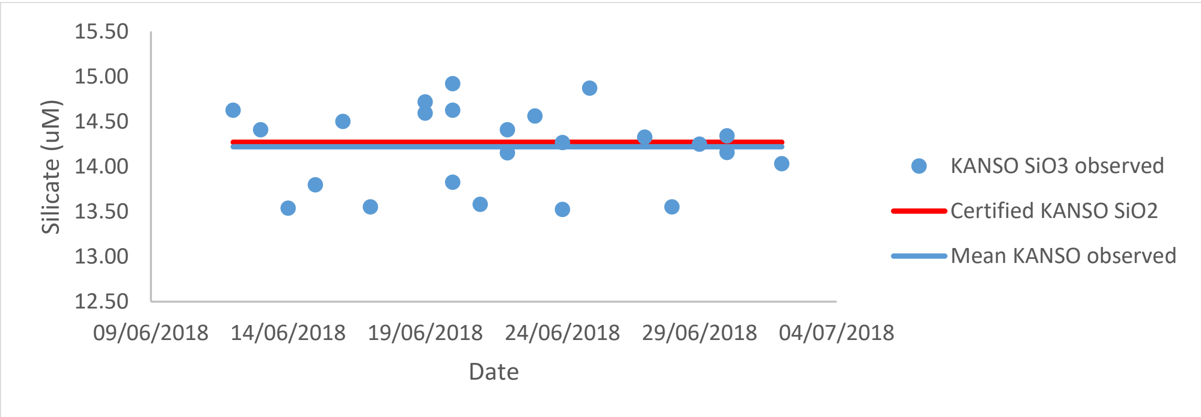


Figure 5.2: Analysis of KANSO Pacific water (Batch CD) Standard Reference material, silicate results.

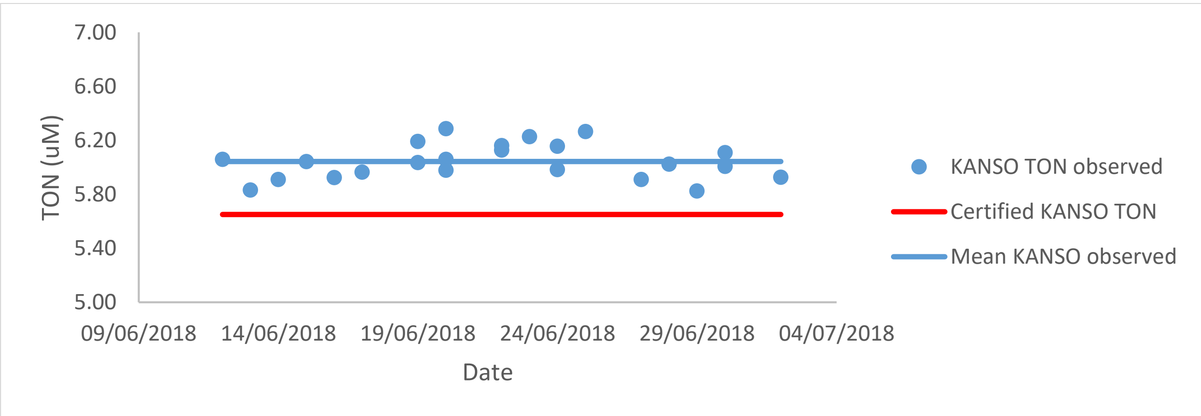


Figure 5.3: Analysis of KANSO Pacific water (Batch CD) Standard Reference material, nitrate results.

6 Primary Production

Callum Whyte & Sharon McNeill (SAMS)

Use of 14C for the Measurement of Marine Primary Production
This report summarises the experiments conducted on board the RRS James Clark Ross from June 11th to July 5th 2018 as part of the Arctic PRIZE project. It also includes a summary of the safety monitoring and procedures used. Results of wipe tests conducted at the end of the cruise are also included.

6.1 Primary Production Incubations

Primary Production Incubations of natural phytoplankton assemblages over a range of light intensities

6.1.1 Aims and Objectives

Aims: To estimate marine primary production rates within the Barents Sea at15 stations, which covered the north of Svalbard and the 30º Longitude line and crossed over into polar waters. Primary production estimations were made using 24 hour incubations with ^{14}C. Samples were also taken to link the micro-plankton community and chemical composition of the water associated with the primary production incubations.
Objectives:

- To estimate spring primary production rates along a latitudinal transect through the Barents Sea up into the marginal ice zone, under simulated light conditions.
- To assess the surface phytoplankton community structure and estimate biomass associated with the primary production sampling along the transect via microscopy.
- To assess various chemical components associated with the primary production sampling along the transect, including fluorescence, POC, DOC, & DOP.
- To estimate concentrations of bacterioplankton and smallest protists in the surface water & throughout the primary production incubation experiments using flow-cytometry.

6.1.2 Methods

6.1.2.1 Sampling

Seawater was collected from five depths within the euphotic zone, including the sea surface and the fluorescence maximum from a standard environmental CTD cast as close to midday as possible. The water was pre-screened with a 200µm mesh and was collected in five 10 litre carboys. These were blacked out using black polythene bags and wrapped in tape. Water was collected through tubing that was blacked out using black tape. Both carboys and tubing were thoroughly rinsed with seawater from the sample depth before the water was collected. Samples were transferred to the CT room, which was set at 4ºC.

For primary production, a total of 0.5 litres was collected into five 0.5 L acid washed plastic bottles which were blacked out using black polythene bags and tape to minimise the impact of daylight on the samples. Filtering of the later samples for chemical and microplankton analysis was delayed until the primary production incubations had begun.

6.1.2.2 Incubations

Water from the surface depth was dispensed into two sets of 4 x 60ml acid washed polycarbonate bottles, triplicated in light conditions with one fully blacked out polycarbonate bottle. These eight bottles were then incubated under five different light conditions i.e.1%, 15%, 25%,50% and 100% PAR, making a total of 40 bottles in total for each station. Dispensing was carried out as quickly as possible in the Radiation laboratory in dim light conditions with full bottles being returned to the cool box and dark swiftly. Each bottle was spiked with 10 µCi (370 kBq) of $NaH^{14}CO^{3}$. Bottles were placed into the incubation tanks under their corresponding light conditions. The samples were incubated for 24 hours.

6.1.2.3 Filtrations

Following incubation each set of samples were removed, light samples were filtered first, then dark samples. Samples were placed in their sets of 4 into a cool box and kept there until filtering was complete. They were filtered sequentially, one set through 47 mm 0.2 µm polycarbonate membrane filters the other set through 47mm 5 µm polycarbonate membrane filters, under a low vacuum. The filters were removed and placed into pony vials. These were placed into an acidifier, under a fume hood, for a minimum of one hour, removed then placed into a covered desiccator for 24 hours. On removal from the desiccator, the samples were filled with 4 ml of Optiphase Hisafe III cocktail, capped and stored in the dark at room temperature until they could be analysed on a scintillation counter. Problems were encountered with the counter on board the JCR, it jammed frequently, so while analysis of wipe tests were able to be carried out on board, the bulk of the samples will be returned to SAMS for further analysis.

For each set of experimental samples there were 3 standards taken of 100 µl from the spiked 60 ml bottles and placed into pony vials – 3 at random from the light samples and three from the dark samples – Carbosorb was added followed by Optiphase Hisafe III cocktail. These samples were stored at room temperature in the dark and will be returned to SAMS for further analysis.

6.1.2.4 Other samples

To complement the primary production incubations, samples were taken at the same depth as the primary production for the following:

1. Chlorophyll.a/fluorescence – between 0.5 and1L filtered through a 25mm GFF filter & frozen. Duplicated.
2. POCN – between 0.5 and 1L filtered through an ashed 25mm GFF filter & frozen. Duplicated.
3. DOP – 50ml sample filtered through an ashed 25mm GFF filter into acid washed falcon tubes & frozen. Duplicated.
4. DOCN -20ml sample filtered through an ashed 25mm GFF filter, fixed with 50µl 85% orthophosphoric acid & stored at 5^{o}C. Duplicated.
5. Flow cytometry – 4ml fixed with 180µl of Glutaraldehyde & stored at -80^{o}C. Duplicated.
6. Phytoplankton taxonomy – 250ml fixed with Lugol’s iodine and stored at 5^{o}C.

7. Coccolithophore samples – 400ml fixed with 37% Formaldehyde and stored at 5°C.

To complement the primary production incubations there were flow cytometry samples taken for each experiment in duplicate, at each time point and for each light condition to track any changes in bacteria and picoplankton. Samples fixed and stored as above. These samples will undergo analysis back at in the UK (SAMS).

Table 6.1: Summary of stations sampled for primary productivity work.

Event No.	Date	Start Time (UTC)	Station	Latitude	Longitude	Depth(m)	Cast no.
005	12/06/18	09:59	JR77	78 00.778 N	09 28.426 E	453	CTD 002
025	14/06/18	08:28	M. West	81 02.031 N	18 24.811 E	266	CTD 010
047	15/06/18	11:59	JR80	81 54.887 N	18 29.730 E	3395	CTD 012
069	17/06/18	10:40	M. East	81 18.168 N	31 20.628 E	208	CTD 022
085	18/06/18	09:53	JR85	82 35.581 N	30 06.650 E	3714	CTD 023
115	20/06/18	11:47	JR89	81 27.505 N	31 04.487 E	546	CTD 028
124	22/06/18	06:46	JR96	81 15.798 N	18 27.063 E	560	CTD 031
143	24/06/18	11:18	B16	80 06.017 N	29 59.877 E	294	CTD 042
146	25/06/18	10:48	H51	78 10.013 N	30 00.093 E	339	CTD 045
186	27/06/18	10:46	B34	77 33.858 N	29 59.452 E	238	CTD 046
205	28/06/18	07:11	HH49	76 59.999 N	29 59.982 E	268	CTD 050
221	29/06/18	08:06	B14	76 30.00 N	29 59.996 E	323	CTD 054
235	30/06/18	10:44	B13	74 29.999 N	29 59.995 E	393	CTD 058
270	02/07/18	08:39	B35	75 29.997 N	29 59.987 E	364	CTD 059
281	03/07/18	14:35	B7	75 59.99 N0	16 49.926 E	321	CTD 061

6.2 Safety Procedures and Monitoring

A comprehensive Risk Assessment and Safe System of Work was drafted with the SAMS Radiation Safety Officer Sharon McNeill prior to conducting the PRIZE field experiments described above. Spiking of samples were done exclusively in the fume cupboard in the isotope container to minimize the risk of contamination. Work areas were routinely monitored at the start and end of each experiment using a portable Geiger counter (RMT/Mini 900 monitor). Hands, lab coat and bottom of shoes were also checked for contamination using the portable counter. Wipe tests were conducted throughout the cruise including the last day of the cruise after all experiments were completed (July, 2018). Cotton swabs were wetted with Milli-Q and an area of approximately 100 cm^2 was wiped.

Unfortunately as the scintillation counter on board was malfunctioning at the end of the cruise these tests will be run back at SAMS. However, the wipe tests run periodically throughout the cruise showed no contamination. Additionally the containers, fume hood, sink and floor were tested by a RMT/Mini 900 monitor Geiger counter on the final day of the cruise after the container was stripped down and no contamination was found.

6.3 Storage of Radioactive Samples and Liquid Filtrate

Filtrate from the primary production experiments conducted by Whyte and McNeill were contained within two waste drums. Dry waste was stored in a separate drum. Each drum was labelled with estimates of activity and volume from the two users. The drums were well secured under the benches and fumehood area of the isotope container onboard the ship and bungee cord was used to prevent the containers from moving in rough weather.

Standard samples contained within 6 ml pony vials for scintillation counting were stored in a small plastic container lined with absorbent blue roll to and then wrapped with two plastic bin bags sealed with tape. The box was labelled and secured in the fume hood with the sash down.

All radioactive containers were clearly labelled and safety documentation was fixed to the laboratory door with contact information.

7 Phytoplankton and Microbial Community

7.1 Optics and Pigments

Andrew Orkney (DPhil student), Department of Earth Sciences, University of Oxford

7.1.1 Background and objectives

The assessment of ocean colour, facilitated by remote sensing, makes it possible to perceive the chlorophyll-a content of case-1 (open-ocean; free of terrigenous input) surface waters and hence to contrive synoptic estimates of primary production. The retrieval of chlorophyll estimates in the high boreal latitudes, such as the Barents Sea, is however complicated by lurking variables that are not directly perceived as part of general assessments of ocean colour, leading to uncertainty and bias in chlorophyll-a estimates. Taxonomy is an example of an important lurking variable, because different phytoplankton taxa have different cell sizes, intracellular pigment concentrations and accessory pigments. Differences in the way taxa package pigment inside their cells exert a strong influence on the apparent colour of the sea water they inhabit, by way of the 'packaging effect'. This means that- even if two phytoplankton blooms of different taxonomic composition possess exactly the same chlorophyll-a concentration- that taxonomically naïve ocean colour algorithms may report different chlorophyll-a concentrations.

I aim to help redress this problem by investigating means to identify different taxonomic groups by their optical properties, so that future ocean colour algorithms might be able to attain more accurate retrievals of chlorophyll-a content in boreal waters.

This cruise is the last of 4 collections over the 2017-2018 period, which were spaced in order to resolve seasonal variations in the phytoplankton community in the Barents Sea, although it has also become clear that there is a significant component of inter-annual variation in this window. I previously took samples in July-August of 2017, January and April of 2018. This final collection represents the early-summer period.

7.1.2 Samples

I need to know about the optical properties, pigment compliment and taxonomic composition of representative wild populations of phytoplankton from the Barents sea in order to achieve my research aims.

Ancillary information such as the nutrient content of the seawater, physical state of the sea, and physiology of different phytoplankton populations will also be important for providing context to my work and contriving primary production estimates from chlorophyll-content measurements.

7.1.2.1 -Absorption spectra (optical properties)

I ascertained the optical properties of wild phytoplankton samples by filtering sea water that I took from Niskin bottles on the ship's CTD (Conductivity-Temperature-Depth) rosette. The rosette allowed me to sample the water column at a variety of depths and the sampled seawater was stored in 5 litre dark Nalgene carboys, which were themselves hosted in a temperature controlled room (~5˚C) to prevent the onset of thermal degradation of the

samples.
I generally collected samples near to local noon so that complimentary photo-physiology samples, which must be collected near noon, would be concomitant with my samples.
I filtered between 250 and 500 millilitres of sea water onto a 25 mm GF-F filter, and froze it instantaneously in liquid nitrogen, before transferring it to the ship's -80C storage.
This process preserves the cell structure and pigment compliments for the return journey to the UK. The absorption spectra of the filters will then be measured at the University of Oxford with a Shimadzu brand photospectrometer.

7.1.2.2 -Pigment compliment
I discerned the chlorophyll-a content of the sampled populations aboard the ship, by filtering 200ml of the sampled water onto a GF-F filter which I then immersed in 10 millilitres of 90% acetone solution and stored in dark, cold conditions (-20˚C) overnight. The acetone digested the cells, allowing their chlorophyll-a to be released into solution.
On the following morning I used a Turner designs Trilogy fluorometer, calibrated at the University of Oxford by Doctor Heather Bouman, to measure the fluorescence of the samples before and after acidification by a trace of 10% HCl solution, which enabled phaeophytins to be distinguished from chlorophyll-a.

The numerous other pigments that comprise a phytoplankton sample's pigment compliment are to be investigated by High Performance Liquid Chromatography (HPLC). I do not possess the appropriate equipment to perform this kind of laboratory work at sea, so I collected samples of cells by filtering 500-1000 millilitres of sea water onto GF-F filters and instantaneously freezing in liquid nitrogen, before subsequently transferring them to long-term -80C storage.

7.1.2.3 -Taxonomy:
Basic taxonomic descriptions were possible for some samples of seawater aboard this ship. I used a basic optical microscope to describe the dominant microplankton community (e.g. 'diatom', 'dinoflagellate').
More detailed descriptions will be made possible by Lugols solution collections that were taken by other scientists I am working in concert with. These samples will be stored in cool conditions (5˚C), before being shipped to SAMS, where I will describe their taxonomic content at the species level with the aid of optical microscopy.

Flow-cytometry will be used to describe the small-celled phytoplankton community.

7.1.3 Additional samples:
I collected samples of the phytoplankton community that I preserved with glutaraldehyde on behalf of Doctor Heather Bouman and Glaucia Fragoso.
I used acid-washed and milli-Q rinsed 50ml falcon tubes to collect these samples. I rinsed the falcon tubes with sample sea water three times before collecting 45ml of sample. I then added 450 microliters of glutaraldehyde solution, wrapped the falcon tubes in parafilm (to prevent leakage) and covered them in foil to prevent photodegradation. I transferred the foiled falcon tubes to a refrigerator (5˚C) for 30 minutes to allow fixation to occur, before subsequent storage of the tubes in cold storage (-80˚C) to preclude thermal degradation.

Table 7.1: List of samples taken:

Station	lat	lon	Depth (m)	chl (mg/m^3)	Gluteraldehyde	Optical_Microscopy	Optics (L)	HPLC (L)
JR77	78.01317	9.47313	5	2.50	x		0.5	0.71
JR77	78.01317	9.47313	15	2.68	x		0.5	0.5
JR77	78.01317	9.47313	40	2.99			0.5	0.7
JR77	78.01317	9.47313	60	3.42			0.471	0.5
JR78c	80.06438	10.79241	5	1.94		phaeocystis	0.25	0.5
JR78c	80.06438	10.79241	40	3.33		phaeocystis	0.25	0.5
JR78c	80.06438	10.79241	105	3.14		phaeocystis	0.25	0.5
Mwest	81.03374	18.38546	5	3.18	x	ambiguous	0.25	0.5
Mwest	81.03374	18.38546	25	2.10	x	ambiguous	0.25	0.5
Mwest	81.03374	18.38546	65	2.21		ambiguous	0.25	0.5
JR80	81.91604	18.46036	5	2.22	x	diatoms and phaeocystis	0.25	0.5
JR80	81.91604	18.46036	27	4.09	x	diatoms and phaeocystis	0.25	0.5
JR80	81.91604	18.46036	50	0.42		diatoms and phaeocystis	0.5	1
Meast	81.30537	31.3339	5	2.59	x	diatoms	0.25	0.5
Meast	81.30537	31.3339	18	2.91	x	diatoms	0.25	0.5
Meast	81.30537	31.3339	35	1.65		Diatoms	0.5	1
JR85	82.59166	30.14443	2	5.67	x	diatoms	0.25	0.5
JR85	82.59166	30.14443	10	5.85	x	diatoms	0.25	0.5
JR85	82.59166	30.14443	20	5.01		diatoms	0.5	1
JR89	81.45836	31.07706	2	1.65			0.5	1
JR89	81.45836	31.07706	22	2.27			0.5	1
JR89	81.45836	31.07706	75	0.94			0.5	1
Rijp	80.29297	22.32005	0.9	0.42			0.5	1
Rijp	80.29297	22.32005	20	0.89			0.5	1
JR96	81.26324	18.45155	2	2.45		Unspecified colonies (likely dinobryon) and phaeocystis	0.25	0.5
JR96	81.26324	18.45155	12	2.67		Unspecified colonies (likely dinobryon) and phaeocystis	0.25	0.5
JR96	81.26324	18.45155	40	3.16		Unspecified colonies (likely dinobryon) and phaeocystis	0.25	0.5
JR96	81.26324	18.45155	60	2.07		Unspecified colonies (likely dinobryon) and phaeocystis	0.5	0.475
Meast2	81.30279	31.31536	2	0.96			0.5	1
Meast2	81.30279	31.31536	50	4.58			0.25	0.75
B27	80.99211	29.30787	2	1.12		Unspecified colonies (likely dinobryon) and phaeocystis	0.5	1

B27	80.99211	29.30787	36	4.05		Unspecified colonies (likely dinobryon) and phaeocystis	0.25	0.5
JR93	80.85011	29.29974	1.5	0.86		colonies (unspecified)	0.5	0.75
JR93	80.85011	29.29974	48	2.24		colonies (unspecified)	0.25	0.5
B16	80.10027	29.99826	2	9.29	x	diatoms	0.25	0.5
B16	80.10027	29.99826	10	11.01		diatoms	0.25	0.5
B16	80.10027	29.99826	25	11.26	x	diatoms	0.25	0.5
B16	80.10027	29.99826	56	2.60		diatoms	0.5	1
JR98	79.33328	29.99977	0.8	0.63			0.5	1
JR98	79.33328	29.99977	40	5.55			0.25	0.5
H51	78.1668	30.00139	2	1.07	x	colonies (unspecified)	0.5	1
H51	78.1668	30.00139	15	1.55		colonies (unspecified)	0.5	0.5
H51	78.1668	30.00139	30	3.00	x	colonies (unspecified)	0.5	0.5
H51	78.1668	30.00139	45	1.44		colonies (unspecified)	0.3	0.5
B34	77.54955	30.00149	2	1.07	x	senescent diatom chains, senescent phaeocystis colonies, likely dinobryon colonies	0.5	0.5
B34	77.54955	30.00149	20	1.13		senescent diatom chains, senescent phaeocystis colonies, likely dinobryon colonies	0.5	0.5
B34	77.54955	30.00149	35	4.22	x	senescent diatom chains, senescent phaeocystis colonies, likely dinobryon colonies	0.5	0.5
B34	77.54955	30.00149	50	2.43		senescent diatom chains, senescent phaeocystis colonies, likely dinobryon colonies	0.5	0.5
HH50	77.30027	29.99962	5	0.66			0.5	1
HH50	77.30027	29.99962	30	3.33			0.25	0.4
HH49	77.00004	30.00013	3	0.39			0.5	1
HH49	77.00004	30.00013	27	1.19			0.5	0.848
HH48	76.73265	29.99927	2	1.32			0.5	1
HH48	76.73265	29.99927	38	2.14			0.5	1
B14	76.50004	29.99991	2	1.80	x	dinoflagellates	0.5	1
B14	76.50004	29.99991	20	1.92	x	dinoflagellates	0.25	0.5
B14	76.50004	29.99991	45	1.49		dinoflagellates	0.5	1
B14	76.50004	29.99991	60	0.53		dinoflagellates	0.5	1
Glider	74.88428	30.03979	6	1.13		orange-red	0.5	1
Glider	74.88428	30.03979	21	1.18		orange-red	0.5	1
B13	74.50	30.00	2	1.12	x		0.5	1
B13	74.50	30.00	15	1.19			0.5	1
B13	74.50	30.00	29	1.26	x		0.5	1

B13	74.50	30.00	45	0.62			0.5	1
B35	75.49999	30.00	3	1.22			0.5	1
B35	75.49999	30.00	20	1.36			0.5	1
B35	75.49999	30.00	60	0.66			0.5	1
B12	75.5	26	1	0.4			0.5	1
B12	75.5	26	33	0.72			0.5	1
B7	76	16.87	5	0.81			0.5	1
B7	76	16.87	30	0.69			0.5	1
B7	76	16.87	45	0.45			0.5	1
B6	75.18	17.53	1	2.45			0.5	1
B6	75.18	17.53	15	4.05			0.25	0.5
B6	75.18	17.53	30	3.28			0.25	0.5
B5	74.37	18.17	1	0.36			1	1
B5	74.37	18.17	5	0.18			2	2
B3	72.63	19.25	1	0.11			1	1
B3	72.63	19.25	25	0.19			1	1
B3	72.63	19.25	40	0.25			1	1

7.1.4 Preliminary results:

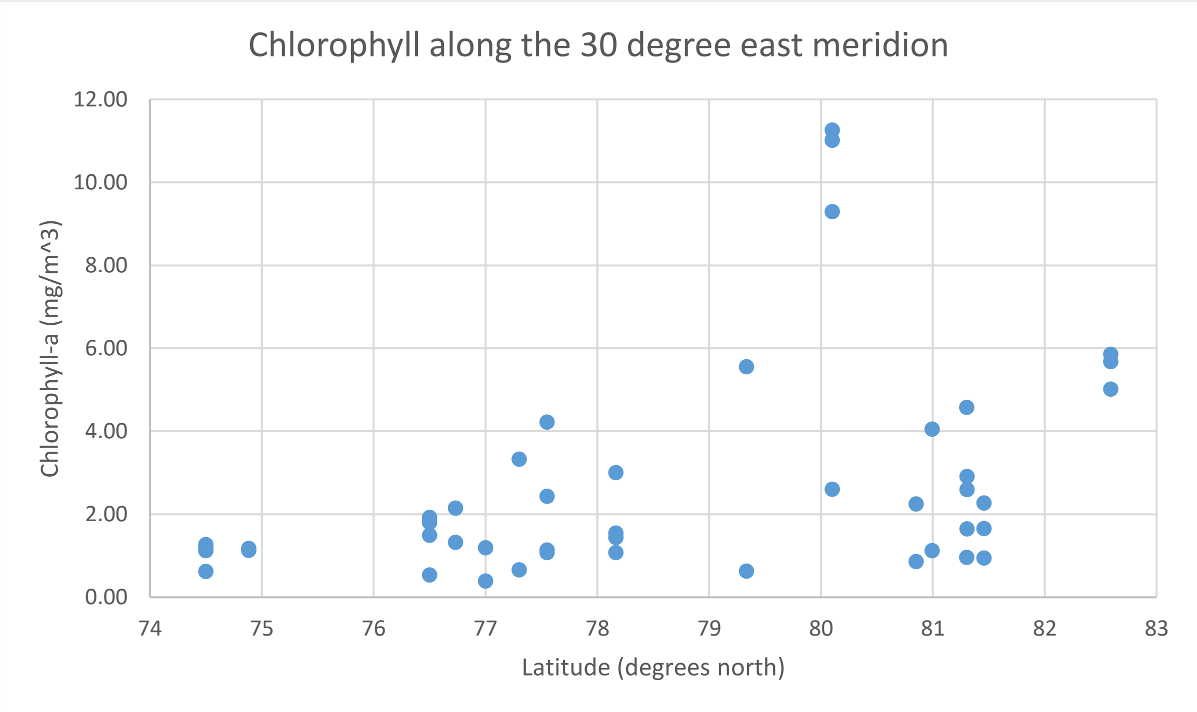


Figure 7.1: Chlorophyll-a concentration, as measured by Turner Fluorometry, as a function of latitude along the 30th meridion east.

Figure 7.1 shows that chlorophyll-a concentrations were low south of the polar front (~75˚N), not exceeding 2 milligrams per cubic metre. Values grew higher further north, reaching maximums of ~6 milligrams at ~79˚N and almost 12 milligrams at ~80˚N, between

Nordaustlandet and Kvitøya. This high-chlorophyll region, north of the polar front, had been ice-covered in spring and experienced some level of ice-cover in the weeks before sampling. Chlorophyll-a concentrations were slightly lower, though still approaching ~6 milligrams per cubic metre, in the very far north (approaching the ice edge north of 82˚N). The ice edge was exceptionally far north this summer, especially compared to the samples from the summer of 2018, when sea ice extended south to 78˚N.

The general latitudinal trend in chlorophyll suggests that stations peripheral to the ice edge, or in recently ice-covered regions, were experiencing pronounced phytoplankton blooms, while stations further south may have been waning or entering post-bloom conditions.
In general optical microscopy indicated that the northern most stations were dominated by chain-forming diatoms, while the southern most stations were replete with dinoflagellates. The stations of intermediary latitude were very gelatinous and difficult to filter, but they did not possess large amounts of chlorophyll; optical microscopy often indicated the presence of tattered-looking *Phaeocystis* colonies or likely *Dinobryon* structures.

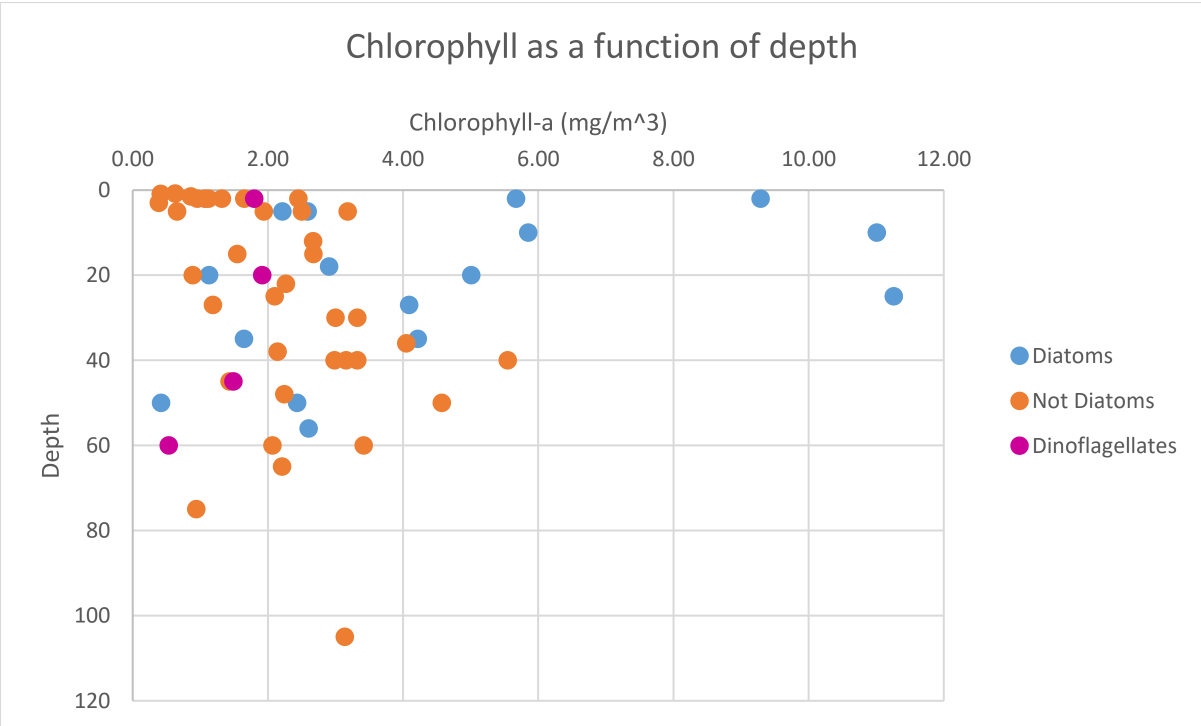


Figure 7.2: Vertical profiles of chlorophyll concentration, divided by broad taxonomic category: (Blue: Diatoms, Orange: few Diatoms, Pink: many Dinoflagellates)

Figure 7.2 is a loose rendition of the vertical profiles of chlorophyll-a concentration in the sea and is divided into broad taxonomic groupings. It shows that the highest chlorophyll content was exclusive to diatom dominated samples, which usually had Subsurface Chlorophyll Maxima (SCMs) at or just below the surface. By contrast those stations with few diatoms and more *Dinobryon* or *Phaeocystis* colonies usually had lower chlorophyll contents and deeper maxima, often fixed to the local halocline, thermocline or euphotic depth. These samples may represent post-bloom stations where the phytoplankton community has receded to greater depth to find a compromise between available light and nutrient, having depleted the most superficial levels of the ocean of their essential nutrients. The dinoflagellate dominated samples had shallow but low SCMs.

Phaeophytin measurements were produced in conjunction with the chlorophyll-a estimates. They broadly showed that the phaeophytin content of diatom-dominated samples was low, in comparison to other samples.

This lower ratio of decay products to photosynthetic pigment might be commensurate with the interpretation of the diatom-dominated stations as bloom-period stations and the remainder as post-bloom stations, which have presumably experienced greater production of decay products due to senescence of phytoplankton cells (Figure 7.3).

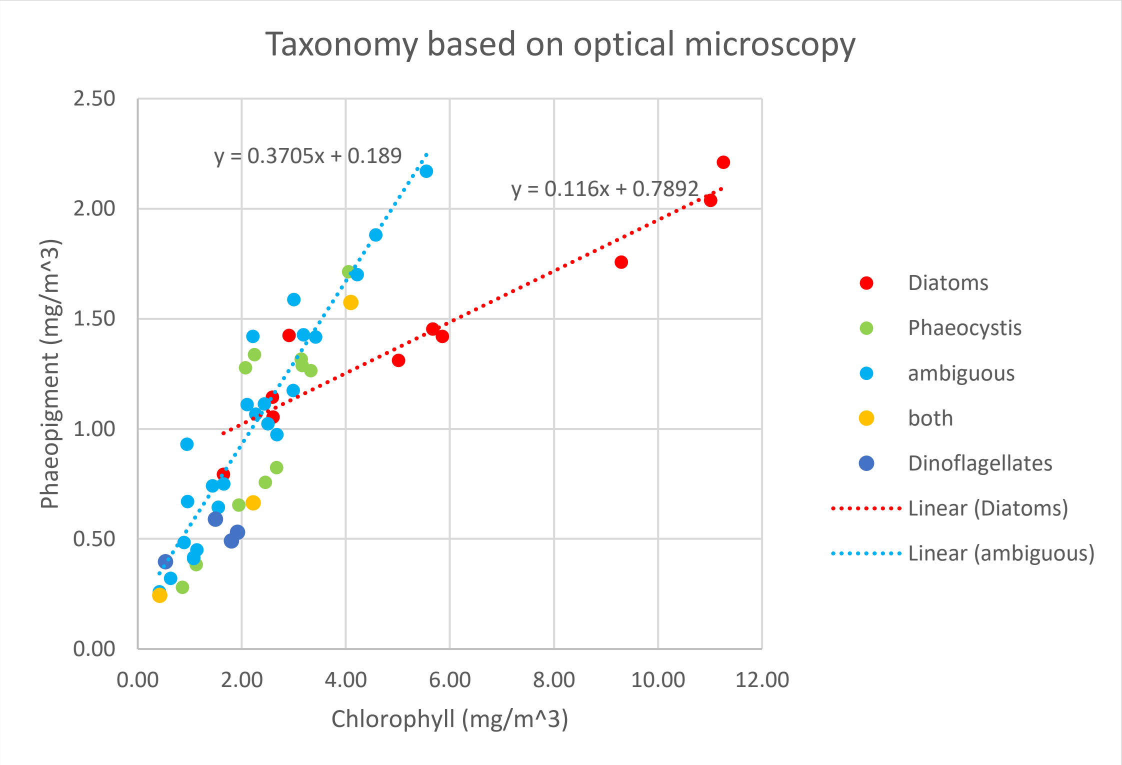


Figure 7.3: Plot of phaeophytin against chlorophyll, by broad taxonomic grouping. (Red: Diatoms, Green: Phaeocystis, Blue: ambiguous, Yellow: mix of diatoms and phaeocystis, Navy: Dinoflagellates.)

8 Zooplankton

CHASE project - Chronobiology in Arctic Sea Ecosystems
Kim Last (SAMS), David Wilcockson (Aberystwyth) and Lucas Hüppe (AWI and Oldenburg).

8.1 Swimming behavior

We conducted on-board activity experiments on the swimming behavior of copepods in relation to species and daylength (photoperiod). The experiments were designed to investigate the response of animals to photoperiod and to determine changes in respiration rate and gene expression. All measurements were made on individual copepods using Trikinetics Locomotor Activity Monitors (LAMS) and Drosophila Locomotor Monitors (DAMS). Activity measurements using the LAMS/DAMS yield activity as a proxy for swimming, quantified as the number of beam breaks across the experimental chamber per specified unit of time, usually 30 minutes. Activity screens were carried out with *Calanus finmarchicus, C. glacialis* and *C. hyperboreus* focusing on the dominant stages at this time of year. All experimental runs and their conditions are annotated in Table 8.1**.**

Table 8.1: Summary of swimming behaviour experiments

Station	Net	Depth (m)	Experiment	N	Species	Temp	Activity monitors	Start UTC + 2h	End UTC + 2h	Storage
JR77	MIK	Towed~150-0	LD 24:0	32	*C. hyp CV*	4	3	12/6/18 21:00	16/06/18 08:30	Photo only
JR77	MIK	Towed~150-0	LD 0:24	32	*C. hyp CV*	4	5	12/6/18 21:00	16/06/18 08:30	Photo only
JR77	MIK	Towed~150-0	LD 12:12 (on: 06:00, off: 18:00)	32	*C. hyp CV*	4	7	12/6/18 21:00	16/06/18 08:30	Photo only
West mooring	WP 2	200-0	LD 6:18 (on: 09:00, off: 15:00)	64	*C. gla CIV*	4	1, 2	15/6/18 13:00	19/6/18 14:00	Photo & frozen -20
West mooring	WP 2	200-0	LD 24:0	32	*C. gla CIV*	4	4	14/6/18 day	19/6/18 14:00	Photo & frozen -20
West mooring	WP 2	200-0	LD 0:24	32	*C. gla CIV*	4	6	14/6/18 day	19/6/18 14:00	Photo & frozen -20
West mooring	WP 2	200-0	LD 12:12 (on: 06:00, off: 18:00)	32	*C. gla CIV*	4	8	14/6/18 day	19/6/18 14:00	Photo & frozen -20

West mooring	WP 2	200-0	LD 18:6 (on: 03:00, off: 21:0)	64	*C. gla CIV*	4	9,10	14/6/18 day	19/6/18 14:00	Photo & frozen -20
JR85	WP 2	200-0	LD 6:18 (on: 09:00, off: 15:00)	32	*C. fin CV*	2	2	19/6/18 14:00	24/06/18 09:00	Photo & frozen -20
JR85	WP 2	200-0	LD 24:0	32	*C. fin CV*	2	3	19/6/18 14:00	24/06/18 09:00	Photo & frozen -20
JR85	WP 2	200-0	LD 0:24	32	*C. fin CV*	2	5	19/6/18 14:00	24/06/18 09:00	Photo & frozen -20
JR85	WP 2	200-0	LD 12:12 (on: 06:00, off: 18:00)	32	*C. fin CV*	2	7	19/6/18 14:00	24/06/18 09:00	Photo & frozen -20
JR85	WP 2	200-0	LD 18:6 (on: 03:00, off: 21:0)	32	*C. fin CV*	2	10	19/6/18 14:00	24/06/18 09:00	Photo & frozen -20
Rijp	WP 2	200-0	LD 24:00	32	*C.gla CIV*	2	4	21/06/18 20:26	(26/06/18) 15:00	Photo & frozen -20
Rijp	WP 2	200-0	LD 0:24	32	*C.gla CIV*	2	6	21/06/18 20:26	(26/06/18) 15:00	Photo & frozen -20
HH51	WP 2	200-0	LD 6:18 LD 24:0 LD 0:24 LD 12:12 LD 18:6	64 64 64 64 64	*C. gla CV*	2	1, 2 3, 4 5, 6 7, 8 9, 10	26/06/18 15:00	29/06/18 12:00	Photo & frozen -20
HH51	WP 2	200-0	LD 0:24	160	*C. gla CV*	2	DAMS 1 - 5	26/06/18 17:00	27/06/18 19:00	RNAlater & -80C
B14	WP 2	200-0	LD 6:18 LD 24:0 LD 0:24 LD 12:12 LD 18:6	32 32 32 32 32	*C. fin CV*	4	1 3 5 7 9	29/06/18 16:30	3/06/18 10:30	Photo & frozen -20
B13	WP 2	200-0	LD 6:18 LD 24:0 LD 0:24 LD 12:12 LD 18:6	32 32 32 32 32	*C.fin CV*	4	2 4 6 8 10	30/06/18 20:30	5/06/18 11:00	Photo & frozen -20
B13	WP 2	200-0	LD 0:24	160	*C. fin CV*	4	DAMS 1 - 5	01/07/18 ~13:30	02/07/18 12:00	RNAlater & -80C

Total animals screened behaviourally: 1472

8.2 Respiration

We conducted oxygen consumption experiments to provide a physiological correlate to rhythmic activity measurements made on copepods from the same field collections. Experimental runs occurred during daytime, nighttime, and in one case over a consecutive 48h period. All measurements were made on individual copepods using a 24-well Loligo microplate respirometry system. Experimental runs are annotated in Table 8.2. Temperature was 4.5 ºC and 2.0 ºC and salinity was 35 psu for all runs, barometric pressure at the start of each run is noted. After each run, species and stage of individual copepods was confirmed, each was photographed for later measurement of prosome length (to be converted to dry weight) and lipid sac volume (where applicable). Oxygen consumption data will be processed to calculate respiration rates and critical partial pressures (Pcrit). These values will be compared among stations, species, stage, sex, energetic status as measured by lipid reserves, and time of day to test whether respiration rates reflect periods of increased activity observed in the LAM experiments.

Table 8.2: Summary of respiration experiments

Run	**Species**	**Net and depth**	**Station (event No)**	**Run Start (UTC +2)**	**Run stop (UTC+2)**	**Well size (µl)**	**Pressure (hPa)**	**Temp**	**notes**
1	*C. hyp CV*	MIK 200-0	JR77	12/6/18 21:19	13/6/18 08:22	1700	1005	4	
2	*C. hyp CV*	MIK 200-0	JR77	13/6/18 21:17	14/6/18 08:15	1700	996	4	
3	*C. hyp CV*	MIK 200-0	JR77	14/6/18 13:11	14/6/18 23:12	1700	1001	4	
4	*C. gla CIV*	WP2 200-0	W. Mooring (020)	15/6/18 22:35	16/6/18 09:10	500	1012	4	
5	*C. gla CIV*	WP2 200-0	W. Mooring (020)	16/6/18 12:44	16/6/18 21:07	500	1005	4	
6	*C.fin/glaC V*	WP2 200-0	E. mooring	17/06/18 18:53	18/06/18 08:05	500	1012	2	
7	*C. fin CV*	WP2 200-0	JR85	18/06/18 15:08	19/06/18 02:04	500	1003	2	Temp fluc. 4-2C May discard
8	*C. fin CV*	WP2 200-0	JR85	19/06/18 11:28	19/06/18 19:21	500	1012	2	
9	*C. fin CV*	WP2 200-0	JR85 (107)	19/06/18 22:51	20/06/18 08:17	500	1007	2	
10	*C.fin CIV and C.gla CIV*	WP2 150-0	Rijp (120)	21/06/18 16:00	23/06/18 14:50	1700	1020	2	
11	*C.gla CV*	WP2 200-0	HH51	26/06/18 17:23	27/06/18 00:50	500	990	2	Freshly collected
12	*C.gla CV*	WP2 200-0	HH51	27/06/18 23:19	28/06/18 09:55	500	997	2	36 hours old
13	*C.gla CV*	WP2 200-0	HH51	28/06/18	28/06/18	500	1001	2	40 hours old

				13:45	17:25				
14	*C. gla AF*	WP2 200-0	HH51	28/06/18 19:42	29/06/18 ??	500	1001	2	48 hours old
15	*C. gla AF*	WP2 200-0	HH51	29/06/18 12:35	29/06/18 17:44	500	1002	2	72 hours old
16	*C. fin CV*	WP2 200-0	B14	29/06/18 22:16	30/06/18 09:03	500	1004	4	Freshly collected
17	*C. fin CV*	WP2 200-0	B14	30/06/18 13:03	30/06/18 22:44	500	1011	4	
18	*C. fin CV*	WP2 200-0	B13	30/06/18 23:56	01/07/18 14:12	500	1015	4	Freshly collected
19	*C. fin CIV*	WP2 200-0	B13	01/07/18 20:32	02/07/18 ??	500	1011	4	Freshly collected
20	*C. fin CIV*	WP2 200-0	B13	02/07/18 ??	02/07/18 ??	500	??	4	24 hours old

Total animals respiration: 400

8.3 Clock and seasonal gene expression

To determine clock gene expression *C. finmarchicus* / *C. glacialis* CV (dominant stage at this time of year) were collected at three stations over 24 hours along a latitudinal transect for subsequent transcription analysis (Table 8.3) Samples at these stations also provided animal to be used for lipid, enzyme and dry weight analysis with a further two stations sampled for seasonal transcriptome analysis. Krill (*T. inermis*) were also sampled for clock and seasonal transcriptome analysis at midday and midnight but abundance was generally very low and hence no 24 hour time-series were possible.

Table 8.3: Summary of samples collected for genetic analysis

Date	Time [UTC+2]	Station	Lat. [° N]	Long. [° E]	Gear	Depth sampled (m)	Species / Stage sampled	Sample type	Comments
14_15.06.18	05:30	Mooring West	81,03375	18,3852	WP2	200 – 0	*C. glacialis CIV*	Bulk sample for clock gene expression, enzymes, lipids, dry weight	24-hour sampling (4-hour interval / 7 time points)
18_19.06.18	08:15	JR85	82,59502	30,03248	WP2	200 – 0	*C. finmarchicus CV*	Bulk sample for clock gene expression, enzymes, lipids, dry weight	24-hour sampling (4-hour interval / 7 time points)
23.06.18	01:00	On Transit (Rijpfjorden – Mooring West)	81,1532	23,79384	MIK (trawled)	150 – 0	*T. inermis*	Seasonal transcriptome	
25_26.06.18	23:00 / 12:15	HH51	78,16673	29,72975	MIK (trawled) / WP2	200 – 0	*T. inermis* / *C. glacialis CV*	Seasonal transcriptome (Krill)/ DAMs for clock gene expression, enzymes, lipids, dry weight (Copepods)	Copepods sampled from behavioural experiment (DAM) for clock gene expression
26_27.06.18	23:00	B34	77,56739	30,01569	MIK (trawled)	250 – 0	*T. inermis*	Seasonal transcriptome, clock gene expression, enzymes, lipids, dry weight	24-hour sampling (4-hour interval / 7 time points)
29.06.18	13:30	B13	74,49988	30,00025	WP2	200 – 0	*C. finmarchicus CV*	Bulk sample for clock gene expression, DAMs for clock gene expression enzymes, lipids, dry weight	24-hour sampling (4-hour interval / 7 time points) and copepods sampled from behavioural experiment (DAM) for clock gene expression

9 Benthic Fauna

9.1 Faunal Communities (Narayanaswamy)

Bhavani Narayanaswamy, Ashlie McIvor, Colin Abernethy (SAMS); Joanna Beja (BODC); Raphaelle Descoteaux (UiT); Richard Phipps (NMF) plus the entire PRIZE Science team

9.1.1 Introduction

The Arctic is changing rapidly in response to warming global climate, with reduction in sea-ice coverage providing the most obvious indicator. However, the impact of this reduction in sea ice on water column and seafloor ecology is much less certain. Changing physical conditions potentially impacts on the timing, magnitude and distribution of both ice algae and pelagic primary production with as yet unresolved effects on trophic pathways which support both pelagic and benthic consumers.

As late spring approaches, ice-algae dissociates from underneath the ice and sinks rapidly to the seafloor providing a sudden and large input of food to the benthic community underneath. Phytoplankton production starts only once sea-ice has started to melt leading to a temporal discontinuity between sea-ice and open-water production.

Pelagic grazing pressure in the Arctic is relatively low, thus the benthic fauna tend to receive a greater fraction of available organic material and respond quickly to this input by utilising it for growth/reproduction before it is lost through burial within the sediment.

Much of the work looking at uptake of ice algae versus phytoplankton has been conducted on zooplankton, pelagic fauna and larger mammals, with relatively little research undertaken on benthic communities.

The hypothesis is that benthic communities will preferentially feed on ice algae as opposed to phytoplankton

The main objectives are to determine the composition &, species and functional diversity of the benthic communities, to investigate uptake of ice algae vs phytoplankton using the new H-print analysis and to determine the molecular (lipids) and isotopic (δ15N and δ13C) ratios of selected fauna representing the different size classes at pre-determined locations in order to identify trophic position, relationships and resource partitioning

9.1.2 Methodology

9.1.2.1 Boxcorer

Box core samples were taken to assess the benthic infaunal communities in and around the marginal ice zone. A total of seven stations were sampled (Table 9.1) with the aim of taking four replicates at every station. The exceptions were MWest and the deep water station (JR87) at ~1560 m where only two replicates were taken, and station B34 where the first deployment was a failure, the second deployment the spade had not closed and the final deployment the wire got wrapped around the corer itself.

Once the box had been removed from the corer, the overlying water was siphoned off over a 0.5 mm mesh sieve in order to retain fauna living on the surface-water interface. The sediment surface was then inspected to ensure that it was intact and that there was no slumping. If the sample was deemed good, then the processing of the sediment for biology could be undertaken. From each core a 0.1 m^2 area was subsampled in 5 cm slices down to a depth of 15 cm. Each fraction was sieved on a 0.5 mm mesh sieve and fixed in 4% Formalin solution. Further material was taken from each station for 15N and H-print analysis.

9.1.2.2 Agassiz Trawl

The Agassiz trawl was deployed at seven stations (Table 9.2). Each trawl was run for 3 minutes along the seafloor before being hauled in. Once on board deck the trawl was emptied into buckets and washed over 4 mm mesh sieves. One person would sort the fauna using nitrile gloves as the material is for H-print analysis. Once sorted, the larger fauna are wrapped in foil that had been pre-baked at 400 °C, or the smaller fauna would be placed in pre-cleaned glass vials and topped with pre-baked foil. The specimens were then frozen at -20°C.

9.1.3 Post-cruise Processing

All the biological samples will be processed post cruise.

9.1.3.1 Faunal composition analysis

Samples collected using the boxcore will be gently washed over a 0.5 mm mesh sieve to remove the formalin and any excess sediment. The resulting residue will be sorted using a microscope and the fauna identified to the lowest possible taxonomic level; species level or putative species before being preserved in ethanol.

9.1.3.2 H-Print Analysis

Samples collected for H-print analysis from both the boxcore and the Agassiz trawl will also be processed on return to SAMS.

Table 9.1: Boxcore deployment log

EVENT	ID	DATE/TIME	LAT	LON	Water depth (m)
34	MWest	14-Jun-18	81.0338	18.38249	289
77	MEast	17-Jun-18	81.30203	31.3439	190
78	MEast	17-Jun-18	81.30201	31.34389	191
79	MEast	17-Jun-18	81.30202	31.34381	189
80	MEast	17-Jun-18	81.30202	31.34395	189
81	MEast	17-Jun-18	81.30201	31.34391	189
82	MEast	17-Jun-18	81.30199	31.34386	189
111	JR87	20-Jun-18	81.58946	30.76675	1561
112	JR87	20-Jun-18	81.58943	30.76675	1571
160	H51	26-Jun-18	78.16666	30.00039	337
161	H51	26-Jun-18	78.1663	29.99914	340
169	H51	26-Jun-18	78.16816	30.00251	339
170	H51	26-Jun-18	78.16861	30.00209	338
171	H51	26-Jun-18	78.16995	30.00599	330
173	H51	26-Jun-18	78.17103	29.99991	332
188	B34	27-Jun-18	77.55138	29.99875	233
191	B34	27-Jun-18	77.52863	29.97625	234
192	B34	27-Jun-18	77.52861	29.97619	233
222	B14	29-Jun-18	76.50002	29.99975	290
223	B14	29-Jun-18	76.50001	29.99987	290
224	B14	29-Jun-18	76.50003	29.99988	293
228	B14	29-Jun-18	76.50003	29.9999	292
229	B14	29-Jun-18	76.50004	29.99994	293
256	B13	01-Jul-18	74.49989	30.00022	363
259	B13	01-Jul-18	74.49988	30.00066	356
260	B13	01-Jul-18	74.4999	30.00056	355
261	B13	01-Jul-18	74.49991	30.00062	354
271	B35	02-Jul-18	75.49999	29.99981	361
272	B35	02-Jul-18	75.5	29.99977	364
273	B35	02-Jul-18	75.49999	29.99981	365
277	B35	02-Jul-18	75.49995	29.99989	364
278	B35	02-Jul-18	75.50002	29.99981	364

Table 9.2: Agassiz Trawl deployment log

EVENT	ID	TYPE	DATE/TIME	LAT	LON	DATE/TIME	LAT	LON	DATE/TIME	LAT	LON	WDEPTH
			START			**BOTTOM**			**END**			
63		AGT001	17/06/2018	81.27332	31.31495	17/06/2018	81.26869	31.3191	17/06/2018	81.26696	31.32102	210
157	H51	AGT002	26/06/2018	78.16626	29.79687	26/06/2018	78.16233	29.76628	26/06/2018	78.15887	29.7397	336
179	B34	AGT003	27/06/2018	77.55813	30.00997	27/06/2018	77.54633	29.99535	27/06/2018	77.54056	29.98801	210
206	HH49	AGT004	28/06/2018	76.99754	29.98	28/06/2018	76.99778	29.97352	28/06/2018	76.99832	29.96059	236
215	B14	AGT005	28/06/2018	76.49784	30.0189	28/06/2018	76.50272	29.98757	28/06/2018	76.50377	29.98069	290
242	B13	AGT006	30/06/2018	74.49777	30.00579	30/06/2018	74.5002	29.99942	30/06/2018	74.50797	29.98293	358
269	B35	AGT007	02/07/2018	75.49843	30.00956	02/07/2018	75.49993	30.00308	02/07/2018	75.50189	29.98705	361

9.2 Go-Pro Agassiz

Colin Abernethy, Kim Last, Bhavani Narayanaswamy (SAMS)

9.2.1 Aim

The aim is to collect seabed video of benthos at Arctic Prize stations around Svalbard initially, travelling north then east and finishing the cruise collecting data along the 30˚E longitude line crossing over polar waters into open Arctic waters to the East of Svalbard. Data will be analysed post cruise at SAMS. This data will contribute towards WP5 of the project.

9.2.2 Equipment

A Go-Pro and dual light rig attachment system for the Agassiz trawl will be utilised to collect video at 1080x30 frames per second.

Figure 9.1: Agassiz trawl and camera system rigged prior to deployment from JCR.

9.2.3 Proposed Agassiz Survey Plan

The Agassiz will be deployed with camera and lights mounted to an attachment point on the front of the trawl, Figure 9.1. The trawl will run with the net open for a bottom time duration of 60 minutes.

9.2.4 Station and Cruise Event Summary

The summary of the deployments is provided in

Table 9.3: Summary table of Go-Pro Agassiz deployments

Station	Event #	Trawl Start, Lat/Lon	Trawl End Lat/Lon
JR77	006	78.02007 9.4671	78.04792 9.42546
M West	037	81.03461 18.41117	81.05611 18.28967
JR83	060	81.27677 29.14879	81.26249 29.23951
M East	062	81.29977 31.28234	81.27429 31.31426
M East	068	81.27793 31.35185	81.27461 31.37624
Ripfjorden	122	80.30429 22.2893	80.33983 22.19738
JR83	130	81.28002 29.11872	81.25775 29.22146
H51	152	78.16714 30.0204	78.16729 29.79733
H51	159	78.15914 30.05767	78.16051 29.82429
B34	175	77.52988 29.97808	77.50151 29.96217
B34	198	77.55158 29.98107	77.52538 29.88124
HH49	204	76.99944 30.08879	76.99981 29.89907
B14	211	76.50386 29.95745	76.51862 29.77707
B14	219	76.49546 30.04008	76.52352 29.90813
B14	230	76.50388 29.99183	76.53887 29.90489
B13	238	74.499 29.99976	74.52668 29.87412
B13	248	74.50569 29.99149	74.50919 29.89694
B13	265	74.50004 30.0206	74.49316 29.86234
B35	268	75.49944 29.99993	75.52223 29.84928
B35	279	75.50331 30.00192	75.5095 29.8657

9.2.5 Go-Pro Agassiz Trawl Deployment Diary

Event 006
JR77 12/06/2018 12:24
Trawl landed upside down on first deployment, small sections of video confirm coarse grained and rocky seabed. Housings were hit by rocks but did not sustain critical damage. Modifications will be made to weighting of the trawl to try and insure that it lands on seabed in the correct orientation.

Event 037
M West 14/06/2018 17:08
Modifications to trawl system worked well. Good footage collected at mooring site. Heterogeneous seafloor ranging from soft sediment to coarser rocky bottom.

Event 060
JR83 16/06/2018 18:07
Majority of footage unusable due to soft sediment being disturbed by winch cable and camera housing being covered in mud.

Event 062
M East 16/06/2018 23:54
Successful deployment with usable footage.

Event 068
M East 17/06/2018 08:27
Trawl landed upside down. Some usable footage and no damage to housings.

Event 122
Ripfjorden 21/06/2018 14:37
Successful deployment with usable footage.

Event 130
JR83 23/06/2018 05:00
Successful deployment with some usable footage. Lens was obscured with sediment for a portion of the deployment.

Event 152
H51 25/06/2018 17:42
Insufficient winch line paid out in deployment due to increase in vessel speed meant that trawl captured video of water column rather than seafloor.

Event 159
H51 26/06/2018 03:34
Successful deployment with usable footage.

Event 175
B34 26/06/2018 22:10

Successful deployment with usable footage.

Event 198
B34 27/06/2018 19:32
Successful deployment with usable footage.

Event 204
HH49 28/06/2018 04:20
Successful deployment with usable footage.

Event 211
B14 28/06/2018 16:21
Some usable footage. Winch safety line partially obscuring the camera and sediment clouds caused by undulating seabed.

Event 219
B14 29/06/2018 04:14
Usable footage. Poor visibility with clouded water column above seafloor.

Event 230
B14 29/06/2018 15:01
Usable footage. Poor visibility with clouded water column above seafloor.

Event 238
B13 30/06/2018 12:32
Successful deployment with usable footage.

Event 248
B13 30/06/2018 22:05
Deployment was shortened due to time constraints. Usable footage.

Event 265
B13 01/07/2018 14:00
Successful deployment with usable footage.

Event 268
B35 02/07/2018 04:10
15 minutes of usable footage. Trawl flipped over whilst on seafloor causing the camera system to be knocked out of position.

Event 279
B35 02/07/2018 16:15
Successful deployment with usable footage.

9.3 Early-life stages of benthic invertebrates

Raphaelle Descoteaux (UiT the Arctic University of Norway)

The aim of this work package is to characterize the community composition of benthic invertebrates at early life stages including the larval stages in the zooplankton, also called meroplankton, and the juvenile stages on the seafloor. In addition, feeding ecology of larval invertebrates will be determined through gut content DNA sequencing.

9.3.1 Meroplankton

A 64 or 180µm-mesh closing WP2 (Hydro-Bios, mouth opening 0.25 m^2) was towed vertically at 0.5ms^{-1}. Depth intervals were selected depending on the density profile identified from a CTD preceding sampling for every station (Table 9.4). The zooplankton samples were immediately fixed in 96% ethanol and the ethanol drained and replaced with fresh ethanol after ~24 hours in order to maintain high concentration. These samples will later be sorted and meroplankton counted, identified to the lowest taxonomic level possible visually and their DNA individually sequenced for identification to deeper taxonomic resolution. In addition, DNA from the larval gut content will be sequenced to determine their diet.

An additional WP2 net tow was taken at each station from ~10 m above bottom to surface in order to provide live larvae for gut content analysis starvation controls. Zooplankton from this tow was diluted with cold filtered seawater and kept at 2°C until sorting. Between ~10 to 30% of the sample was sorted at 25x magnification under a dissecting microscope. Suspected larval stages were removed, rinsed three times in filtered seawater and placed in groups of 1 to 12 (of the same type) in vials filled with filtered seawater at 2°C for 12-48 hours. After this period, larvae were transferred to 96% ethanol for preservation. This process aimed to starve the larvae so that they could evacuate their guts and effectively function as a negative control in analysis of larval gut content. Larval types found in live samples and used for starvation controls included echinoderm larvae and juveniles, polychaete larvae and juveniles, shrimp larvae, crab larvae, barnacle larvae and bivalve larvae.

9.3.2 Water samples

In order to determine the selectivity of larval invertebrate feeding, water samples were collected to determine the local assemblages of microorganisms at each water mass identified from the CTD profiles preceding some of the zooplankton sampling (Table 9.4). Water masses were identified as temperature and salinity fluctuations on the downward cast of the CTD and water was collected towards the middle of each water mass using the rosette bottles attached to the CTD on the upward cast. At a minimum, water was collected at 5m, chlorophyll maximum and above seafloor but additional depths were added when necessary to capture each water mass identified on the CTD profile. Sampling bottles were acid-washed and rinsed with sample water three times before filling. Approximately 250-500 mL of water for each depth was filtered on a 25 mm, 0.2 µm polycarbonate filter and immediately frozen at -80°C. In addition, a MilliQ water control was included to check for contamination. DNA will later be extracted from each sample to determine microbial community composition. The microbial community composition in ambient seawater will then be compared to the community composition of the larval guts as a measure of feeding selectivity.

Juveniles

Juvenile marine invertebrates were collected from the box core at stations M-WEST, JR87, H51, B14, B13 and B35 (Table 9.5). At most stations, 3 subcores (4 cm diameter, 2 cm depth) were extracted from the undisturbed surface sediments of two box cores (6 subcores per station in total) and preserved whole in 96% ethanol. These samples will be later sorted in the laboratory at UiT to extract small juvenile stages of marine invertebrates. To provide additional material in case of insufficient quantities from the subcores, a larger volume of sediment (120-300 cm^2 x 5-10 cm deep depending on depth of dense clay layer) from one box core per station was sieved sequentially over 500 and 250 µm sieves and preserved in 96% ethanol.

Table 9.4: Zooplankton and water sampling information.

Date	Station	Event	Water depth (m)	Depth start (m)	Depth stop (m)	Mesh (µm)	Net	CTD	Water sampling depth (m)
13-06-2018	JR78c	13	400	390	0	180	WP2	12	NA
13-06-2018	JR78c	14	400	20	0	180	WP2	12	NA
14-06-2018	MWEST	23	265	35	0	180	WP2	26	5, 25m
14-06-2018	MWEST	27	265	200	166	180	WP2	26	223
14-06-2018	MWEST	28	265	170	35	180	WP2	26	125
15-06-2018	JR80	49	3380	200	95	180	WP2	55	220
15-06-2018	JR80	51	3380	100	15	180	WP2	55	60, 28
15-06-2018	JR80	52	3380	20	0	180	WP2	55	5
17-06-2018	MEAST	73	190	30	0	180	WP2	69	5, 18
17-06-2018	MEAST	75	190	175	0	180	WP2	69	170
18-06-2018	JR85	93	3700	200	125	64	WP2	88	160
18-06-2018	JR85	94	3700	120	25	64	WP2	88	70
18-06-2018	JR85	97	3700	25	0	64	WP2	88	5, 15
21-06-2018	Rijpfjord	119	168	150	0	200	WP2	121	NA
23-06-2018	B27	137	385	40	0	64	WP2	135	5, 36
23-06-2018	B27	138	385	370	0	64	WP2	135	379
26-06-2018	H51	164	340	145	36	64	WP2	146	120
26-06-2018	H51	165	340	40	0	64	WP2	146	5, 30
26-06-2018	H51	166	340	330	145	64	WP2	146	321
27-06-2018	B34	193	205	185	130	64	WP2	186	193
27-06-2018	B34	194	205	130	18	64	WP2	186	100, 35
27-06-2018	B34	195	205	15	0	180	WP2	186	5
29-06-2018	B14	225	288	275	50	64	WP2	221	278, 170
29-06-2018	B14	226	288	50	0	64	WP2	221	5, 20
01-07-2018	B13	266	358	200	45	64	WP2	235	180
01-07-2018	B13	267	358	45	0	64	WP2	235	5, 29
02-07-2018	B35	274	360	345	45	64	WP2	270	350, 90
02-07-2018	B35	276	360	45	0	64	WP2	270	5, 20
03-07-2018	B7	282	320	310	0	64	WP2	281	306, 30, 5

Table 9.5: Sediment sampling information

Date	Station	Event	Sed depth (cm)	Method subsampling	Replicates	Sieved?	Mesh (µm)
14-06-2018	MWEST	34	2	4-cm cores	4	No	NA
14-06-2018	MWEST	34	8	Scraping 300cm2	1	Yes	250
14-06-2018	MWEST	34	8	Scraping 300cm2	1	Yes	500
17-06-2018	MEAST	77	2	4-cm cores	2	No	NA
17-06-2018	MEAST	78	2	4-cm cores	2	No	NA
17-06-2018	MEAST	81	2	4-cm cores	2	No	NA
17-06-2018	MEAST	82	8	Scraping 120cm2	1	Yes	250
17-06-2018	MEAST	82	8	Scraping 120cm2	1	Yes	500
20-06-2018	JR87	111	2	4-cm cores	3	No	NA
20-06-2018	JR87	111	10	Scraping 120cm2	1	Yes	250
20-06-2018	JR87	111	10	Scraping 120cm2	1	Yes	500
20-06-2018	JR87	112	2	4-cm cores	3	No	NA
26-06-2018	H51	169	2	4-cm cores	3	No	NA
26-06-2018	H51	170	2	4-cm cores	3	No	NA
26-06-2018	H51	170	9	Scraping 120cm2	1	Yes	250
26-06-2018	H51	170	9	Scraping 120cm2	1	Yes	500
29-06-2018	B14	222	2	4-cm cores	3	No	NA
29-06-2018	B14	228	2	4-cm cores	3	No	NA
29-06-2018	B14	229	7	Scraping 120cm2	1	Yes	250
29-06-2018	B14	229	7	Scraping 120cm2	1	Yes	500
01-07-2018	B13	256	2	4-cm cores	3	No	NA
01-07-2018	B13	261	7	Scraping 120cm2	1	Yes	250
01-07-2018	B13	261	7	Scraping 120cm2	1	Yes	500
01-07-2018	B13	260	2	4-cm cores	3	No	NA
02-07-2018	B35	278	7	Scraping 120cm2	1	Yes	250
02-07-2018	B35	278	7	Scraping 120cm2	1	Yes	500
02-07-2018	B35	272	2	4-cm cores	3	No	NA
02-07-2018	B35	277	2	4-cm cores	3	No	NA

10 Appendix A: Cruise Event Log

			START			BOTTOM			END					
EVENT	**ID**	**TYPE**	**DATE/TIME**	**LAT**	**LON**	**DATE/TIME**	**LAT**	**LON**	**DATE/TIME**	**LAT**	**LON**	**WDEPTH**	**RESPONSIBLE**	**COMMENTS**
1	JR77	CTD001	12/06/2018 06:13	78.013	9.473				12/06/2018 06:20	78.013	9.473	461	E Venables	Aborted
2	JR77	CTD001	12/06/2018 06:41	78.013	9.473	12/06/2018 06:53	78.013	9.473	12/06/2018 07:06	78.013	9.473	461	E Venables	
3	JR77	MIK001	12/06/2018 07:42	78.014	9.482	12/06/2018 08:00	78.022	9.485	12/06/2018 08:30	78.039	9.475	361	K Last	
4	JR77	MIK002	12/06/2018 08:34	78.041	9.473	12/06/2018 08:50	78.050	9.464	12/06/2018 09:30	78.069	9.455	361	K Last	
5	JR77	CTD002	12/06/2018 10:08	78.013	9.474	12/06/2018 10:21	78.013	9.474	12/06/2018 10:54	78.013	9.474	475	E Venables	
6	JR77	GoPro001	12/06/2018 12:24	78.020	9.468				12/06/2018 13:32	78.047	9.428		C Abernethy	Trial GoPro
7	JR77	CTD003	12/06/2018 14:16	78.013	9.472	12/06/2018 14:29	78.013	9.473	12/06/2018 14:49	78.013	9.472	481	E Venables	Test mooring releases
8	JR77	MSS-001	12/06/2018 15:18	78.010	9.474				12/06/2018 15:39	78.014	9.466	485	E Venables	Trial MSS
9	JR77	DG001	12/06/2018 17:20	78.015	9.465	12/06/2018 17:35	78.015	9.465	12/06/2018 17:50	78.015	9.465	490	R Descoteaux	No sample recovered
10	JR78a	CTD004	13/06/2018 06:04	80.008	11.240	13/06/2018 06:14	80.008	11.240	13/06/2018 06:27	80.008	11.240	205	E Venables	
11	JR78b	CTD005	13/06/2018 07:20	80.048	10.927	13/06/2018 07:33	80.048	10.927	13/06/2018 07:44	80.048	10.927	312	E Venables	
12	JR78c	CTD006	13/06/2018 08:29	80.064	10.792	13/06/2018 08:42	80.064	10.793	13/06/2018 09:17	80.064	10.793	411	E Venables	
13	JR78c	WP2-001	13/06/2018 09:40	80.064	10.793				13/06/2018 10:09	80.064	10.792		R Descoteaux	Net deployed to 380m
14	JR78c	WP2-002	13/06/2018 10:15	80.064	10.793				13/06/2018 10:21	80.064	10.793		R Descoteaux	Net deployed to 20m
15	JR78d	CTD007	13/06/2018 11:22	80.097	10.514	13/06/2018 11:36	80.098	10.514	13/06/2018 11:53	80.098	10.514	491	E Venables	
16	JR78e	CTD008	13/06/2018 14:06	80.292	8.909	13/06/2018 14:24	80.292	8.909	13/06/2018 14:37	80.292	8.909	600	E Venables	
17	JR78e	WP2-003	13/06/2018 15:00	80.292	8.909	13/06/2018 15:12	80.292	8.909	13/06/2018 15:24	80.292	8.909		K Last	Net deployed to 200m
18	MWest	CTD009	14/06/2018 02:33	81.034	18.385	14/06/2018 02:43	81.034	18.385	14/06/2018 03:10	81.034	18.385	260	E Venables	
19	MWest	WP2-004	14/06/2018 03:26	81.034	18.385	14/06/2018 03:38	81.034	18.385	14/06/2018 03:53	81.034	18.385	260	K Last	Net deployed to 200m
20	MWest	WP2-005	14/06/2018 03:59	81.034	18.385	14/06/2018 04:10	81.034	18.385	14/06/2018 04:22	81.034	18.385	260	K Last	Net deployed to 200m
21	MWest	MOOR	14/06/2018 04:36	81.034	18.385				14/06/2018 05:55	81.037	18.532	260	B Platt	MWest recovery
22	MWest	WP2-006	14/06/2018 06:42	81.034	18.414	14/06/2018 06:57	81.034	18.414	14/06/2018 07:07	81.034	18.413	260	R Descoteaux	Net deployed to 255m
23	MWest	WP2-007	14/06/2018 07:12	81.034	18.414	14/06/2018 07:14	81.034	18.414	14/06/2018 07:16	81.034	18.414	266	R Descoteaux	Net deployed to 35m
24	MWest	WP2-008	14/06/2018 07:25	81.034	18.414				14/06/2018 07:51	81.034	18.414	262	K Last	Net deployed to 200m

25	MWest	WP2-009	14/06/2018 07:55	81.034	18.414				14/06/2018 08:16	81.034	18.414	235	K Last	Net deployed to 200m
26	MWest	CTD010	14/06/2018 08:30	81.034	18.414	14/06/2018 08:42	81.034	18.414	14/06/2018 09:04	81.034	18.414	237	E Venables	
27	MWest	WP2-010	14/06/2018 09:47	81.034	18.414				14/06/2018 10:15	81.034	18.414	263	R Descoteaux	Net deployed to 200m
28	MWest	WP2-011	14/06/2018 10:24	81.034	18.414				14/06/2018 10:43	81.034	18.414	263	R Descoteaux	Net deployed to 170m
29	MWest	MSS-002	14/06/2018 10:50	81.034	18.411				14/06/2018 11:19	81.033	18.381	288	J Rodgers	
30	MWest	WP2-012	14/06/2018 11:30	81.035	18.412	14/06/2018 11:40	81.035	18.413	14/06/2018 11:50	81.035	18.413	236	K Last	Net deployed to 200m
31	MWest	WP2-013	14/06/2018 11:55	81.035	18.413	14/06/2018 12:04	81.035	18.413	14/06/2018 12:14	81.035	18.413	267	K Last	Net deployed to 200m
32	MWest	BC001	14/06/2018 12:58	81.034	18.413	14/06/2018 13:11	81.034	18.413	14/06/2018 13:21	81.034	18.413	264.1	R Descoteaux	No sample taken
33	MWest	MSS-003	14/06/2018 13:35	81.034	18.411				14/06/2018 14:07	81.034	18.383	265	J Rodgers	
34	MWest	BC002	14/06/2018 14:18	81.034	18.383	14/06/2018 14:28	81.034	18.382	14/06/2018 14:38	81.034	18.382	289	R Descoteaux	
35	MWest	MSS-004	14/06/2018 14:43	81.034	18.383				14/06/2018 15:16	81.034	18.359	295	J Rodgers	
36	MWest	WP2-014	14/06/2018 15:33	81.035	18.411				14/06/2018 15:58	81.035	18.411	269	K Last	Net deployed to 200m
37	MWest	GoPro002	14/06/2018 17:34	81.035	18.408	14/06/2018 18:28	81.046	18.343	14/06/2018 19:22	81.056	18.291	310	C Abernethy	
38	MWest	WP2-015	14/06/2018 19:43	81.055	18.285	14/06/2018 19:55	81.055	18.285	14/06/2018 20:08	81.055	18.285	309	K Last	Net deployed to 200m
39	MWest	WP2-016	14/06/2018 20:13	81.055	18.285	14/06/2018 20:24	81.055	18.285	14/06/2018 20:37	81.055	18.285	309	K Last	Net deployed to 200m
40	MWest	MSS-005	14/06/2018 21:15	81.032	18.412	14/06/2018 21:19	81.032	18.411	14/06/2018 22:58	81.042	18.386		J Rodgers	
41	MWest	WP2-017	14/06/2018 23:32	81.034	18.414	14/06/2018 23:43	81.034	18.414	14/06/2018 23:58	81.034	18.414	236	K Last	Net deployed to 200m
42	MWest	WP2-018	15/06/2018 00:07	81.034	18.414	15/06/2018 00:18	81.034	18.414	15/06/2018 00:33	81.034	18.414	267	K Last	Net deployed to 200m
43	MWest	MSS-006	15/06/2018 00:42	81.034	18.411				15/06/2018 01:09	81.030	18.403	221	J Rodgers	
44	MWest	WP2-019	15/06/2018 03:25	81.034	18.413	15/06/2018 03:37	81.034	18.413	15/06/2018 03:52	81.034	18.413	268	K Last	Net deployed to 200m
45	MWest	WP2-020	15/06/2018 03:55	81.034	18.413	15/06/2018 04:05	81.034	18.413	15/06/2018 04:15	81.034	18.413	267	K Last	Net deployed to 200m
46	MWest	CTD011	15/06/2018 04:31	81.034	18.413	15/06/2018 04:43	81.034	18.413	15/06/2018 05:26	81.034	18.414	236	E Venables	
47	JR79	CTD012	15/06/2018 11:55	81.915	18.496	15/06/2018 12:05	81.915	18.493	15/06/2018 12:24	81.916	18.482	3359	E Venables	
48	JR80	CTD013	15/06/2018 13:14	81.916	18.460				15/06/2018 13:21	81.916	18.458	3368	E Venables	Aborted due to oil drip from gantry
49	JR80	WP2-021	15/06/2018 13:54	81.917	18.446	15/06/2018 14:02	81.917	18.444	15/06/2018 14:09	81.917	18.442	3370	R Descoteaux	Net deployed to 200m

50	JR80	WP2-022	15/06/2018 14:23	81.918	18.436	15/06/2018 14:30	81.918	18.436	15/06/2018 14:31	81.918	18.436		R Descoteaux	Net deployed to 100m
51	JR80	WP2-023	15/06/2018 14:38	81.918	18.432	15/06/2018 14:41	81.918	18.431	15/06/2018 14:45	81.918	18.431		R Descoteaux	Net deployed to 100m
52	JR80	WP2-024	15/06/2018 14:52	81.918	18.428				15/06/2018 14:53	81.918	18.428		R Descoteaux	Net deployed to 20m
53	JR80	CTD014	15/06/2018 15:08	81.918	18.422				15/06/2018 15:23	81.918	18.421	3358	E Venables	Aborted due to oil drip from gantry
54	JR80	WP2-025	15/06/2018 15:28	81.918	18.421	15/06/2018 15:34	81.918	18.420	15/06/2018 15:41	81.918	18.419	3373	K Last	Net deployed to 200m
55	JR80	CTD015	15/06/2018 17:15	81.922	18.382	15/06/2018 18:21	81.924	18.355	15/06/2018 19:35	81.927	18.297	3347	E Venables	
56	JR79	CTD016	16/06/2018 00:12	81.398	18.486	16/06/2018 00:30	81.398	18.486	16/06/2018 01:00	81.398	18.486	760	E Venables	
57	JR81	CTD017	16/06/2018 13:49	81.251	28.027	16/06/2018 13:58	81.251	28.027	16/06/2018 14:15	81.251	28.027	100	E Venables	
58	JR82	CTD018	16/06/2018 15:19	81.262	28.464	16/06/2018 15:28	81.262	28.464	16/06/2018 15:46	81.262	28.464	185	E Venables	
59	JR83	CTD019	16/06/2018 17:04	81.278	29.146	16/06/2018 17:12	81.278	29.147	16/06/2018 17:30	81.278	29.147	310	E Venables	
60	JR83	GoPro003	16/06/2018 18:07	81.277	29.148	16/06/2018 19:27	81.264	29.224	16/06/2018 19:53	81.263	29.237	333	C Abernethy	
61	B17	CTD020	16/06/2018 21:21	81.300	30.000	16/06/2018 21:27	81.300	30.000	16/06/2018 21:41	81.300	30.000	157	E Venables	
62	B17	GoPro004	17/06/2018 00:08	81.301	31.279	17/06/2018 01:25	81.279	31.309	17/06/2018 01:39	81.275	31.314	189	C Abernethy	
63	B17	AGT001	17/06/2018 02:09	81.273	31.315	17/06/2018 02:32	81.269	31.319	17/06/2018 02:43	81.267	31.321	210	B Narayanaswamy	
64	MEast	MSS-007	17/06/2018 03:08	81.267	31.320				17/06/2018 03:46	81.254	31.350	224	J Rodgers	
65	MEast	CTD021	17/06/2018 04:55	81.305	31.334	17/06/2018 05:06	81.306	31.331	17/06/2018 05:25	81.306	31.331	197	E Venables	
66	MEast	MOOR	17/06/2018 05:32	81.306	31.332				17/06/2018 07:02	81.274	31.396	193	B Platt	East mooring recovery
67	MEast	MSS-008	17/06/2018 07:24	81.279	31.346				17/06/2018 08:09	81.277	31.359	193	J Rodgers	
68	MEast	GoPro005	17/06/2018 08:31	81.277	31.358				17/06/2018 10:03	81.265	31.441	192	C Abernethy	
69	MEast	CTD022	17/06/2018 10:43	81.303	31.343	17/06/2018 10:51	81.303	31.343	17/06/2018 11:11	81.303	31.343	183	E Venables	
70	MEast	MSS-009	17/06/2018 11:23	81.302	31.344				17/06/2018 12:19	81.300	31.349	201	J Rodgers	
71	MEast	WP2-026	17/06/2018 12:29	81.300	31.349	17/06/2018 12:38	81.300	31.351	17/06/2018 12:45	81.300	31.355	201	R Descoteaux	Net deployed to 190m
72	MEast	WP2-027	17/06/2018 12:51	81.300	31.355	17/06/2018 12:58	81.301	31.358	17/06/2018 13:06	81.301	31.362	201	K Last	Net deployed to 190m
73	MEast	WP2-028	17/06/2018 13:16	81.301	31.363	17/06/2018 13:18	81.301	31.364	17/06/2018 13:20	81.301	31.364	201	R Descoteaux	Net deployed to 30m
74	MEast	MOOR	17/06/2018 14:01	81.326	31.307				17/06/2018 14:18	81.322	31.314		B Platt	Deployment aborted
75	MEast	WP2-029	17/06/2018 15:26	81.305	31.342				17/06/2018 15:43	81.304	31.351	195	R Descoteaux	Net deployed to 175m
76	MEast	MSS-010	17/06/2018 15:50	81.303	31.355				17/06/2018 16:30	81.288	31.392		J Rodgers	

77	MEast	BC003	17/06/2018 17:39	81.302	31.344	17/06/2018 17:46	81.302	31.344	17/06/2018 17:57	81.302	31.344	190	B Narayanaswamy	
78	MEast	BC004	17/06/2018 18:20	81.302	31.344	17/06/2018 18:28	81.302	31.344	17/06/2018 18:38	81.302	31.344	191	B Narayanaswamy	
79	MEast	BC005	17/06/2018 19:05	81.302	31.344	17/06/2018 19:13	81.302	31.344	17/06/2018 19:20	81.302	31.344	189	B Narayanaswamy	No sample collected
80	MEast	BC006	17/06/2018 19:21	81.302	31.344	17/06/2018 19:29	81.302	31.344	17/06/2018 19:39	81.302	31.344	189	B Narayanaswamy	No sample collected
81	MEast	BC007	17/06/2018 19:53	81.302	31.344	17/06/2018 20:02	81.302	31.344	17/06/2018 20:13	81.302	31.344	189	B Narayanaswamy	
82	MEast	BC008	17/06/2018 20:32	81.302	31.344	17/06/2018 20:40	81.302	31.344	17/06/2018 20:51	81.302	31.344	189	B Narayanaswamy	
83	JR85	WP2-030	18/06/2018 08:00	82.595	30.032	18/06/2018 08:13	82.595	30.042	18/06/2018 08:36	82.594	30.069	3723	K Last	Net deployed to 200m
84	JR85	WP2-031	18/06/2018 09:02	82.594	30.088	18/06/2018 09:09	82.594	30.095	18/06/2018 09:21	82.593	30.109	3717	K Last	Net deployed to 200m
85	JR85	CTD023	18/06/2018 09:53	82.592	30.144	18/06/2018 10:05	82.591	30.159	18/06/2018 10:26	82.589	30.183	3707	E Venables	CTD deployed to 200m
86	JR85	WP2-032	18/06/2018 12:32	82.605	30.501	18/06/2018 12:42	82.604	30.509	18/06/2018 12:54	82.603	30.521	3670	K Last	Net deployed to 200m
87	JR85	WP2-033	18/06/2018 13:00	82.602	30.531	18/06/2018 13:09	82.601	30.540	18/06/2018 13:20	82.599	30.552	3666	K Last	Net deployed to 200m
88	JR85	CTD024	18/06/2018 13:44	82.596	30.581	18/06/2018 14:49	82.588	30.643	18/06/2018 16:12	82.581	30.720	3659	E Venables	
89	JR85	WP2-034	18/06/2018 16:30	82.580	30.744	18/06/2018 16:41	82.579	30.751	18/06/2018 16:55	82.578	30.764	3634	K Last	Net deployed to 200m
90	JR85	WP2-035	18/06/2018 16:59	82.577	30.769	18/06/2018 17:09	82.576	30.779	18/06/2018 17:24	82.575	30.793	3627	K Last	Net deployed to 200m
91	JR85	MSS-011	18/06/2018 17:40	82.575	30.804				18/06/2018 18:26	82.571	30.854		J Rodgers	
92	JR85	WP2-036	18/06/2018 18:53	82.569	30.882	18/06/2018 19:04	82.569	30.888	18/06/2018 19:21	82.568	30.901	3613	R Descoteaux	Net deployed to 200m
93	JR85	WP2-037	18/06/2018 19:30	82.567	30.913	18/06/2018 19:39	82.567	30.921	18/06/2018 19:57	82.566	30.941	3612	R Descoteaux	Net deployed to 200m
94	JR85	WP2-038	18/06/2018 20:08	82.565	30.952	18/06/2018 20:15	82.565	30.959	18/06/2018 20:26	82.565	30.969		R Descoteaux	Net deployed to 125m
95	JR85	WP2-039	18/06/2018 20:36	82.564	30.979	18/06/2018 20:46	82.564	30.987	18/06/2018 21:04	82.563	31.005	3599	K Last	Net deployed to 200m
96	JR85	WP2-040	18/06/2018 21:06	82.563	31.008	18/06/2018 21:18	82.562	31.020	18/06/2018 21:31	82.562	31.031	3566	K Last	Net deployed to 200m
97	JR85	WP2-041	18/06/2018 21:40	82.561	31.039				18/06/2018 21:46	82.561	31.044		R Descoteaux	Net deployed to 20m
98	JR85	MSS-012	18/06/2018 22:45	82.559	31.101				18/06/2018 22:53	82.558	31.108		J Rodgers	
99	JR85	MSS-013	18/06/2018 22:56	82.558	31.109				18/06/2018 23:18	82.558	31.134		J Rodgers	
100	JR85	MSS-014	18/06/2018 23:23	82.557	31.136				18/06/2018 23:37	82.557	31.148		J Rodgers	
101	JR85	WP2-042	19/06/2018 00:32	82.554	31.190	19/06/2018 00:43	82.554	31.199	19/06/2018 00:56	82.553	31.209		K Last	Net deployed to 200m
102	JR85	WP2-043	19/06/2018 01:00	82.553	31.214	19/06/2018 01:12	82.552	31.223	19/06/2018 01:26	82.552	31.230		K Last	Net deployed to 200m

103	JR85	WP2-044	19/06/2018 01:31	82.552	31.232	19/06/2018 01:41	82.551	31.237	19/06/2018 01:54	82.550	31.244		K Last	Net deployed to 200m
104	JR85	WP2-045	19/06/2018 01:57	82.550	31.246	19/06/2018 02:09	82.550	31.252	19/06/2018 02:22	82.549	31.257		K Last	Net deployed to 200m
105	JR85	WP2-046	19/06/2018 04:29	82.547	31.298	19/06/2018 04:39	82.547	31.301	19/06/2018 04:52	82.547	31.305		K Last	Net deployed to 200m
106	JR85	WP2-047	19/06/2018 04:55	82.547	31.306	19/06/2018 05:08	82.548	31.308	19/06/2018 05:20	82.548	31.312		K Last	Net deployed to 200m
107	JR85	WP2-048	19/06/2018 08:32	82.554	31.390							2736	K Last	Net deployed to 200m
108	JR85	WP2-049	19/06/2018 08:55	82.554	31.396	19/06/2018 09:06	82.554	31.401	19/06/2018 09:17	82.555	31.405	2994	K Last	Net deployed to 200m
109	JR86	CTD025	19/06/2018 15:35	82.466	31.560	19/06/2018 15:59	82.466	31.560	19/06/2018 16:32	82.466	31.560	3385	E Venables	
110	JR87	CTD026	19/06/2018 21:58	81.589	30.767	19/06/2018 22:29	81.589	30.767	19/06/2018 23:11	81.589	30.767	1570	E Venables	
111	JR87	BC009	19/06/2018 23:56	81.589	30.767	20/06/2018 00:35	81.589	30.767	20/06/2018 01:18	81.589	30.767	1561	B Narayanaswamy	
112	JR87	BC010	20/06/2018 01:42	81.589	30.767	20/06/2018 02:14	81.589	30.767	20/06/2018 02:47	81.589	30.767	1571	B Narayanaswamy	
113	JR88	CTD027	20/06/2018 04:21	81.503	30.960	20/06/2018 04:43	81.503	30.960	20/06/2018 05:16	81.503	30.960	705	E Venables	
114	Meast	MOOR	20/06/2018 07:32	81.325	31.260								B Platt	MEast Deployment
115	JR89	CTD028	20/06/2018 11:51	81.458	31.077	20/06/2018 12:05	81.458	31.077	20/06/2018 12:30	81.458	31.077	503	E Venables	
116	Lander	MOOR	21/06/2018 02:00	80.296	22.314				21/06/2018 05:04	80.292	22.327		B Platt	
117	Lander	MOOR	21/06/2018 05:47	80.291	22.328				21/06/2018 07:10	80.294	22.315		B Platt	
118	Lander	MOOR	21/06/2018 07:15	80.294	22.315				21/06/2018 11:33	80.293	22.320		B Platt	
119	Lander	WP2-050	21/06/2018 12:15	80.293	22.320	21/06/2018 12:21	80.293	22.320	21/06/2018 12:26	80.293	22.320		K Last	Net deployed to 150m
120	Lander	WP2-051	21/06/2018 12:29	80.293	22.320	21/06/2018 12:33	80.293	22.320	21/06/2018 12:39	80.293	22.320		K Last	Net deployed to 150m
121	Lander	CTD029	21/06/2018 13:06	80.293	22.320	21/06/2018 13:20	80.293	22.320	21/06/2018 13:49	80.293	22.320	168	E Venables	
122	Lander	GoPro006	21/06/2018 14:15	80.296	22.311	21/06/2018 15:00	80.315	22.258	21/06/2018 16:15	80.339	22.198	279	C Abernethy	
123	JR95	CTD030	22/06/2018 03:12	81.476	18.455	22/06/2018 03:45	81.476	18.455	22/06/2018 04:37	81.476	18.455	1560	E Venables	
124	JR96	CTD031	22/06/2018 06:26	81.263	18.452	22/06/2018 06:45	81.263	18.451	22/06/2018 07:16	81.263	18.451	549	E Venables	
125	JR97	CTD032	22/06/2018 08:42	81.145	18.408				22/06/2018 09:16	81.145	18.408	379	E Venables	
126	MWest	MOOR	22/06/2018 10:43	81.048	18.519				22/06/2018 12:31	81.033	18.410	267.5	B Platt	Mooring East deployment
127	MWest	CTD033	22/06/2018 13:51	81.039	18.411	22/06/2018 14:03	81.039	18.411	22/06/2018 14:26	81.039	18.411	257	E Venables	
128		MIK003	22/06/2018 21:44	81.153	23.792				22/06/2018 21:47	81.153	23.794		K Last	Deployment aborted due to winch problems

129		MIK004	22/06/2018 22:44	81.153	23.794	22/06/2018 23:01	81.146	23.817	22/06/2018 23:28	81.133	23.856		K Last	Net deployed to 225m
130	JR83	GoPro007	23/06/2018 05:03	81.279	29.122	23/06/2018 05:38	81.270	29.166	23/06/2018 06:52	81.258	29.220	450	C Abernethy	
131	JR90	CTD034	23/06/2018 08:58	81.432	31.146	23/06/2018 09:08	81.432	31.146	23/06/2018 09:16	81.432	31.146		E Venables	
132	JR90	MIK005	23/06/2018 09:42	81.429	31.170				23/06/2018 10:18	81.411	31.286	264	K Last	
133	JR91	CTD035	23/06/2018 10:51	81.383	31.293	23/06/2018 10:59	81.383	31.294	23/06/2018 11:17	81.383	31.293	220	E Venables	
134	MEast	CTD036	23/06/2018 12:23	81.303	31.315	23/06/2018 12:34	81.303	31.315	23/06/2018 12:54	81.303	31.315	184	E Venables	
135	B27	CTD037	23/06/2018 17:03	80.992	29.308	23/06/2018 17:16	80.992	29.308	23/06/2018 17:42	80.992	29.308		E Venables	
136	B27	WP2-052	23/06/2018 18:04	80.992	29.308				23/06/2018 18:30	80.992	29.308	389	R Descoteaux	Net deployed to 370 m
137	B27	WP2-053	23/06/2018 18:36	80.992	29.308				23/06/2018 18:41	80.992	29.308	389	R Descoteaux	Net deployed to 40m
138	B27	WP2-054	23/06/2018 18:46	80.992	29.308				23/06/2018 19:10	80.992	29.308	391	R Descoteaux	Net deployed to 370 m
139	JR92	CTD038	23/06/2018 22:30	80.800	27.799	23/06/2018 22:36	80.800	27.799	23/06/2018 22:48	80.800	27.799	430	E Venables	
140	JR93	CTD039	24/06/2018 01:43	80.850	29.300	24/06/2018 01:57	80.850	29.300	24/06/2018 02:19	80.850	29.300	425	E Venables	
141	JR94	CTD040	24/06/2018 04:07	80.878	30.188	24/06/2018 04:18	80.878	30.188	24/06/2018 04:37	80.878	30.188	145	E Venables	
142	B28	CTD041	24/06/2018 06:51	80.670	29.292	24/06/2018 07:09	80.670	29.292	24/06/2018 07:31	80.670	29.292	428	E Venables	
143	B16	CTD042	24/06/2018 11:13	80.100	29.998	24/06/2018 11:24	80.100	30.000	24/06/2018 11:47	80.100	30.000	295	E Venables	
144	JR98	CTD043	24/06/2018 18:20	79.333	30.000	24/06/2018 18:30	79.333	30.000	24/06/2018 18:45	79.333	30.000	299	E Venables	
145	B15	CTD044	25/06/2018 09:08	78.250	30.000	25/06/2018 09:19	78.250	30.000	25/06/2018 09:38	78.250	30.000	313	E Venables	
146	H51	CTD045	25/06/2018 10:49	78.167	30.001	25/06/2018 11:00	78.167	30.000	25/06/2018 11:24	78.167	30.000	337	E Venables	
147	H51	MSS-015	25/06/2018 11:39	78.167	30.000				25/06/2018 12:52	78.164	29.973		J Rodgers	
148	H51	Lander001	25/06/2018 13:27	78.170	30.002	25/06/2018 13:45	78.170	30.002	25/06/2018 14:20	78.170	30.002		C Abernethy	Lander Test
149	H51	MSS-016	25/06/2018 14:35	78.172	30.011				25/06/2018 14:53	78.172	29.995		J Rodgers	
150	H51	Lander002	25/06/2018 15:31	78.171	29.998	25/06/2018 15:49	78.171	29.998	25/06/2018 16:00	78.171	29.997	332	C Abernethy	Deployment
151	H51	MSS-017	25/06/2018 16:13	78.169	29.993				25/06/2018 17:10	78.166	29.975		J Rodgers	
152	H51	GoPro008	25/06/2018 17:43	78.167	30.020				25/06/2018 19:15	78.167	29.802	338	C Abernethy	
153	H51	MSS-018	25/06/2018 19:28	78.167	29.783				25/06/2018 20:22	78.166	29.741		J Rodgers	
154	H51	MIK006	25/06/2018 20:40	78.167	29.730				25/06/2018 21:40	78.164	29.553	347	K Last	
155	H51	MIK007	25/06/2018 22:00	78.159	29.522				25/06/2018 22:31	78.146	29.476	324	K Last	
156	H51	MSS-019	25/06/2018 22:43	78.145	29.472				25/06/2018 23:39	78.142	29.463		J Rodgers	
157	H51	AGT002	26/06/2018 00:29	78.166	29.797	26/06/2018 01:03	78.162	29.766	26/06/2018 01:25	78.159	29.740	336	B Narayanaswamy	

158	H51	MSS-020	26/06/2018 01:35	78.159	29.739				26/06/2018 02:30	78.155	29.704		J Rodgers	
159	H51	GoPro009	26/06/2018 03:34	78.159	30.058				26/06/2018 05:13	78.160	29.832	335	C Abernethy	
160	H51	BC011	26/06/2018 06:24	78.167	30.000	26/06/2018 06:39	78.167	30.000	26/06/2018 06:51	78.167	30.000	337	B Narayanaswamy	
161	H51	BC012	26/06/2018 07:09	78.166	29.999	26/06/2018 07:23	78.166	29.999	26/06/2018 07:35	78.166	29.999	340	B Narayanaswamy	
162	H51	WP2-055	26/06/2018 07:57	78.166	29.999	26/06/2018 08:09	78.166	29.999	26/06/2018 08:20	78.166	29.999	342	R Descoteaux	Net deployed to 330m
163	H51	WP2-056	26/06/2018 08:33	78.166	29.999				26/06/2018 08:58	78.166	29.999	341	R Descoteaux	Net deployed to 330m
164	H51	WP2-057	26/06/2018 09:21	78.166	29.999	26/06/2018 09:27	78.166	29.999	26/06/2018 09:33	78.167	30.000	371	R Descoteaux	Net deployed to 145m
165	H51	WP2-058	26/06/2018 09:44	78.166	29.999	26/06/2018 09:47	78.166	29.999	26/06/2018 09:49	78.167	30.000	372	R Descoteaux	Net deployed to 36m
166	H51	WP2-059	26/06/2018 09:52	78.167	30.000	26/06/2018 10:06	78.167	30.000	26/06/2018 10:18	78.167	30.001	371	R Descoteaux	
167	H51	WP2-060	26/06/2018 10:24	78.167	30.001	26/06/2018 10:32	78.167	30.001	26/06/2018 10:39	78.168	30.002		K Last	
168	H51	WP2-061	26/06/2018 10:41	78.168	30.002	26/06/2018 10:49	78.168	30.002	26/06/2018 10:56	78.168	30.002		K Last	
169	H51	BC013	26/06/2018 11:20	78.168	30.003	26/06/2018 11:33	78.168	30.003	26/06/2018 11:47	78.168	30.002	339	B Narayanaswamy	
170	H51	BC014	26/06/2018 12:12	78.169	30.002	26/06/2018 12:23	78.169	30.002	26/06/2018 12:34	78.169	30.002	338	B Narayanaswamy	
171	H51	BC015	26/06/2018 13:05	78.171	30.004	26/06/2018 13:16	78.170	30.006	26/06/2018 13:29	78.170	30.006	330	B Narayanaswamy	
172	H51	Lander002	26/06/2018 14:08	78.172	30.000				26/06/2018 14:44	78.171	30.000		B Narayanaswamy	Lander recovery
173	H51	BC016	26/06/2018 15:22	78.171	30.000	26/06/2018 15:34	78.171	30.000	26/06/2018 15:47	78.171	30.000	332	B Narayanaswamy	
174	B34	MIK008	26/06/2018 20:53	77.567	30.016				26/06/2018 21:35	77.544	29.991	208	K Last	
175	B34	GoPro010	26/06/2018 22:10	77.530	29.978				26/06/2018 23:51	77.491	29.963	203	C Abernethy	
176	B34	MSS-021	27/06/2018 00:17	77.509	29.959				27/06/2018 00:45	77.508	29.953		J Rodgers	
177	B34	MIK009	27/06/2018 01:01	77.510	29.962				27/06/2018 01:44	77.501	29.870	200	K Last	
178	B34	MSS-022	27/06/2018 02:30	77.549	29.996				27/06/2018 03:00	77.544	29.991		J Rodgers	
179	B34	AGT003	27/06/2018 03:31	77.558	30.010	27/06/2018 04:05	77.546	29.995	27/06/2018 04:23	77.541	29.988	210	B Narayanaswamy	
180	B34	MSS-023	27/06/2018 04:25	77.540	29.987				27/06/2018 04:49	77.535	29.980		J Rodgers	
181	B34	MIK010	27/06/2018 04:58	77.532	29.977				27/06/2018 05:48	77.500	29.947	202	K Last	
182	B34	MSS-024	27/06/2018 05:59	77.498	29.944				27/06/2018 06:45	77.505	29.937		J Rodgers	
183	B34	Lander003	27/06/2018 07:26	77.556	30.029				27/06/2018 07:45	77.557	30.029	211	B Narayanaswamy	Lander deployed
184	B34	MSS-025	27/06/2018 07:58	77.557	30.015				27/06/2018 08:45	77.548	29.989			
185	B34	MIK011	27/06/2018 08:57	77.542	29.980				27/06/2018 09:44	77.515	29.927	197	K Last	
186	B34	CTD046	27/06/2018 10:46	77.550	30.001	27/06/2018 10:55	77.550	30.001	27/06/2018 11:16	77.550	30.001	237	E Venables	

187	B34	MSS-026	27/06/2018 11:29	77.549	30.001				27/06/2018 11:50	77.554	29.997		J Rodgers	
188	B34	BC017	27/06/2018 12:10	77.552	29.999	27/06/2018 12:20	77.551	29.999	27/06/2018 12:31	77.551	29.999		B Narayanaswamy	
189	B34	MIK012	27/06/2018 12:58	77.552	29.993	27/06/2018 13:30	77.555	29.915	27/06/2018 13:44	77.557	29.882	235	K Last	
190	B34	MSS-027	27/06/2018 13:51	77.558	29.869				27/06/2018 14:10	77.558	29.862		J Rodgers	
191	B34	BC018	27/06/2018 14:44	77.529	29.976	27/06/2018 14:52	77.529	29.976	27/06/2018 15:02	77.529	29.976	234	B Narayanaswamy	No triggered
192	B34	BC019	27/06/2018 15:02	77.529	29.976	27/06/2018 15:10	77.529	29.976	27/06/2018 15:23	77.529	29.976	233	B Narayanaswamy	Not closed, wire wrapped around corer
193	B34	WP2-062	27/06/2018 15:52	77.531	29.979	27/06/2018 15:59	77.531	29.979	27/06/2018 16:07	77.530	29.979	204	R Descoteaux	
194	B34	WP2-063	27/06/2018 16:14	77.530	29.979				27/06/2018 16:30	77.530	29.980	233	R Descoteaux	Net deployed to 130m
195	B34	WP2-064	27/06/2018 16:39	77.530	29.980				27/06/2018 16:44	77.530	29.980	202	R Descoteaux	
196	B34	MIK013	27/06/2018 17:00	77.530	29.976	27/06/2018 17:32	77.540	29.902	27/06/2018 17:45	77.544	29.876	202	K Last	
197	B34	Lander003	27/06/2018 18:20	77.555	30.030				27/06/2018 18:48	77.556	30.030		B Narayanaswamy	Lander recovery
198	B34	GoPro011	27/06/2018 19:34	77.551	29.979	27/06/2018 19:49	77.545	29.957	27/06/2018 20:37	77.527	29.885	205	C Abernethy	
199	B34	MIK014	27/06/2018 21:01	77.541	29.937	27/06/2018 21:16	77.534	29.909	27/06/2018 21:32	77.526	29.883	203	K Last	
200	B34	WP2-065	27/06/2018 21:57	77.517	29.854	27/06/2018 22:04	77.517	29.854	27/06/2018 22:11	77.517	29.854		R Descoteaux	Net deployed to 185m
201	JR99	CTD047	27/06/2018 23:10	77.450	30.000	27/06/2018 23:22	77.450	30.000	27/06/2018 23:30	77.450	30.000	208	E Venables	
202	HH50	CTD048	28/06/2018 01:00	77.300	30.000	28/06/2018 01:07	77.300	30.000	28/06/2018 01:20	77.300	30.000	190	E Venables	
203	HH54	CTD049	28/06/2018 02:41	77.150	30.001	28/06/2018 02:50	77.150	30.001	28/06/2018 02:59	77.150	30.001	203	E Venables	
204	HH49	GoPro012	28/06/2018 04:18	76.999	30.093	28/06/2018 04:43	77.000	30.051	28/06/2018 06:12	77.000	29.903	241	C Abernethy	
205	HH49	CTD050	28/06/2018 06:52	77.000	30.000	28/06/2018 07:08	77.000	30.000	28/06/2018 07:33	77.000	30.000	236	E Venables	
206	HH49	AGT004	28/06/2018 08:02	76.998	29.980	28/06/2018 08:14	76.998	29.974	28/06/2018 08:34	76.998	29.961	236	B Narayanaswamy	
207	HH55	CTD051	28/06/2018 09:47	76.866	29.999	28/06/2018 09:56	76.866	29.999	28/06/2018 10:11	76.866	29.999	260	E Venables	
208	HH48	CTD052	28/06/2018 11:23	76.733	29.999	28/06/2018 11:32	76.733	29.999	28/06/2018 11:51	76.733	30.000	257	E Venables	
209	JR100	CTD053	28/06/2018 13:07	76.617	30.000	28/06/2018 13:16	76.617	30.000	28/06/2018 13:28	76.617	30.000	287	E Venables	
210	B14	MSS-028	28/06/2018 14:45	76.500	30.000				28/06/2018 16:03	76.504	29.977		J Rodgers	
211	B14	GoPro013	28/06/2018 16:16	76.504	29.966	28/06/2018 16:45	76.504	29.918	28/06/2018 18:15	76.518	29.781	321	C Abernethy	
212	B14	MSS-029	28/06/2018 18:26	76.519	29.774				28/06/2018 19:21	76.521	29.758		J Rodgers	
213	B14	WP2-066	28/06/2018 19:35	76.521	29.758	28/06/2018 19:47	76.521	29.757	28/06/2018 20:01	76.521	29.756	309	K Last	Net deployed to 200m
214	B14	MSS-030	28/06/2018 20:58	76.491	30.109				28/06/2018 21:54	76.493	30.089		J Rodgers	

215	B14	AGT005	28/06/2018 22:30	76.498	30.019	28/06/2018 23:20	76.503	29.988	28/06/2018 23:34	76.504	29.981	290	B Narayanaswamy	
216	B14	MSS-031	29/06/2018 00:06	76.503	29.982				29/06/2018 00:54	76.507	29.960		J Rodgers	
217	B14	MSS-032	29/06/2018 01:42	76.499	30.015				29/06/2018 02:30	76.502	29.995		J Rodgers	
218	B14	MSS-033	29/06/2018 03:16	76.491	30.069				29/06/2018 04:06	76.494	30.049		J Rodgers	
219	B14	GoPro014	29/06/2018 04:14	76.495	30.041	29/06/2018 04:34	76.500	30.011	29/06/2018 05:55	76.524	29.908	289	C Abernethy	
220	B14	WP2-067	29/06/2018 06:53	76.512	29.960	29/06/2018 07:05	76.512	29.961	29/06/2018 07:18	76.511	29.962	289	K Last	Net deployed to 200m
221	B14	CTD054	29/06/2018 08:08	76.500	30.000	29/06/2018 08:21	76.500	30.000	29/06/2018 08:50	76.500	30.000	323	E Venables	
222	B14	BC020	29/06/2018 09:26	76.500	30.000	29/06/2018 09:39	76.500	30.000	29/06/2018 09:49	76.500	30.000	290	B Narayanaswamy	
223	B14	BC021	29/06/2018 10:10	76.500	30.000	29/06/2018 10:21	76.500	30.000	29/06/2018 10:30	76.500	30.000	290	B Narayanaswamy	
224	B14	BC022	29/06/2018 10:52	76.500	30.000	29/06/2018 11:02	76.500	30.000	29/06/2018 11:12	76.500	30.000	293	B Narayanaswamy	
225	B14	WP2-068	29/06/2018 11:38	76.500	30.000				29/06/2018 12:00	76.500	30.000		R Descoteaux	
226	B14	WP2-069	29/06/2018 12:09	76.500	30.000				29/06/2018 12:14	76.500	30.000		R Descoteaux	
227	B14	WP2-070	29/06/2018 12:16	76.500	30.000				29/06/2018 12:36	76.500	30.000		R Descoteaux	
228	B14	BC023	29/06/2018 12:58	76.500	30.000	29/06/2018 13:10	76.500	30.000	29/06/2018 13:22	76.500	30.000		B Narayanaswamy	
229	B14	BC024	29/06/2018 13:38	76.500	30.000	29/06/2018 13:51	76.500	30.000	29/06/2018 14:05	76.500	30.000		B Narayanaswamy	
230	B14	GoPro015	29/06/2018 15:03	76.504	29.991	29/06/2018 15:18	76.509	29.978	29/06/2018 16:41	76.539	29.904	290	C Abernethy	
231	HH63	CTD055	29/06/2018 19:20	76.183	30.000	29/06/2018 19:29	76.183	30.000	29/06/2018 19:46	76.183	30.000	302	E Venables	
232	HH71	CTD056	29/06/2018 21:39	75.950	30.000	29/06/2018 21:50	75.950	30.000	29/06/2018 22:09	75.950	30.000	309	E Venables	
233	Glider station	Glider	30/06/2018 06:30	74.886	30.031				30/06/2018 06:54	74.885	30.043		Marie	Glider recovery
234	Glider station	CTD057	30/06/2018 07:15	74.884	30.040	30/06/2018 07:29	74.884	30.039	30/06/2018 07:44	74.884	30.039	387	E Venables	
235	B13	CTD058	30/06/2018 10:33	74.500	30.002	30/06/2018 10:44	74.500	30.000	30/06/2018 11:17	74.500	30.000	393	E Venables	
236	B13	WP2-071	30/06/2018 11:38	74.500	30.000	30/06/2018 11:38	74.500	30.000	30/06/2018 11:46	74.500	30.000		K Last	Net deployed to 200m
237	B13	WP2-072	30/06/2018 11:48	74.500	30.000	30/06/2018 11:56	74.500	30.000	30/06/2018 12:03	74.500	30.000		K Last	Net deployed to 200m
238	B13	GoPro016	30/06/2018 12:30	74.498	30.002	30/06/2018 12:52	74.504	29.976	30/06/2018 14:15	74.526	29.877	363	C Abernethy	
239	B13	MSS-034	30/06/2018 14:24	74.528	29.868				30/06/2018 15:21	74.533	29.846		J Rodgers	
240	B13	WP2-073	30/06/2018 15:23	74.533	29.845	30/06/2018 15:30	74.533	29.845	30/06/2018 15:37	74.533	29.845	366	K Last	Net deployed to 200m
241	B13	WP2-074	30/06/2018 15:41	74.533	29.845	30/06/2018 15:46	74.533	29.845				366	K Last	Net deployed to 200m
242	B13	AGT006	30/06/2018 16:50	74.498	30.006	30/06/2018 17:10	74.500	29.999	30/06/2018 17:46	74.508	29.983	358	B Narayanaswamy	

243	B13	MSS-035	30/06/2018 18:46	74.506	30.023				30/06/2018 19:21	74.506	30.012		J Rodgers	
244	B13	WP2-075	30/06/2018 19:30	74.506	30.011	30/06/2018 19:36	74.506	30.011	30/06/2018 19:48	74.506	30.011	359	K Last	Net deployed to 200m
245	B13	WP2-076	30/06/2018 19:52	74.506	30.011	30/06/2018 19:58	74.506	30.011	30/06/2018 20:10	74.506	30.014	357	K Last	Net deployed to 200m
246	B13	Lander004	30/06/2018 20:34	74.506	30.024				30/06/2018 21:02	74.506	30.023		C Abernethy	Lander deployment
247	B13	MSS-036	30/06/2018 21:16	74.505	30.017				30/06/2018 21:56	74.505	30.000		J Rodgers	
248	B13	GoPro017	30/06/2018 22:05	74.506	29.993				30/06/2018 23:09	74.509	29.895	365	C Abernethy	
249	B13	WP2-077	30/06/2018 23:28	74.507	29.923	30/06/2018 23:35	74.507	29.923	30/06/2018 23:47	74.507	29.923		K Last	Net deployed to 200m
250	B13	WP2-078	30/06/2018 23:50	74.507	29.923	30/06/2018 23:57	74.507	29.923	01/07/2018 00:07	74.507	29.923		K Last	Net deployed to 200m
251	B13	MSS-037	01/07/2018 00:18	74.506	29.932				01/07/2018 00:59	74.507	29.920		J Rodgers	
252	B13	MSS-038	01/07/2018 02:08	74.500	30.007				01/07/2018 03:09	74.502	29.989		J Rodgers	
253	B13	WP2-079	01/07/2018 03:52	74.502	30.015	01/07/2018 04:09	74.502	30.020	01/07/2018 04:24	74.503	30.021	360	K Last	Net deployed to 200m
254	B13	WP2-080	01/07/2018 04:43	74.502	30.002	01/07/2018 04:55	74.502	30.004	01/07/2018 05:08	74.502	30.005	364	K Last	Net deployed to 200m
255	B13	MSS-039	01/07/2018 05:15	74.503	30.008				01/07/2018 05:37	74.503	30.003		J Rodgers	
256	B13	BC025	01/07/2018 06:16	74.500	30.000	01/07/2018 06:29	74.500	30.000	01/07/2018 06:39	74.500	30.000	363	B Narayanaswamy	
257	B13	WP2-081	01/07/2018 07:04	74.500	30.000	01/07/2018 07:14	74.500	30.001	01/07/2018 07:26	74.500	30.001	357	K Last	Net deployed to 200m
258	B13	WP2-082	01/07/2018 07:29	74.500	30.001	01/07/2018 07:39	74.500	30.001	01/07/2018 07:50	74.500	30.001	357	K Last	Net deployed to 200m
259	B13	BC026	01/07/2018 08:01	74.500	30.001	01/07/2018 08:11	74.500	30.001	01/07/2018 08:21	74.500	30.001	356	B Narayanaswamy	
260	B13	BC027	01/07/2018 08:38	74.500	30.001	01/07/2018 08:48	74.500	30.001	01/07/2018 08:58	74.500	30.001		B Narayanaswamy	
261	B13	BC028	01/07/2018 09:10	74.500	30.001	01/07/2018 09:21	74.500	30.001	01/07/2018 09:36	74.500	30.001		B Narayanaswamy	
262	B13	WP2-083	01/07/2018 11:14	74.500	30.006	01/07/2018 11:26	74.500	30.005	01/07/2018 11:39	74.500	30.003		K Last	Net deployed to 200m
263	B13	WP2-084	01/07/2018 11:42	74.500	30.003	01/07/2018 11:53	74.500	30.003	01/07/2018 12:05	74.500	30.003		K Last	Net deployed to 200m
264	B13	Lander004	01/07/2018 12:38	74.507	30.029				01/07/2018 13:12	74.506	30.026		C Abernethy	Lander recovery
265	B13	GoPro18	01/07/2018 14:00	74.500	30.021	01/07/2018 14:19	74.499	29.992	01/07/2018 15:45	74.493	29.864	358	C Abernethy	
266	B13	WP2-085	01/07/2018 16:36	74.493	29.862	01/07/2018 16:46	74.493	29.863	01/07/2018 17:00	74.494	29.864	366	R Descoteaux	Net deployed to 200m
267	B13	WP2-086	01/07/2018 17:06	74.495	29.874	01/07/2018 17:10	74.495	29.874	01/07/2018 17:20	74.495	29.877	367	R Descoteaux	Net deployed to 45m
268	B13	GoPro019	02/07/2018 04:11	75.499	30.000	02/07/2018 04:31	75.504	29.971	02/07/2018 05:57	75.522	29.849	361	C Abernethy	
269	B35	AGT007	02/07/2018 06:57	75.498	30.010	02/07/2018 07:10	75.500	30.003	02/07/2018 07:31	75.502	29.987	361	B Narayanaswamy	

270	B35	CTD059	02/07/2018 08:40	75.500	30.000	02/07/2018 08:45	75.500	30.000	02/07/2018 09:15	75.500	30.000	360	E Venables	
271	B35	BC029	02/07/2018 09:43	75.500	30.000	02/07/2018 09:52	75.500	30.000	02/07/2018 10:02	75.500	30.000	361	B Narayanaswamy	
272	B35	BC030	02/07/2018 10:19	75.500	30.000	02/07/2018 10:31	75.500	30.000	02/07/2018 10:45	75.500	30.000	364	B Narayanaswamy	
273	B35	BC031	02/07/2018 11:01	75.500	30.000	02/07/2018 11:11	75.500	30.000	02/07/2018 11:21	75.500	30.000	365	B Narayanaswamy	
274	B35	WP2-087	02/07/2018 11:42	75.500	30.000	02/07/2018 11:55	75.500	30.000	02/07/2018 12:08	75.500	30.000		R Descoteaux	Net deployed to 345m
275	B35	WP2-088	02/07/2018 12:15	75.500	30.000	02/07/2018 12:28	75.500	30.000	02/07/2018 12:40	75.500	30.000		R Descoteaux	Net deployed to 345m
276	B35	WP2-089	02/07/2018 12:44	75.500	30.000	02/07/2018 12:46	75.500	30.000	02/07/2018 12:48	75.500	30.000		R Descoteaux	Net deployed to 45m
277	B35	BC032	02/07/2018 13:06	75.500	30.000	02/07/2018 13:18	75.500	30.000	02/07/2018 13:30	75.500	30.000	364	B Narayanaswamy	
278	B35	BC033	02/07/2018 13:44	75.500	30.000	02/07/2018 13:56	75.500	30.000	02/07/2018 14:06	75.500	30.000		B Narayanaswamy	
279	B35	GoPro020	02/07/2018 14:50	75.503	30.005	02/07/2018 15:10	75.505	29.972	02/07/2018 16:44	75.512	29.818	359	C Abernethy	
280	B12	CTD060	02/07/2018 22:22	75.500	26.000	02/07/2018 22:29	75.500	26.000	02/07/2018 22:40	75.500	26.000	138	E Venables	
281	B7	CTD061	03/07/2018 14:30	76.000	16.832	03/07/2018 14:40	76.000	16.831	03/07/2018 15:05	76.000	16.823	319	E Venables	
282	B7	WP2-90	03/07/2018 14:30	76.000	16.832	03/07/2018 14:43	76.000	16.829	03/07/2018 14:53	76.000	16.825	319	R Descoteaux	Net deployed to 310m
283	B6	CTD062	03/07/2018 19:53	75.183	17.533				03/07/2018 20:13	75.183	17.533	144	E Venables	
284	B5	CTD063	04/07/2018 04:04	74.366	18.166	04/07/2018 04:19	74.366	18.166	04/07/2018 04:35	74.366	18.166	123	E Venables	
285	B3	CTD064	04/07/2018 13:10	72.632	19.250	04/07/2018 13:22	72.633	19.250	04/07/2018 13:58	72.633	19.250	368	E Venables	

11 Appendix B – Mooring Instrument Setup Logs

11.1 Star Odi

East

S/N T4254

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4254\T4254.RDT
       SeaStar 7.70
       ---------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4254
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:39:13
       ---------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 16/06/2018 12:00:00
       ---------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       --------------------------------------------
       Start delay     : 00:09:20:47
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ---------------------------------------------------
       Battery energy at start (%): 76,4
       ---------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  16/03/2019 12:00:00    2     18      65521
        2/2  14/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/09/2020 12:00:00    8     56     196561
        2/2  12/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/03/2022 12:00:00   14     93     327601
       Memory full        : 11/06/2022 05:24:00
         After (days:hours)   : 1455:17
         In Cycle        : 3
         In sequence      : 2
         In Interval      : 1
         In measurement     : 21774
         Total meas. taken   : 349375
         Battery used (%)    : 15,4
         Battery left (%)    : 61,0
```

S/N T4255

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4255\T4255.RDT
       SeaStar 7.70
       ---------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4255
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:37:47
       ---------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
```

```
Measurement start time   : 16/06/2018 12:00:00
----------------------------------------------
Measurement settings: [dd:hh:mm:ss] x number
---------------------------------------------
Start delay     : 00:09:22:13
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,4
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  16/03/2019 12:00:00    2     18      65521
 2/2  14/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/09/2020 12:00:00    8     56     196561
 2/2  12/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full        : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

S/N T4256

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4256\T4256.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4256
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:36:31
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 16/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:09:23:29
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,4
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  16/03/2019 12:00:00    2     18      65521
        2/2  14/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/09/2020 12:00:00    8     56     196561
        2/2  12/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
```

```
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full        : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

S/N T4258

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4258\T4258.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4258
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:34:01
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 16/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:09:25:59
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,4
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  16/03/2019 12:00:00    2     18      65521
        2/2  14/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/09/2020 12:00:00    8     56     196561
        2/2  12/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/03/2022 12:00:00   14     93     327601
       Memory full        : 11/06/2022 05:24:00
         After (days:hours)   : 1455:17
         In Cycle        : 3
         In sequence      : 2
         In Interval      : 1
         In measurement     : 21774
         Total meas. taken   : 349375
         Battery used (%)    : 15,4
         Battery left (%)    : 61,1
```

S/N T4259

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4259\T4259.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4259
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
```

```
Recorder memory(byte/meas.) : 524063 / 349375
Measurement sequence number : 3
Recorder started from PC  : 16/06/2018 02:31:59
----------------------------------------------
Measurement interval def.  : Single interval = 00:06:00
Measurement start time   : 16/06/2018 12:00:00
----------------------------------------------
Measurement settings: [dd:hh:mm:ss] x number
---------------------------------------------
Start delay     : 00:09:28:01
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,4
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  16/03/2019 12:00:00    2     18      65521
 2/2  14/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/09/2020 12:00:00    8     56     196561
 2/2  12/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full         : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

S/N T4284

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4284\T4284.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4284
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:30:09
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 16/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:09:29:51
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,4
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  16/03/2019 12:00:00    2     18      65521
        2/2  14/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
```

```
 1/1  12/09/2020 12:00:00    8     56     196561
 2/2  12/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full         : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

S/N T4285

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4285\T4285.RDT
       SeaStar 7.70
       ---------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4285
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:28:25
       ---------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 16/06/2018 12:00:00
       ---------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       --------------------------------------------
       Start delay     : 00:09:31:35
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ---------------------------------------------------
       Battery energy at start (%): 76,4
       ---------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  16/03/2019 12:00:00    2     18      65521
        2/2  14/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/09/2020 12:00:00    8     56     196561
        2/2  12/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  12/03/2022 12:00:00   14     93     327601
       Memory full         : 11/06/2022 05:24:00
         After (days:hours)   : 1455:17
         In Cycle        : 3
         In sequence      : 2
         In Interval      : 1
         In measurement     : 21774
         Total meas. taken   : 349375
         Battery used (%)    : 15,4
         Battery left (%)    : 61,1
```

S/N T4286

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4286\T4286.RDT
       SeaStar 7.70
       ---------------------------------------------
       Recorder type        : Starmon mini
```

```
Recorder number       : T4286
Recorder version      : 17 CRC8/19200
Recorder measures      : Temperature
Recorder memory(byte/meas.) : 524063 / 349375
Measurement sequence number : 3
Recorder started from PC  : 16/06/2018 02:26:40
----------------------------------------------
Measurement interval def.  : Single interval = 00:06:00
Measurement start time   : 16/06/2018 12:00:00
----------------------------------------------
Measurement settings: [dd:hh:mm:ss] x number
---------------------------------------------
Start delay     : 00:09:33:20
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,4
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  16/03/2019 12:00:00    2     18      65521
 2/2  14/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/09/2020 12:00:00    8     56     196561
 2/2  12/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full        : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

S/N T4287

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4287\T4287.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4287
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 3
       Recorder started from PC  : 16/06/2018 02:24:49
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 16/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:09:35:11
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,4
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  16/03/2019 12:00:00    2     18      65521
```

```
 2/2  14/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/09/2020 12:00:00    8     56     196561
 2/2  12/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full         : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

S/N T4288

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4288\T4288.RDT
SeaStar 7.70
----------------------------------------------
Recorder type        : Starmon mini
Recorder number       : T4288
Recorder version      : 17 CRC8/19200
Recorder measures      : Temperature
Recorder memory(byte/meas.) : 524063 / 349375
Measurement sequence number : 3
Recorder started from PC  : 16/06/2018 02:22:12
----------------------------------------------
Measurement interval def.  : Single interval = 00:06:00
Measurement start time   : 16/06/2018 12:00:00
----------------------------------------------
Measurement settings: [dd:hh:mm:ss] x number
---------------------------------------------
Start delay     : 00:09:37:48
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,4
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  16/03/2019 12:00:00    2     18      65521
 2/2  14/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/09/2020 12:00:00    8     56     196561
 2/2  12/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  12/03/2022 12:00:00   14     93     327601
Memory full         : 11/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 61,1
```

West

S/N T4196

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4196\T4196.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4196
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:02:07
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:05:57:53
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,0
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  22/03/2019 12:00:00    2     18      65521
        2/2  20/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/09/2020 12:00:00    8     56     196561
        2/2  18/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/03/2022 12:00:00   14     93     327601
       Memory full        : 17/06/2022 05:24:00
         After (days:hours)   : 1455:17
         In Cycle        : 3
         In sequence      : 2
         In Interval      : 1
         In measurement     : 21774
         Total meas. taken   : 349375
         Battery used (%)    : 15,4
         Battery left (%)    : 60,6
```

S/N T4197

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4197\T4197.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4197
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:06:08
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:05:53:52
```

```
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,0
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  22/03/2019 12:00:00    2     18      65521
 2/2  20/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  18/09/2020 12:00:00    8     56     196561
 2/2  18/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  18/03/2022 12:00:00   14     93     327601
Memory full        : 17/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 60,6
```

S/N T4198

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4198\T4198.RDT
       SeaStar 7.70
       ---------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4198
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:08:38
       ---------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ---------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       --------------------------------------------
       Start delay     : 00:05:51:22
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,0
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  22/03/2019 12:00:00    2     18      65521
        2/2  20/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/09/2020 12:00:00    8     56     196561
        2/2  18/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/03/2022 12:00:00   14     93     327601
       Memory full        : 17/06/2022 05:24:00
         After (days:hours)   : 1455:17
         In Cycle        : 3
         In sequence      : 2
         In Interval      : 1
```

```
In measurement     : 21774
Total meas. taken   : 349375
Battery used (%)    : 15,4
Battery left (%)    : 60,6
```

S/N T4199

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4199\T4199.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4199
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:10:39
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:05:49:21
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,0
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  22/03/2019 12:00:00    2     18      65521
        2/2  20/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/09/2020 12:00:00    8     56     196561
        2/2  18/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/03/2022 12:00:00   14     93     327601
       Memory full        : 17/06/2022 05:24:00
         After (days:hours)   : 1455:17
         In Cycle        : 3
         In sequence      : 2
         In Interval      : 1
         In measurement     : 21774
         Total meas. taken   : 349375
         Battery used (%)    : 15,4
         Battery left (%)    : 60,6
```

S/N T4200

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4200\T4200.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4200
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:12:55
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ----------------------------------------------
```

```
Measurement settings: [dd:hh:mm:ss] x number
---------------------------------------------
Start delay     : 00:05:47:05
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,0
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  22/03/2019 12:00:00    2     18      65521
 2/2  20/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  18/09/2020 12:00:00    8     56     196561
 2/2  18/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  18/03/2022 12:00:00   14     93     327601
Memory full        : 17/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 60,6
```

S/N T4201

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4201\T4201.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4201
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:15:11
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:05:44:49
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,0
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  22/03/2019 12:00:00    2     18      65521
        2/2  20/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/09/2020 12:00:00    8     56     196561
        2/2  18/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/03/2022 12:00:00   14     93     327601
       Memory full        : 17/06/2022 05:24:00
         After (days:hours)   : 1455:17
```

```
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 60,6
```

S/N T4216

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4216\T4216.RDT
      SeaStar 7.70
      ----------------------------------------------
      Recorder type        : Starmon mini
      Recorder number       : T4216
      Recorder version      : 17 CRC8/19200
      Recorder measures      : Temperature
      Recorder memory(byte/meas.) : 524063 / 349375
      Measurement sequence number : 4
      Recorder started from PC  : 22/06/2018 06:17:39
      ----------------------------------------------
      Measurement interval def.  : Single interval = 00:06:00
      Measurement start time   : 22/06/2018 12:00:00
      ----------------------------------------------
      Measurement settings: [dd:hh:mm:ss] x number
      ---------------------------------------------
      Start delay     : 00:05:42:21
      1. interval period  :   00:06:00 x 65520
      2. interval period  :   00:06:00 x 65520
      Estimated time duration and battery usage for NMS
      ---------------------------------------------------
      Battery energy at start (%): 76,0
      ---------------------------------------------------
      Cycle 1                          Meas.taken
      Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
       1/1  22/03/2019 12:00:00    2     18      65521
       2/2  20/12/2019 12:00:00    5     37     131041
      Cycle 2                          Meas.taken
      Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
       1/1  18/09/2020 12:00:00    8     56     196561
       2/2  18/06/2021 12:00:00   11     75     262081
      Cycle 3                          Meas.taken
      Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
       1/1  18/03/2022 12:00:00   14     93     327601
      Memory full        : 17/06/2022 05:24:00
        After (days:hours)   : 1455:17
        In Cycle        : 3
        In sequence      : 2
        In Interval      : 1
        In measurement     : 21774
        Total meas. taken   : 349375
        Battery used (%)    : 15,4
        Battery left (%)    : 60,6
```

S/N T4218

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4218\T4218.RDT
      SeaStar 7.70
      ----------------------------------------------
      Recorder type        : Starmon mini
      Recorder number       : T4218
      Recorder version      : 17 CRC8/19200
      Recorder measures      : Temperature
      Recorder memory(byte/meas.) : 524063 / 349375
      Measurement sequence number : 4
      Recorder started from PC  : 22/06/2018 06:19:26
      ----------------------------------------------
```

```
Measurement interval def.  : Single interval = 00:06:00
Measurement start time   : 22/06/2018 12:00:00
----------------------------------------------
Measurement settings: [dd:hh:mm:ss] x number
---------------------------------------------
Start delay     : 00:05:40:34
1. interval period  :   00:06:00 x 65520
2. interval period  :   00:06:00 x 65520
Estimated time duration and battery usage for NMS
----------------------------------------------------
Battery energy at start (%): 76,1
----------------------------------------------------
Cycle 1                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  22/03/2019 12:00:00    2     18      65521
 2/2  20/12/2019 12:00:00    5     37     131041
Cycle 2                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  18/09/2020 12:00:00    8     56     196561
 2/2  18/06/2021 12:00:00   11     75     262081
Cycle 3                          Meas.taken
Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
 1/1  18/03/2022 12:00:00   14     93     327601
Memory full        : 17/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 60,7
```

S/N T4220

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4220\T4220.RDT
       SeaStar 7.70
       ----------------------------------------------
       Recorder type        : Starmon mini
       Recorder number       : T4220
       Recorder version      : 17 CRC8/19200
       Recorder measures      : Temperature
       Recorder memory(byte/meas.) : 524063 / 349375
       Measurement sequence number : 4
       Recorder started from PC  : 22/06/2018 06:21:22
       ----------------------------------------------
       Measurement interval def.  : Single interval = 00:06:00
       Measurement start time   : 22/06/2018 12:00:00
       ----------------------------------------------
       Measurement settings: [dd:hh:mm:ss] x number
       ---------------------------------------------
       Start delay     : 00:05:38:38
       1. interval period  :   00:06:00 x 65520
       2. interval period  :   00:06:00 x 65520
       Estimated time duration and battery usage for NMS
       ----------------------------------------------------
       Battery energy at start (%): 76,1
       ----------------------------------------------------
       Cycle 1                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  22/03/2019 12:00:00    2     18      65521
        2/2  20/12/2019 12:00:00    5     37     131041
       Cycle 2                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
        1/1  18/09/2020 12:00:00    8     56     196561
        2/2  18/06/2021 12:00:00   11     75     262081
       Cycle 3                          Meas.taken
       Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
```

```
 1/1  18/03/2022 12:00:00   14     93     327601
Memory full        : 17/06/2022 05:24:00
  After (days:hours)   : 1455:17
  In Cycle        : 3
  In sequence      : 2
  In Interval      : 1
  In measurement     : 21774
  Total meas. taken   : 349375
  Battery used (%)    : 15,4
  Battery left (%)    : 60,7
```

S/N T4302

```
Filename: C:\Software\Star-Oddi\SeaStar\Starmon mini\T4302\T4302.RDT
      SeaStar 7.70
      ----------------------------------------------
      Recorder type        : Starmon mini
      Recorder number       : T4302
      Recorder version      : 17 CRC8/19200
      Recorder measures      : Temperature
      Recorder memory(byte/meas.) : 524063 / 349375
      Measurement sequence number : 5
      Recorder started from PC  : 22/06/2018 06:23:20
      ----------------------------------------------
      Measurement interval def.  : Single interval = 00:06:00
      Measurement start time   : 22/06/2018 12:00:00
      ----------------------------------------------
      Measurement settings: [dd:hh:mm:ss] x number
      ---------------------------------------------
      Start delay     : 00:05:36:40
      1. interval period  :   00:06:00 x 65520
      2. interval period  :   00:06:00 x 65520
      Estimated time duration and battery usage for NMS
      ----------------------------------------------------
      Battery energy at start (%): 76,2
      ----------------------------------------------------
      Cycle 1                          Meas.taken
      Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
       1/1  22/03/2019 12:00:00    2     18      65521
       2/2  20/12/2019 12:00:00    5     37     131041
      Cycle 2                          Meas.taken
      Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
       1/1  18/09/2020 12:00:00    8     56     196561
       2/2  18/06/2021 12:00:00   11     75     262081
      Cycle 3                          Meas.taken
      Seq/Inr   Date&Time   Batt.used(%) Mem.used(%)   Temp
       1/1  18/03/2022 12:00:00   14     93     327601
      Memory full        : 17/06/2022 05:24:00
        After (days:hours)   : 1455:17
        In Cycle        : 3
        In sequence      : 2
        In Interval      : 1
        In measurement     : 21774
        Total meas. taken   : 349375
        Battery used (%)    : 15,4
        Battery left (%)    : 60,8
```

11.2 ADCP

East

DEP_W.scl

```
>>>>>> Function starting 06/15/18 18:05:50 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>TS180615180552
>CZ

Powering Down

>>>>>> Function starting 06/15/18 18:06:02 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>AX

--------------------------------------------------------------
----------------
          RDI Compass Error Estimating Algorithm


  Press any key to start taking data after the instrument is
setup.



Rotate the unit in a plane until all data samples are acquired...
  rotate less than 5ø/sec. Press Q to quit.

 N    NE    E    SE    S    SW    W    NW    N
 ^        ^         ^         ^         ^
     Û *******************************************************
Compass performance not evaluated.

>
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>CZ
```

```
Powering Down

>>>>>> Function starting 06/15/18 18:06:41 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>CR1
[Parameters set to FACTORY defaults]
>DEPLOY?
Deployment Commands:
CF = 11111 --------------- Flow Ctrl
(EnsCyc;PngCyc;Binry;Ser;Rec)
CK ----------------------- Keep Parameters as USER Defaults
CR # --------------------- Retrieve Parameters (0 = USER, 1 =
FACTORY)
CS ----------------------- Start Deployment

EA = +00000 --------------- Heading Alignment (1/100 deg)
EB = +00000 --------------- Heading Bias (1/100 deg)
ED = 00000 ---------------- Transducer Depth (0 - 65535 dm)
ES = 35 ------------------- Salinity (0-40 pp thousand)
EX = 11111 --------------- Coord Transform (Xform: Type,Tilts,3
Bm,Map)
EZ = 1111101 -------------- Sensor Source (C,D,H,P,R,S,T)

RE ----------------------- Recorder ErAsE
RN ----------------------- Set Deployment Name

TE = 01:00:00.00 --------- Time per Ensemble
(hrs:min:sec.sec/100)
TF = **/**/**,**:**:** --- Time of First Ping
(yr/mon/day,hour:min:sec)
TP = 01:20.00 ------------ Time per Ping (min:sec.sec/100)
TS = 18/06/15,18:06:43 --- Time Set (yr/mon/day,hour:min:sec)

WD = 111 100 000 --------- Data Out (Vel,Cor,Amp; PG,St,P0;
P1,P2,P3)
WF = 0176 ---------------- Blank After Transmit (cm)
Press any key to continue

WN = 030 ----------------- Number of depth cells (1-128)
WP = 00045 --------------- Pings per Ensemble (0-16384)
WS = 0400 ---------------- Depth Cell Size (cm)
WV = 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)

>SYSTEM?
System Control, Data Recovery and Testing Commands:
AC ----------------------- Output Active Fluxgate & Tilt
Calibration data
```

```
AF ----------------------- Field calibrate to remove hard/soft
iron error
AR ----------------------- Restore factory fluxgate calibration
data
AX ----------------------- Examine compass performance
AZ ----------------------- Zero pressure reading

CB = 411 ----------------- Serial Port Control (Baud; Par; Stop)
CP # --------------------- Polled Mode (0 = NORMAL, 1 = POLLED)
CZ ---------------------- Power Down Instrument

FC ----------------------- Clear Fault Log
FD ----------------------- Display Fault Log

OL ----------------------- Display Features List

PA ----------------------- Pre-Deployment Tests
PC1 ---------------------- Beam Continuity
PC2 ---------------------- Sensor Data
PS0 ---------------------- System Configuration
PS3 ---------------------- Transformation Matrices

RR ----------------------- Recorder Directory
Press any key to continue

RF ----------------------- Recorder Space used/free (bytes)
RY ----------------------- Upload Recorder Files to Host

>TS?
TS 18/06/15,18:08:16 --- Time Set (yr/mon/day,hour:min:sec)
>PS0
 Instrument S/N: 20262
    Frequency: 307200 HZ
  Configuration: 4 BEAM, JANUS
   Match Layer: 10
   Beam Angle: 20 DEGREES
  Beam Pattern: CONVEX
   Orientation: UP
    Sensor(s): HEADING TILT 1 TILT 2 DEPTH TEMPERATURE PRESSURE
Pressure Sens Coefficients:
       c3 = +7.060078E-11
       c2 = +1.504413E-07
       c1 = +3.601307E+00
     Offset = +9.977682E+01

Temp Sens Offset: -0.01 degrees C

  CPU Firmware: 50.40 [0]
  Boot Code Ver: Required: 1.16  Actual: 1.16
  DEMOD #1 Ver: ad48, Type: 1f
  DEMOD #2 Ver: ad48, Type: 1f
```

```
  PWRTIMG Ver: 85d3, Type:  6

Board Serial Number Data:
  28 00 00 07 68 DC 94 09 REC727-1000-04E
  FA 00 00 07 68 E5 BA 09 PIO727-3000-00G
  7C 00 00 07 28 6B 46 09 CPU727-2011-00E
  3A 00 00 07 28 59 91 09 DSP727-2001-04H
>PA

PRE-DEPLOYMENT TESTS

CPU TESTS:
 RTC...................................PASS
 RAM...................................PASS
 ROM...................................PASS
RECORDER TESTS:
 PC Card #0............................DETECTED
  Card Detect..........................PASS
  Communication........................PASS
  DOS Structure........................PASS
  Sector Test (short)..................PASS
 PC Card #1............................NOT DETECTED
DSP TESTS:
 Timing RAM............................PASS
 Demod RAM.............................PASS
 Demod REG.............................PASS
 FIFOs.................................PASS
SYSTEM TESTS:
 XILINX Interrupts... IRQ3 IRQ3 IRQ3 ...PASS
 Wide Bandwidth........................***FAIL***
 Narrow Bandwidth......................PASS
 RSSI Filter...........................PASS
 Transmit..............................***FAIL***
SENSOR TESTS:
 H/W Operation.........................***FAIL***
>PC2

Press any key to quit sensor display ...

All Sensors are Internal Only.
Heading   Pitch   Roll   Up/Down   Attitude Temp   Ambient  Temp
PRESSURE
 49.81ø -25.54ø 23.98ø   Up      6.65øC     5.02øC    -21.2 kPa
 49.54ø -25.54ø 23.99ø   Up      6.67øC     5.06øC    130.0 kPa
 49.91ø -25.54ø 23.99ø   Up      6.67øC     5.06øC     47.9 kPa
 49.77ø -25.54ø 23.98ø   Up      6.66øC     5.06øC    -19.8 kPa
 50.09ø -25.54ø 23.98ø   Up      6.65øC     5.06øC     63.8 kPa
 50.34ø -25.54ø 23.98ø   Up      6.67øC     5.08øC     22.7 kPa
 50.13ø -25.54ø 23.97ø   Up      6.70øC     5.03øC    -53.6 kPa
 50.11ø -25.54ø 23.99ø   Up      6.66øC     5.04øC     64.5 kPa
 49.97ø -25.54ø 23.99ø   Up      6.71øC     5.05øC     12.6 kPa
```

```
 50.12ø -25.54ø 23.98ø   Up      6.67øC     5.04øC    46.5 kPa
 50.32ø -25.54ø 23.98ø   Up      6.67øC     5.03øC    98.3 kPa
 49.86ø -25.54ø 23.98ø   Up      6.69øC     5.09øC    57.3 kPa

>RS
RS = 000,245 ------------- REC SPACE USED (MB), FREE (MB)

>PC1


BEAM CONTINUITY TEST

When prompted to do so, vigorously rub the selected
beam's face.

If a beam does not PASS the test, send any character to
the ADCP to automatically select the next beam.

Collecting Statistical Data...
 44 43 45 50
 […]
 44 43 47 51

Rub Beam 1 = PASS
Rub Beam 2 = PASS
Rub Beam 3 = PASS
Rub Beam 4 = PASS

>CZ

Powering Down

>>>>>> Function starting 06/15/18 18:09:58 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>AZ
Pressure Offset Updated in NVRAM.

>CZ

Powering Down

>>>>>> Function starting 06/15/18 18:10:08 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
```

```
>RE ErAsE erasing...
Recorder erased.

>CZ

Powering Down

>>>>>> Function starting 06/15/18 18:11:12 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>RR
Recorder Directory:
Volume serial number for device #0 is 206f-6241

 No files found.

 Bytes used on device #0 = 0
Total capacity  = 256352256 bytes
Total bytes used =     0 bytes in 0 files
Total bytes free = 256352256 bytes

>
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>CR1
[Parameters set to FACTORY defaults]
>CF11101
>EA0
>EB0
>ED1000
>ES35
>EX11111
>EZ1111101
>WA50
>WB0
>WD111100000
>WF176
>WN25
>WP25
>WS400
>WV175
>TE00:20:00.00
>TP00:48.00
>TF18/06/16 12:00:00
>CK
[Parameters saved as USER defaults]
```

```
>The command CS is not allowed in this command file. It has been ignored.
>The following commands are generated by this program:
>CF?
CF = 11101 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)
>CF11101
>RN DEP_W
>cs
```

DED_E.whp

```
CR1
CF11101
EA0
EB0
ED1000
ES35
EX11111
EZ1111101
WA50
WB0
WD111100000
WF176
WN25
WP25
WS400
WV175
TE00:20:00.00
TP00:48.00
TF18/06/16 12:00:00
CK
CS
;
;Instrument     = Workhorse Sentinel
;Frequency     = 307200
;Water Profile    = YES
;Bottom Track    = NO
;High Res. Modes  = NO
;High Rate Pinging = NO
;Shallow Bottom Mode= NO
;Wave Gauge      = NO
;Lowered ADCP    = NO
;Ice Track     = NO
;Surface Track    = NO
;Beam angle     = 20
;Temperature    = 0.00
;Deployment hours  = 10920.00
;Battery packs    = 1
;Automatic TP    = YES
;Memory size [MB]  = 256
```

```
;Saved Screen    = 2
;
;Consequences generated by PlanADCP version 2.06:
;First cell range  = 6.17 m
;Last cell range  = 102.17 m
;Max range     = 104.22 m
;Standard deviation = 0.71 cm/s
;Ensemble size   = 654 bytes
;Storage required  = 20.43 MB (21425040 bytes)
;Power usage    = 381.16 Wh
;Battery usage   = 0.8
;
; WARNINGS AND CAUTIONS:
; Advanced settings have been changed.
```

West

Dpl1_.scl

```
>>>>>> Function starting 06/21/18 14:22:06 >>>>>>
ø
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>TS180621142208
>CZ

Powering Down

>>>>>> Function starting 06/21/18 14:22:20 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>CR1
[Parameters set to FACTORY defaults]
>DEPLOY?
Deployment Commands:
CF = 11111 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)
CK ----------------------- Keep Parameters as USER Defaults
CR # --------------------- Retrieve Parameters (0 = USER, 1 = FACTORY)
CS ----------------------- Start Deployment

EA = +00000 -------------- Heading Alignment (1/100 deg)
EB = +00000 -------------- Heading Bias (1/100 deg)
ED = 00000 --------------- Transducer Depth (0 - 65535 dm)
ES = 35 ------------------ Salinity (0-40 pp thousand)
EX = 11111 --------------- Coord Transform (Xform: Type,Tilts,3Bm,Map)
EZ = 1111101 ------------- Sensor Source (C,D,H,P,R,S,T)

RE ----------------------- Recorder ErAsE
RN ----------------------- Set Deployment Name

TE = 01:00:00.00 --------- Time per Ensemble (hrs:min:sec.sec/100)
TF = **/**/**,**:**:** --- Time of First Ping (yr/mon/day,hour:min:sec)
TP = 01:20.00 ------------ Time per Ping (min:sec.sec/100)
TS = 18/06/21,14:22:22 --- Time Set (yr/mon/day,hour:min:sec)
```

```
WD = 111 100 000 --------- Data Out (Vel,Cor,Amp; PG,St,P0;
P1,P2,P3)
WF = 0176 ----------------- Blank After Transmit (cm)
Press any key to continue

WN = 030 ----------------- Number of depth cells (1-128)
WP = 00045 ---------------- Pings per Ensemble (0-16384)
WS = 0400 ----------------- Depth Cell Size (cm)
WV = 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)

>SYSTEM?
System Control, Data Recovery and Testing Commands:
AC ----------------------- Output Active Fluxgate & Tilt
Calibration data
AF ----------------------- Field calibrate to remove hard/soft
iron error
AR ----------------------- Restore factory fluxgate calibration
data
AX ----------------------- Examine compass performance
AZ ----------------------- Zero pressure reading

CB = 411 ----------------- Serial Port Control (Baud; Par; Stop)
CP # --------------------- Polled Mode (0 = NORMAL, 1 = POLLED)
CZ ---------------------- Power Down Instrument

FC ----------------------- Clear Fault Log
FD ----------------------- Display Fault Log

OL ----------------------- Display Features List

PA ----------------------- Pre-Deployment Tests
PC1 ---------------------- Beam Continuity
PC2 ---------------------- Sensor Data
PS0 ---------------------- System Configuration
PS3 ---------------------- Transformation Matrices

RR ----------------------- Recorder Directory
Press any key to continue
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>CZ

Powering Down

>>>>>> Function starting 06/21/18 14:22:37 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
```

```
All Rights Reserved.
>CR1
[Parameters set to FACTORY defaults]
>DEPLOY?
Deployment Commands:
CF = 11111 --------------- Flow Ctrl
(EnsCyc;PngCyc;Binry;Ser;Rec)
CK ----------------------- Keep Parameters as USER Defaults
CR # --------------------- Retrieve Parameters (0 = USER, 1 =
FACTORY)
CS ----------------------- Start Deployment

EA = +00000 -------------- Heading Alignment (1/100 deg)
EB = +00000 -------------- Heading Bias (1/100 deg)
ED = 00000 --------------- Transducer Depth (0 - 65535 dm)
ES = 35 ------------------ Salinity (0-40 pp thousand)
EX = 11111 --------------- Coord Transform (Xform: Type,Tilts,3
Bm,Map)
EZ = 1111101 ------------- Sensor Source (C,D,H,P,R,S,T)

RE ----------------------- Recorder ErAsE
RN ----------------------- Set Deployment Name

TE = 01:00:00.00 --------- Time per Ensemble
(hrs:min:sec.sec/100)
TF = **/**/**,**:**:** --- Time of First Ping
(yr/mon/day,hour:min:sec)
TP = 01:20.00 ------------ Time per Ping (min:sec.sec/100)
TS = 18/06/21,14:22:38 --- Time Set (yr/mon/day,hour:min:sec)

WD = 111 100 000 --------- Data Out (Vel,Cor,Amp; PG,St,P0;
P1,P2,P3)
WF = 0176 ---------------- Blank After Transmit (cm)
Press any key to continue

WN = 030 ----------------- Number of depth cells (1-128)
WP = 00045 --------------- Pings per Ensemble (0-16384)
WS = 0400 ---------------- Depth Cell Size (cm)
WV = 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)

>SYSTEM?
System Control, Data Recovery and Testing Commands:
AC ----------------------- Output Active Fluxgate & Tilt
Calibration data
AF ----------------------- Field calibrate to remove hard/soft
iron error
AR ----------------------- Restore factory fluxgate calibration
data
AX ----------------------- Examine compass performance
AZ ----------------------- Zero pressure reading
```

```
CB = 411 ----------------- Serial Port Control (Baud; Par; Stop)
CP # --------------------- Polled Mode (0 = NORMAL, 1 = POLLED)
CZ ---------------------- Power Down Instrument

FC ----------------------- Clear Fault Log
FD ----------------------- Display Fault Log

OL ----------------------- Display Features List

PA ----------------------- Pre-Deployment Tests
PC1 ---------------------- Beam Continuity
PC2 ---------------------- Sensor Data
PS0 ---------------------- System Configuration
PS3 ---------------------- Transformation Matrices

RR ----------------------- Recorder Directory
Press any key to continue

RF ----------------------- Recorder Space used/free (bytes)
RY ----------------------- Upload Recorder Files to Host

>TS?
TS = 18/06/21,14:22:47 --- Time Set (yr/mon/day,hour:min:sec)
>PS0
 Instrument S/N: 10628
    Frequency: 307200 HZ
  Configuration: 4 BEAM, JANUS
   Match Layer: 10
   Beam Angle: 20 DEGREES
  Beam Pattern: CONVEX
   Orientation: UP
    Sensor(s): HEADING TILT 1 TILT 2 DEPTH TEMPERATURE PRESSURE
Pressure Sens Coefficients:
       c3 = +1.486705E-11
       c2 = -1.731377E-06
       c1 = +1.659940E+00
     Offset = +3.217947E+02

Temp Sens Offset: -0.19 degrees C

  CPU Firmware: 50.36 [0]
  Boot Code Ver: Required: 1.13  Actual: 1.13
  DEMOD #1 Ver: ad48, Type: 1f
  DEMOD #2 Ver: ad48, Type: 1f
  PWRTIMG Ver: 85d3, Type:  6

Board Serial Number Data:
  CE 00 00 05 29 A7 20 09 PIO727-3000-00G
  7E 00 00 00 D9 AB ED 09 DSP727-2001-04G
  7C 00 00 05 17 78 37 09 CPU727-2000-00J
  34 00 00 00 D9 B5 F7 09 REC727-1000-04E
```

```
>PA

PRE-DEPLOYMENT TESTS

CPU TESTS:
 RTC.....................................PASS
 RAM.....................................PASS
 ROM.....................................PASS
RECORDER TESTS:
 PC Card #0..............................DETECTED
  Card Detect...........................PASS
  Communication.........................PASS
  DOS Structure.........................PASS
  Sector Test (short)...................PASS
 PC Card #1..............................NOT DETECTED
DSP TESTS:
 Timing RAM..............................PASS
 Demod RAM..............................PASS
 Demod REG..............................PASS
 FIFOs...................................PASS
SYSTEM TESTS:
 XILINX Interrupts... IRQ3 IRQ3 IRQ3 ...PASS
 Wide Bandwidth..........................PASS
 Narrow Bandwidth........................PASS
 RSSI Filter.............................PASS
 Transmit.............................***FAIL***
SENSOR TESTS:
 H/W Operation........................***FAIL***
>PC2

Press any key to quit sensor display ...

All Sensors are Internal Only.
Heading   Pitch   Roll   Up/Down   Attitude Temp   Ambient Temp
PRESSURE
114.54ø 21.73ø -23.67ø   Up      7.82øC     5.81øC     8.0 kPa
114.48ø 21.73ø -23.67ø   Up      7.82øC     5.81øC    -8.6 kPa
114.48ø 21.73ø -23.67ø   Up      7.83øC     5.83øC    26.9 kPa
114.47ø 21.73ø -23.67ø   Up      7.79øC     5.81øC   -11.9 kPa

>RS
RS = 015,1952 ------------- REC SPACE USED (MB), FREE (MB)

>PC1


BEAM CONTINUITY TEST

When prompted to do so, vigorously rub the selected
beam's face.
```

```
If a beam does not PASS the test, send any character to
the ADCP to automatically select the next beam.

Collecting Statistical Data...
 42 47 46 46
 […]
 42 45 44 45

Rub Beam 1 = PASS
Rub Beam 2 = PASS
Rub Beam 3 = PASS
Rub Beam 4 = PASS

>CZ

Powering Down

>>>>>> Function starting 06/21/18 14:24:03 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>AZ
Pressure Offset Updated in NVRAM.

>CZ

Powering Down

>>>>>> Function starting 06/21/18 14:36:26 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>RE ErAsE erasing...
Recorder erased.

>CZ

Powering Down

>>>>>> Function starting 06/21/18 14:37:41 >>>>>>

[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>RR
Recorder Directory:
```

```
Volume serial number for device #0 is 0000-0000

 No files found.

 Bytes used on device #0 = 0
Total capacity  = 2061991936 bytes
Total bytes used =     0 bytes in 0 files
Total bytes free = 2061991936 bytes

>
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.36
Teledyne RD Instruments (c) 1996-2009
All Rights Reserved.
>CR1
[Parameters set to FACTORY defaults]
>CF11101
>EA0
>EB0
>ED0
>ES35
>EX11111
>EZ1111101
>WA50
>WB0
>WD111100000
>WF176
>WN25
>WP29
>WS400
>WV175
>TE00:20:00.00
>TP00:41.37
>CK
[Parameters saved as USER defaults]
>The command CS is not allowed in this command file. It has been ignored.
>The following commands are generated by this program:
>CF?
CF = 11101 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)
>CF11101
>RN Dpl1_
>cs
```

Dpl1_whp

```
CR1
CF11101
EA0
EB0
ED0
```

```
ES35
EX11111
EZ1111101
WA50
WB0
WD111100000
WF176
WN25
WP29
WS400
WV175
TE00:20:00.00
TP00:41.37
CK
CS
;
;Instrument      = Workhorse Sentinel
;Frequency      = 307200
;Water Profile    = YES
;Bottom Track     = NO
;High Res. Modes   = NO
;High Rate Pinging = NO
;Shallow Bottom Mode= NO
;Wave Gauge      = NO
;Lowered ADCP     = NO
;Ice Track      = NO
;Surface Track    = NO
;Beam angle      = 20
;Temperature     = 0.00
;Deployment hours   = 10920.00
;Battery packs    = 1
;Automatic TP     = YES
;Memory size [MB]   = 256
;Saved Screen     = 1
;
;Consequences generated by PlanADCP version 2.06:
;First cell range   = 6.17 m
;Last cell range   = 102.17 m
;Max range      = 103.73 m
;Standard deviation = 0.66 cm/s
;Ensemble size    = 654 bytes
;Storage required   = 20.43 MB (21425040 bytes)
;Power usage     = 442.19 Wh
;Battery usage    = 1.0
;WARNINGS AND CAUTIONS:
; There are no warnings or cautions present
```

11.3 SBE 16

East

```
StartDateTime=06202018000000
<Executed/>StartLater
start logging at = 20 Jun 2018 00:00:00, sample interval = 7200
seconds
 SBE 16plus
S>time out
 SBE 16plus
S>
SBE 16plus V 3.1.9 SERIAL NO. 50214  19 Jun 2018 16:50:16
vbatt = 13.5, vlith = 8.5, ioper = 62.9 ma, ipump = 56.3 ma,
wait four seconds for biowiper to close: <Executing/>
<Executing/>
<Executing/>
<Executing/>
iext01 = 22.8 ma, wait four seconds for biowiper to close:
<Executing/>
<Executing/>
<Executing/>
<Executing/>
iext2345 = 13.7 ma
waiting to start at 20 Jun 2018 00:00:00
samples = 0, free = 3133244
sample interval = 7200 seconds, number of measurements per
sample = 1
pump = run pump during sample, delay before sampling = 4.0
seconds, delay after sampling = 4.0 seconds
transmit real-time = yes
battery cutoff = 7.5 volts
pressure sensor = strain gauge, range = 10000.0
SBE 38 = no, SBE 50 = no, WETLABS = no, OPTODE = no, SBE63 = no,
SeaFET = no, Gas Tension Device = no
Ext Volt 0 = yes, Ext Volt 1 = yes
Ext Volt 2 = yes, Ext Volt 3 = no
Ext Volt 4 = no, Ext Volt 5 = no
echo characters = yes
output format = converted decimal
output salinity = yes, output sound velocity = no
serial sync mode disabled
<Executed/>
<ERROR type='NOT ALLOWED' msg='Command not allowed while
logging'/>
<Executed/>
logging stopped
<Executed/>startdatetime=06202018120000
<Executed/>startlater
```

```
start logging at = 20 Jun 2018 12:00:00, sample interval = 7200
seconds
 SBE 16plus
S>
SBE 16plus V 3.1.9 SERIAL NO. 50214  19 Jun 2018 16:52:02
vbatt = 13.5, vlith = 8.5, ioper = 62.9 ma, ipump = 56.7 ma,
wait four seconds for biowiper to close: <Executing/>
<Executing/>
<Executing/>
<Executing/>
iext01 = 22.2 ma, wait four seconds for biowiper to close:
<Executing/>
<Executing/>
<Executing/>
<Executing/>
iext2345 = 13.9 ma
waiting to start at 20 Jun 2018 12:00:00
samples = 0, free = 3133244
sample interval = 7200 seconds, number of measurements per
sample = 1
pump = run pump during sample, delay before sampling = 4.0
seconds, delay after sampling = 4.0 seconds
transmit real-time = yes
battery cutoff = 7.5 volts
pressure sensor = strain gauge, range = 10000.0
SBE 38 = no, SBE 50 = no, WETLABS = no, OPTODE = no, SBE63 = no,
SeaFET = no, Gas Tension Device = no
Ext Volt 0 = yes, Ext Volt 1 = yes
Ext Volt 2 = yes, Ext Volt 3 = no
Ext Volt 4 = no, Ext Volt 5 = no
echo characters = yes
output format = converted decimal
output salinity = yes, output sound velocity = no
serial sync mode disabled
<Executed/>
SBE 16plus V 3.1.9 SERIAL NO. 50214  19 Jun 2018 16:53:00
vbatt = 13.4, vlith = 8.5, ioper = 62.8 ma, ipump = 66.4 ma,
wait four seconds for biowiper to close: <Executing/>
<Executing/>
<Executing/>
<Executing/>
iext01 = 22.3 ma, wait four seconds for biowiper to close:
<Executing/>
<Executing/>
<Executing/>
<Executing/>
iext2345 = 14.3 ma
waiting to start at 20 Jun 2018 12:00:00
samples = 0, free = 3133244
sample interval = 7200 seconds, number of measurements per
sample = 1
```

```
pump = run pump during sample, delay before sampling = 4.0
seconds, delay after sampling = 4.0 seconds
transmit real-time = yes
battery cutoff = 7.5 volts
pressure sensor = strain gauge, range = 10000.0
SBE 38 = no, SBE 50 = no, WETLABS = no, OPTODE = no, SBE63 = no,
SeaFET = no, Gas Tension Device = no
Ext Volt 0 = yes, Ext Volt 1 = yes
Ext Volt 2 = yes, Ext Volt 3 = no
Ext Volt 4 = no, Ext Volt 5 = no
echo characters = yes
output format = converted decimal
output salinity = yes, output sound velocity = no
serial sync mode disabled
<Executed/>
 SBE 16plus
S>
```

West

```
ds
SBE37SM-RS232 v4.1 SERIAL NO. 9382 22 Jun 2018 09:17:03
vMain = 13.26, vLith = 3.00
samplenumber = 32250, free = 526990
not logging, stop command
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3352.5
<Executed/>
samplenumber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
sampleinterval=7200
<Executed/>
startdatetime=06221200002018
<Error type='INVALID ARGUMENT' msg='invalid year'/>
<Executed/>
startdatetime-=06222018
<Error type='INVALID ARGUMENT' msg='datetime string is the wrong
length'/>
<Error type='INVALID ARGUMENT' msg='invalid hour'/>
<Executed/>
0622startdatetime=062218120000
```

<Error type='INVALID ARGUMENT' msg='datetime string is the wrong length'/>
<Error type='INVALID ARGUMENT' msg='invalid year'/>
<Error type='INVALID ARGUMENT' msg='invalid second'/>
<Executed/>
startdatetime=06222018120000
<start dateTime = 22 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 22 Jun 2018 12:00:00, sample interval = 7200 seconds-->
<Executed/>
ds
SBE37SM-RS232 v4.1 SERIAL NO. 9382 22 Jun 2018 09:22:22
vMain = 13.19, vLith = 3.01
samplenumber = 0, free = 559240
not logging, waiting to start at 22 Jun 2018 12:00:00
sample interval = 7200 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3352.5
<Executed/>
Qs

11.4 SBE 37

East

```
ds
SBE37SM-RS232 3.0h SERIAL NO. 7289 19 Jun 2018 16:54:18
vMain = 6.94, vLith = 2.89
samplenumber = 0, free = 559240
not logging, stop command
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenumber =0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
startdatetime=06202018120000
<start dateTime = 20 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 20 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 3.0h SERIAL NO. 7289 19 Jun 2018 16:55:59
vMain = 6.94, vLith = 2.89
samplenumber = 0, free = 559240
not logging, waiting to start at 20 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
Qs
```

```
ds
SBE37SM-RS232 3.0h SERIAL NO. 7290 19 Jun 2018 17:03:50
vMain = 6.93, vLith = 2.77
samplenumber = 0, free = 559240
not logging, stop command
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
outputformatrt=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenumber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
startdatetime=06202018120000
<start dateTime = 20 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 20 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 3.0h SERIAL NO. 7290 19 Jun 2018 17:05:09
vMain = 6.94, vLith = 2.77
samplenumber = 0, free = 559240
not logging, waiting to start at 20 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
qs

<Executed/>
GetHD
<HardwareData DeviceType = 'SBE37SM-RS232' SerialNumber =
'03707291'>
```

```
  <Manufacturer>Sea-Bird Electronics, Inc.</Manufacturer>
  <FirmwareVersion>3.0h</FirmwareVersion>
  <FirmwareDate>20 March 2009 09:25</FirmwareDate>
  <PCBAssembly>41647</PCBAssembly>
  <PCBAssembly>41610B</PCBAssembly>
  <PCBAssembly>41611D</PCBAssembly>
  <MfgDate>25 Aug 2009</MfgDate>
  <FirmwareLoader>SBE 37 FirmwareLoader V 1.0</FirmwareLoader>
  <InternalSensors>
   <Sensor id = 'Temperature'>
     <type>temperature-1</type>
     <SerialNumber>03707291</SerialNumber>
   </Sensor>
   <Sensor id = 'Conductivity'>
     <type>conductivity-1</type>
     <SerialNumber>03707291</SerialNumber>
   </Sensor>
   <Sensor id = 'Pressure'>
     <type>strain-0</type>
     <SerialNumber>2073302</SerialNumber>
   </Sensor>
  </InternalSensors>
</HardwareData>
<Executed/>
```


```
ds
SBE37SM-RS232 3.0h SERIAL NO. 7291 19 Jun 2018 17:06:21
vMain = 6.88, vLith = 2.77
samplenumber = 0, free = 559240
not logging, stop command
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenumber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
```

```
syatartdatetime=06202018120000
<start dateTime = 20 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 20 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 3.0h SERIAL NO. 7291 19 Jun 2018 17:07:37
vMain = 6.88, vLith = 2.77
samplenumber = 0, free = 559240
not logging, waiting to start at 20 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
qs

ds
SBE37SM-RS232 3.0h SERIAL NO. 7292 19 Jun 2018 17:09:36
vMain = 6.88, vLith = 2.77
samplenumber = 0, free = 559240
not logging, stop command
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenumber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumnerber=0
<Executed/>
startdatetime=06202018120000
<start dateTime = 20 Jun 2018 12:00:00/>
<Executed/>
startlater
```

```
<!--start logging at = 20 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 3.0h SERIAL NO. 7292 19 Jun 2018 17:10:49
vMain = 6.89, vLith = 2.77
samplenumber = 0, free = 559240
not logging, waiting to start at 20 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
qs
```

West

```
ds
SBE37SM-RS232 3.0h SERIAL NO. 7294 22 Jun 2018 05:35:10
vMain = 7.02, vLith = 2.78
samplenumber = 1890, free = 557350
not logging, stop command
sample interval = 6 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenumber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
startdatetime=062220182120000
<start dateTime = 22 Jun 2018 12:00:00/>
<Executed/>
startlater
```

```
<!--start logging at = 22 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 3.0h SERIAL NO. 7294 22 Jun 2018 05:36:16
vMain = 7.01, vLith = 2.78
samplenumber = 0, free = 559240
not logging, waiting to start at 22 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
qs

ds
SBE37SM-RS232 3.0h SERIAL NO. 7295 22 Jun 2018 05:28:25
vMain = 6.96, vLith = 2.77
samplenumber = 1955, free = 557285
not logging, stop command
sample interval = 6 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
sample number=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
startdatetime=06222018120000
<start dateTime = 22 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 22 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
```

```
SBE37SM-RS232 3.0h SERIAL NO. 7295 22 Jun 2018 05:29:42
vMain = 6.95, vLith = 2.77
samplenumber = 0, free = 559240
not logging, waiting to start at 22 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3000.0
<Executed/>
qs

ds
SBE37SM-RS232 v4.1 SERIAL NO. 9395 22 Jun 2018 05:32:50
vMain = 13.14, vLith = 2.78
samplenumber = 1922, free = 557318
not logging, stop command
sample interval = 6 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3295.7
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenu,=mber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
startdatetime=06222018120000
<start dateTime = 22 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 22 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 v4.1 SERIAL NO. 9395 22 Jun 2018 05:33:58
vMain = 13.12, vLith = 2.78
samplenumber = 0, free = 559240
not logging, waiting to start at 22 Jun 2018 12:00:00
```

```
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3295.7
<Executed/>
qs

ds
SBE37SM-RS232 v4.1 SERIAL NO. 9396 22 Jun 2018 05:30:38
vMain = 13.18, vLith = 2.76
samplenumber = 1939, free = 557301
not logging, stop command
sample interval = 6 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency = 3315.4
<Executed/>
outputformat=3
<Executed/>
txrealtime=n
<Executed/>
outputsal=y
<Executed/>
sampleinterval=720
<Executed/>
samplenumber=0
this command will modify memory pointers
repeat the command to confirm
<Executed/>
samplenumber=0
<Executed/>
startdatetime=06222018120000
<start dateTime = 22 Jun 2018 12:00:00/>
<Executed/>
startlater
<!--start logging at = 22 Jun 2018 12:00:00, sample interval =
720 seconds-->
<Executed/>
ds
SBE37SM-RS232 v4.1 SERIAL NO. 9396 22 Jun 2018 05:31:58
vMain = 13.15, vLith = 2.76
samplenumber = 0, free = 559240
not logging, waiting to start at 22 Jun 2018 12:00:00
sample interval = 720 seconds
data format = converted engineering alternate
output salinity
transmit real-time = no
```

```
sync mode = no
pump installed = yes, minimum conductivity frequency = 3315.4
<Executed/>
qs
```

11.5 SUNA

East

SUNA Summary Report

SUNA 1030 Version: V2

Operator: shenley Reference Update Time: 16-Jun-2018 14:43:40

Comment:

Ancillary	Value
Firmware Revision	2.5.1
Total Disk Space (byte)	3954802688
Free Disk Space (byte)	3833692160
Used Lamp Time (sec)	286399
Clock Time	2018/06/20 03:44:54 UTC

Setting	Value
SerialBaudRate	57600
OperationMode	Periodic
FixedDuration	60
FrameTransfer	FULL_ASCII
FrameLogging	FULL_ASCII
OperationControl	Duration
CycleLightFrames	58
CycleDarkFrames	2
CycleLightDuration	58
CycleDarkDuration	2
Baseline	Linear
Adaptive Integration	On
Concentrations Fitted	N03_SW_TSW
Concentrations Availiable	3
Bromide Trace	false
IntegPeriod (ms)	650
WavelenMin (nm)	217.0
WavelenMax (nm)	240.0
NO3DacMin (μM)	-5.0
NO3DacMax (μM)	100.0
SpectralnLightAvg	1
SpectralnDarkAvg	1
PeriodicInterval	2 hr
PeriodicOffset	0
PeriodicDuration	30
PeriodicSamples	30
LogFileType	Daily
LogFileMaxSz	5

West

SUNA Summary Report

SUNA 1029 Version: V2

Operator: shenley Reference Update Time: 21-Jun-2018 08:50:22

Comment:

Ancillary	Value
Firmware Revision	2.5.1
Total Disk Space (byte)	3954802688
Free Disk Space (byte)	3804495872
Used Lamp Time (sec)	260170
Clock Time	2018/06/21 14:44:11 UTC

Setting	Value
SerialBaudRate	57600
OperationMode	Periodic
FixedDuration	60
FrameTransfer	FULL_ASCII
FrameLogging	FULL_ASCII
OperationControl	Duration
CycleLightFrames	58
CycleDarkFrames	2
CycleLightDuration	58
CycleDarkDuration	2
Baseline	Linear
Adaptive Integration	On
Concentrations Fitted	N03_SW_TSW
Concentrations Availiable	3
Bromide Trace	false
IntegPeriod (ms)	300
WavelenMin (nm)	217.0
WavelenMax (nm)	240.0
NO3DacMin (µM)	-5.0
NO3DacMax (µM)	100.0
SpectralnLightAvg	1
SpectralnDarkAvg	1
PeriodicInterval	2 hr
PeriodicOffset	0
PeriodicDuration	30
PeriodicSamples	5
LogFileType	Daily
LogFileMaxSz	5

11.6 Sediment traps

East

```
McLane Research Laboratories, USA
ParFlux 21-Cup Sediment Trap
Version: PST-21_3.c  S/N: ML12283-01
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
°      Main Menu      °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
Fri Jun 15 15:11:22 2018
<1> Set Time       <5> Create Schedule
<2> Diagnostics     <6> Deploy System
<3> Fill Containers   <7> Offload Data
<4> Sleep        <8> Contacting McLane
Selection ? 6
Is the rotator aligned to the
open hole (Yes/No) [N] ? y
Clock reads 06/15/2018 15:12:23
Change time & date (Yes/No) [N] ? n
Existing deployment data file will be
erased. Continue (Yes/No) [N] ? y
Enter new deployment schedule (Yes/No) [N] ? n
Schedule Verification
Event  1 of 22 = 06/21/2018 00:00:00
Event  2 of 22 = 07/05/2018 00:00:00
Event  3 of 22 = 07/19/2018 00:00:00
Event  4 of 22 = 08/02/2018 00:00:00
Event  5 of 22 = 08/16/2018 00:00:00
Event  6 of 22 = 09/01/2018 00:00:00
Event  7 of 22 = 10/01/2018 00:00:00
Event  8 of 22 = 12/01/2018 00:00:00
Event  9 of 22 = 02/01/2019 00:00:00
Event 10 of 22 = 03/01/2019 00:00:00
Event 11 of 22 = 03/15/2019 00:00:00
Event 12 of 22 = 03/29/2019 00:00:00
Event 13 of 22 = 04/12/2019 00:00:00
Event 14 of 22 = 04/26/2019 00:00:00
Event 15 of 22 = 05/10/2019 00:00:00
Event 16 of 22 = 05/24/2019 00:00:00
Press any key to continue.
Event 17 of 22 = 06/07/2019 00:00:00
Event 18 of 22 = 06/21/2019 00:00:00
Event 19 of 22 = 07/05/2019 00:00:00
Event 20 of 22 = 07/19/2019 00:00:00
Event 21 of 22 = 08/02/2019 00:00:00
Event 22 of 22 = 09/01/2019 00:00:00
Modify an event (Yes/No) [N] ? n
Current Header reads:
Do you want a different header (Yes/No) [N] ? y
Enter new header (three lines, 80 characters/line)
> JR17008_MWEST_deployment66_MWEST_deployment_2018
Current Header reads:
JR17006_MWEST_deployment_2018
Do you want a different header (Yes/No) [N] ? n
System status:
06/15/2018 15:14:34  19.0 Vb   2 øC aligned
Caution: Deployment will overwrite the
EEPROM data backup cache.
Proceed with the deployment (Yes/No) [N] ? y
>>> Remove communication cable and <<<
>>> attach dummy plug. <<<
>>> Sediment trap is ready to deploy. <<<
<06/15/2018 15:15:14> Waiting for Event 01 of 22 @ 06/21/2018 00:00:00
06/15/2018 15:15:16 Sleeping . . .
```

West

```
 McLane Research Laboratories, USA
        ParFlux 21-Cup Sediment Trap
      Version: PST-21_3.c  S/N: ML12432-02
       ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
       º      Main Menu      º
       ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
         Thu Jun 21 13:34:29 2018
      <1> Set Time       <5> Create Schedule
      <2> Diagnostics     <6> Deploy System
      <3> Fill Containers   <7> Offload Data
      <4> Sleep        <8> Contacting McLane
       Selection ? 6
 Is the rotator aligned to the
 open hole (Yes/No) [N] ? y
 Clock reads 06/21/2018 13:35:44
 Change time & date (Yes/No) [N] ? n
 Existing deployment data file will be
 erased. Continue (Yes/No) [N] ? y
 Enter new deployment schedule (Yes/No) [N] ? n
 Schedule Verification
 Event  1 of 22 = 06/28/2018 00:00:00
 Event  2 of 22 = 07/05/2018 00:00:00
 Event  3 of 22 = 07/19/2018 00:00:00
 Event  4 of 22 = 08/02/2018 00:00:00
 Event  5 of 22 = 08/16/2018 00:00:00
 Event  6 of 22 = 09/01/2018 00:00:00
 Event  7 of 22 = 10/01/2018 00:00:00
 Event  8 of 22 = 12/01/2018 00:00:00
 Event  9 of 22 = 02/01/2019 00:00:00
 Event 10 of 22 = 03/01/2019 00:00:00
 Event 11 of 22 = 03/15/2019 00:00:00
 Event 12 of 22 = 03/29/2019 00:00:00
 Event 13 of 22 = 04/12/2019 00:00:00
 Event 14 of 22 = 04/26/2019 00:00:00
 Event 15 of 22 = 05/10/2019 00:00:00
 Event 16 of 22 = 05/24/2019 00:00:00
 Press any key to continue.
 Event 17 of 22 = 06/07/2019 00:00:00
 Event 18 of 22 = 06/21/2019 00:00:00
 Event 19 of 22 = 07/05/2019 00:00:00
 Event 20 of 22 = 07/19/2019 00:00:00
 Event 21 of 22 = 08/02/2019 00:00:00
 Event 22 of 22 = 09/01/2019 00:00:00
 Modify an event (Yes/No) [N] ? n
 Current Header reads:
 Do you want a different header (Yes/No) [N] ? y
 Enter new header (three lines, 80 characters/line)
> JR17006_MWEST_deployment_2018
> *actually west* other sediment trap deployed at MEAST
Current Header reads:
 JR17006_MWEST_deployment_2018
 *actually west* other sediment trap deployed at MEAST
 Do you want a different header (Yes/No) [N] ? n
 System status:
 06/21/2018 13:39:58  18.2 Vb   7 øC aligned
 Caution: Deployment will overwrite the
      EEPROM data backup cache.
 Proceed with the deployment (Yes/No) [N] ? y
 >>> Remove communication cable and <<<
    >>> attach dummy plug. <<<
 >>> Sediment trap is ready to deploy. <<<
 <06/21/2018 13:40:13> Waiting for Event 01 of 22 @ 06/28/2018 00:00:00
 06/21/2018 13:40:14 Sleeping . . .
```