Cruise JR17005

PSO: David Pond

Report Compiled by Geraint A. Tarling

JR17005 Cruise Report Sections

Contents

1. Overview of cruise JR17005 5

1.1 Science personnel 6

1.2 Technical Personnel 6

1.3 Crew and officers 7

1.4 Map of stations 9

2. Hydrography and physics 10

2.1 CTD data processing and calibration 10

2.2 Lowered Acoustic Doppler Current Profiler (LADCP) 34

2.3 Underway navigation, sea surface hydrography and meteorology 39

2.4 Vessel-Mounted Acoustic Doppler Current Profiler (VMADCP) 47

2.5 Data availability 55

3. Oxygen 56

Aims/Objectives 56

Sample Methology 56

Processing Methology 56

Instrument Details 56

Results 56

4. Water column biogeochemistry 60

4.1 Nutrient analysis 60

4.2 CDOM analysis 63

4.3 Phytoplankton, baterioplankton, protists and biogeochemical components 64

4.4 Water column biogeochemistry: nutrients and isotopes 72

Background and objectives 72

Sampling strategy/instrument description 72

Methods/Processing/*Calibrations* 72

Data quality notes/ problems 75

Samples collected 75

Results 76

5. Net deployments 78
MOCNESS deployments during JR17005 78
Bongo net deployments (JR17005) 93
6. Phytoplankton and Zooplankton Community 103
6.1 Zooplankton ecology and physiology 103
6.2 Bulk and compound-specific stable isotope ratios of Arctic *Calanus spp.* 106
6.3 Loligo Microrespirometer Experiments 111
6.4 The effect of temperature on the energy requirement and lipid consumption of Arctic *Calanus* spp 114
7. Sediment Geochemistry 115
Aims and Objectives 115
Sample and Processing Methodology 115
Data quality notes/ problems 117
Table 7.1 Samples collected 117
8. JR17005 IT Engineer's Report 120
Data Logging / SCS 120
Other systems 120
9. AME Electronics Report 121
10. AME Cruise Report 129
Bongo 129
Mocness 129
Bio-wire 130
11 NMF Mega Corer Cruise Report 132
12. SAPs & Salinometry 133
Summary 133
Salinometry 134
In-Situ Pumps (SAPs) 135
Configuration 136
Sea-Bird SBE 39plus Temperature & Pressure Loggers 136
Deployment Summary 137
Technical Issues 139
13. Laboratory Report 140
14. Data Management Report 141
15. Cruise Event log 142

16. Datasets 155
17.Cruise Summary Report 160
18. Relevant Datasets Collected from Data Management Plan (DMP) 168

1. Overview of cruise JR17005

The activities associated with research cruise JR17005 cover two NERC Changing Arctic Ocean projects: DIAPOD and ARISE

Research summary for DIAPOD: Copepod species of the genus *Calanus* (*Calanus* hereafter) are rice grain size crustaceans that occur throughout the Arctic Ocean consuming enormous quantities of phytoplankton. These tiny animals represent the primary food source for many Arctic fish,seabirds and whales. During early spring, they gorge on extensive seasonal blooms of diatoms, fat-rich phytoplankton that proliferates both beneath the sea ice and in the open ocean. This allows *Calanus* to rapidly obtain sufficient fate to survive during the many months of food scarcity during the Arctic winter. Diatoms also produce on the the main marine omega3 polyunsaturated fatty acids that *Calanus* require to successfully survive and reproduce in the frozen Arctic waters. Calanus seasonally migrate into deep waters to save energy and reduce their losses to predation in an overwintering process called diapause that is fuelled entirely by carbon rich fat (lipids). This vertical lipid pump transfers vast quantities of carbon in the oceans interior and ultimate presents the drawdown of atmospheric carbon dioxide. Continued global warming throughout the 21st century is expected to exert a strong influence on the timing, magnitude and spatial distribution of diatom productivity in the Arctic Ocean. Little is known about how *Calanus* will respond to these changes, making it difficult to understand how the wider Arctic ecosystem and its biogeochemistry will be affected by climate change. The overarching goal of this project is to develop a predictive understanding of how *Calanus* in the Arctic will be affected by future climate change.

Research summary for ARISE: Due to unprecedented rates of environmental change, the Arctic is now a crucible of multiple concurrent stressors. A reduction in sea ice concentrations is increasing the persistence and distribution of open water. Along with enhanced warming and riverine inputs, the Arctic is becoming more stratified, causing an alteration in vertical nutrient fluxes. Overall, Arctic primary productivity has increased by 30% over the past decade and there have been regional changes to phytoplankton community size structure and diversity at the base of the food web. We currently don't know how sensitive food webs are to alterations at the base of the food web and thus their spatial and temporal response to these multiple environmental stressors. The overarching goal of this project is to develop a new framework using observations, novel biomarkers and modelling to allow us to detect change in Arctic ecosystems. Rather than characterize the entire ecosystem, we will focus on the base of the food web and two pelagic feeding predators, the harp seal and the ringed seal, both considered as excellent indicator species. During NERC cruises, we will characterize the variability observed at the base of the food web in consideration of gradients in the environment due to sea ice, shelf versus open water and different water masses.

At each station, a series of activities were undertaken to provide samples to address the objectives of both DIAPOD and ARISE. Specifically, for DIAPOD, a series of nets (including Bongo opening closing, Mocness and ring nets) were deployed to different depth horizons to study the depth distribution of Calanus and collect specimens for identification, lipids and determination of key metabolic rates (e.g. respiration and grazing). Subsamples of Calanus were collected for ARISE for biomarker analysis. CTD deployments collected complimentary data on phytoplankton biomass and community structure. A second full depth CTD was used to determine the vertical profile in stable isotopes of dissolved and particulate material, focusing on water mass end members and key

oceanographic features. Standalone pumps collected large quantities of particulate material for biomarker analysis. Finally, a megacorer was deployed to collect a sediment core to quantify the influence of terrestrial material on the Arctic marine ecosystem.

1.1 Science personnel

David Pond (U. Stirling)

Geraint Tarling (BAS)

Dan Mayor (NOC)

Claudia Castellani (PML)

Debra Brennan (SAMS)

Elaine Mitchell (SAMS)

Victoria Fowler (BAS)

Richard Abell (SAMS)

Joanne Hopkins (NOC)

Emma Burns (U. Manchester)

Louisa Norman (U. Liverpool)

Celeste Kellock (U. Edinburgh)

Camille de la Vega (U. Liverpool)

Robyn Tuerena (U. Edinburgh)

Elliot Price (U. Liverpool)

Torgeir Blaesterdalen (Norwegian Polar Institute)

Holly Jenkins (U. Southampton))

Florence Atherden (U. Southampton)

Aiden Hunter (U. Strathclyde)

1.2 Technical Personnel

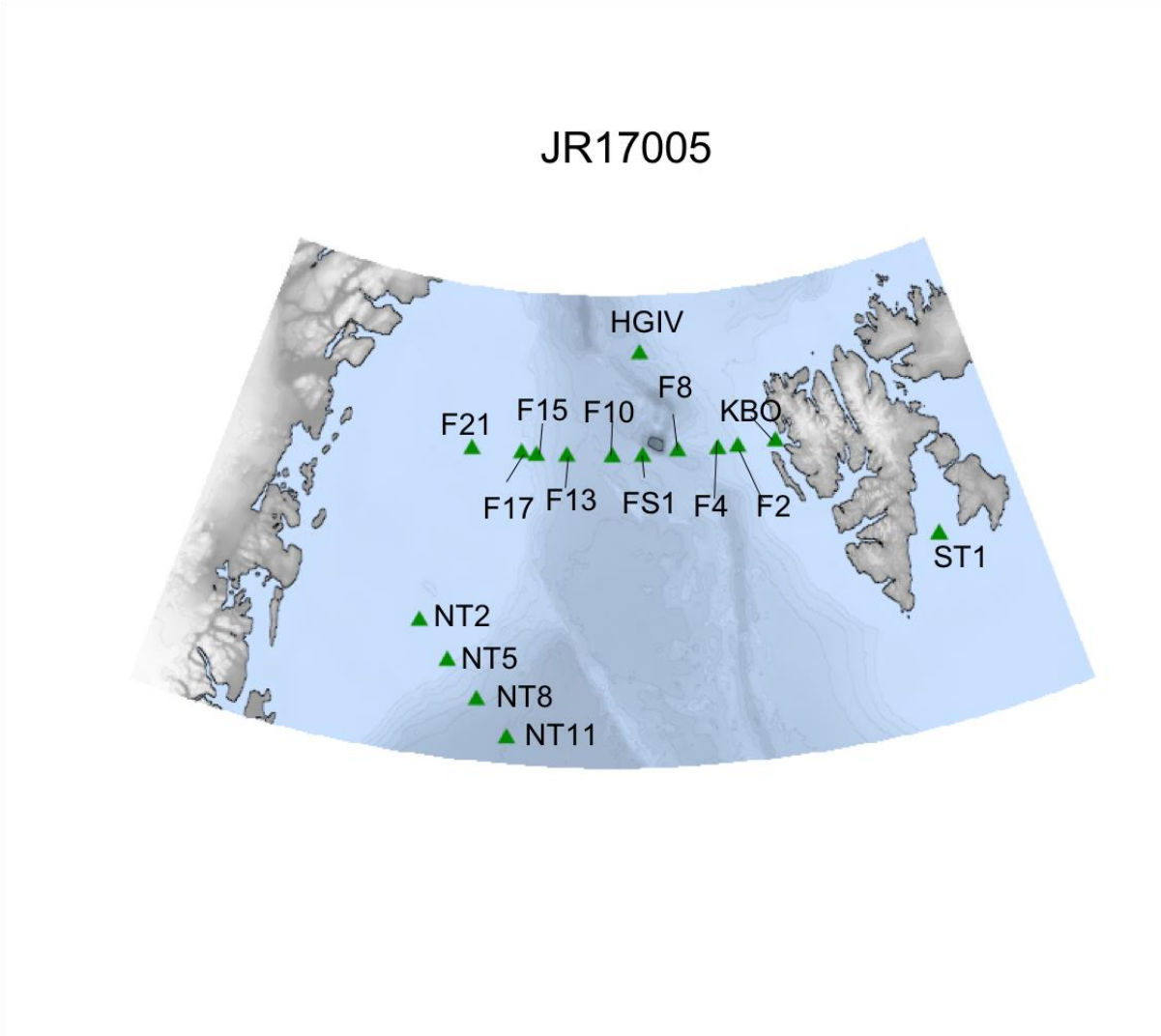
AME Electrical	Ross Sanders
AME Mechanical	Carwyn Davies
	Bjørg Apeland
NMF	Dougal Mountfield
	Ian Murdoch
Lab Manager	Aisling Smith

1.3 Crew and officers

EVANS, Simon	Master
DELPH Georgina M	Chief Officer
O'DONNELL, Colin M	2nd Officer
HILLS, Dominic	3rd Officer
GARNETT, Nigel	3rd Officer
NEWSOM, John M	ETO Comms
KUBULINS Andris	Chief Engineer
DONALDSON Christopher	2nd Engineer
HARDY Aleksandr J W	3rd Engineer
EADIE Steven J M	4th Engineer
BEDERNARK, Stanislaw	ETO
STEVENS, Douglas	xtra ETO
KLEPACKI, Julian	xtra ETO
BIGGS Thomas E	Deck Engineer
SUTTON, Robert	Deck Engineer
HAMILTON, John N	Purser
DUBOIS, Andre	Doctor
MULLANEY Clifford	Bosun Science
FRASER, Grant	Bosun Science
LITTLEHALES Noel C	Bosun
O'DUFFY John	Bosun's mate

LENNON Craig T	Launchman
MOCKLER, Alan	SG1A
MUNOZ GARCIA Paula C	SG1B
DEVITT, Chritopher	SG1A
LEECH, Robert	SG1A
VARGAS LEON Carlos E	MG1
PICTOR Stephen J S	MG1
MUNTEANU, Romica	Chief Cook
ROBERTSON Brian	Cook
LEE Derek W	Senior Stwd
NEWALL James	Stwd
BURCH, Oliver M	Steward
PATTERSON Thomas R	Stwd

1.4 Map of stations



Map of major stations where both DIAPOD and ARISE samples were collected (courtesy of Holly Jenkins)

2. Hydrography and physics

2.1 CTD data processing and calibration

Jo Hopkins[1] (National Oceanography Centre, Liverpool)

[1]*Data set PI and author*

A total of 72 CTD casts were completed during the cruise (including 2 test casts). BAS instrumentation (see Table 1) was mounted onto a stainless steel frame with 24 x 20 L Niskin bottles (supplied by NMF). In addition to the standard suite of BAS supplied instrumentation a WET Labs ECO CDOM fluorometer supplied by the Norwegian Polar Institute was used. The CTD was setup and maintained by Ross Saunders (BAS) and further technical details can be found in his AME Electronics Report.

Three transects were completed. The first from the deep water of the Greenland Basin up into the Norsk Trough (NT-Line) on the East Greenland Shelf at a latitude of 76°N. A second transect was completed at 79°N across the Fram Strait (F-Line), starting at 10°W on the East Greenland Shelf and finishing just a few miles off the coast of Svalbard. A third transect was completed across Storfjorden (ST-Line). Additional sampling stations were completed in deep water to the south (B10) and north (FS1) of Svalbard (see Figure 1).

Table 1. CTD instrumentation and serial numbers. Upward and downward looking TRDI Workhorse Monitor 300 kHz LADCPs were also mounted onto the frame (see LADCP processing section).

Instrument/Sensor	Manufacturer/Model	Serial Number	Frequency/Channel
Seabird primary CTD deck unit (V1)	SBE 11plus	11P15759-0458	
Seabird underwater Unit	SBE 9plus	09P30856-0707	
Primary Temperature Sensor	SBE 3plus	2705	
Primary Conductivity Sensor	SBE 4C	2222	
Digiquartz Pressure Sensor with TC		0480	
Secondary Temperature Sensor	SBE 3plus	5042	
Secondary Conductivity Sensor	SBE 4C	2255	
Transmissometer	WET Labs C-Star	CST-1399DR	V0
Fluorometer	Chelsea Aqua 3	088-216	V1
Fluorometer**	WET Labs ECO CDOM	FLCDRTD-1930	V2

			V3 (free)
Oxygen	SBE 43	2291	V4
			V5 (free)
PAR/Irradiance	Biospherical/Licor	70688	V6
Altimeter		244740	V7

***The CDOM flourometer was removed from the CTD frame after cast 62*

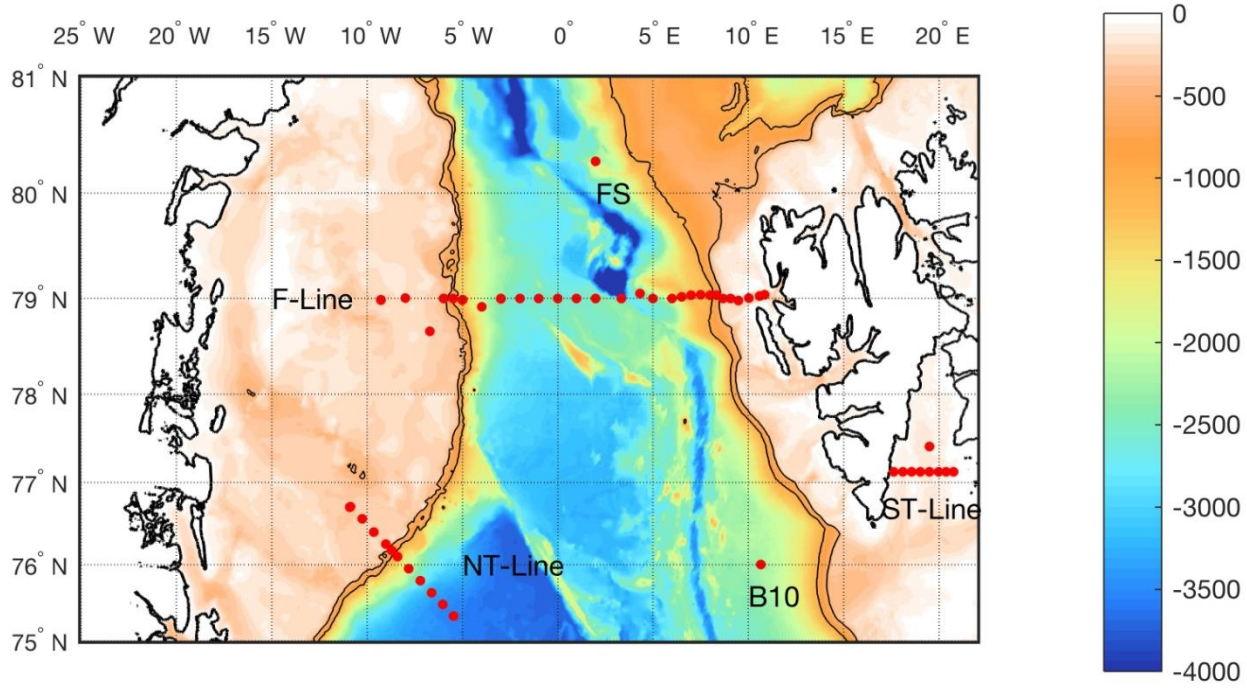


Figure 1. JR15005 CTD cast locations.

Table 2. CTD cast event numbers (STNNBR), and locations. All information has been stripped from the cruise event log. Note that on deep casts the EA600 seemed to be over-reading by 40-50 m.

CTD CAST	STNNBR	STATION	LAT	LON	DEPTH EA600 or EM122 (m)	DATE	TIME
1	1	NB	67.99834	-3.98539	3738	13/05/2018	08:03:00
2	2	NB	67.99833	-3.98545	3735	13/05/2018	09:03:00
3	10	NT11	75.3356	-5.46428	3571	15/05/2018	21:34:00
4	13	NT11	75.33556	-5.46434	3518	15/05/2018	23:24:00
5	19	NT10	75.48844	-6.04536	3495	16/05/2018	13:48:00
6	20	NT9	75.64234	-6.62752	3282	16/05/2018	18:41:00
7	21	NT8	75.79556	-7.21797	2695	16/05/2018	22:50:00
8	24	NT8	75.79556	-7.21794	2695	17/05/2018	00:31:00
9	27	NT8	75.79418	-7.2195	2702	17/05/2018	10:07:00
10	29	NT7	75.94852	-7.81841	2037	17/05/2018	17:29:00
11	30	NT7	75.94908	-7.81496	2040	18/05/2018	01:58:00

12	35	NT6	76.10225	-8.41915	1256	18/05/2018	15:33:00
13	39	NT5	76.25775	-9.02867	287	19/05/2018	00:03:00
14	42	NT5	76.25576	-9.0285	287	19/05/2018	02:08:00
15	50	NT6B	76.17927	-8.72192	753	19/05/2018	12:55:00
16	51	NT4	76.40921	-9.65243	247	19/05/2018	16:03:00
17	52	NT3	76.5683	-10.2649	271	19/05/2018	18:47:00
18	53	NT2	76.71327	-10.905	338	19/05/2018	22:03:00
19	57	NT2	76.71498	-10.8813	343	20/05/2018	17:57:00
20	69	F21	78.98491	-9.2813	257	22/05/2018	21:38:00
21	72	F21	78.98142	-9.27539	257	22/05/2018	23:28:00
22	76	F19	79.00227	-7.9943	203	23/05/2018	14:17:00
23	77	F17B	78.66576	-6.70865	246	24/05/2018	07:07:00
24	85	F17	78.99929	-5.98215	582	24/05/2018	21:35:00
25	89	F17	78.99976	-5.99101	570	24/05/2018	23:35:00
26	91	F16	79.00018	-5.49989	972	25/04/2018	05:43:00
27	99	F15	78.98609	-4.99978	1303	25/05/2018	22:16:00
28	103	F15	78.98248	-5.00698	1271	26/05/2018	00:10:00
29	105	F14	78.91409	-3.99921	2010	26/05/2018	07:38:00
30	110	F13	78.99685	-2.99575	2446	26/05/2018	20:43:00
31	114	F13	78.99649	-2.99958	2444	26/05/2018	23:15:00
32	119	F12	78.99979	-1.9966	2632	27/05/2018	10:53:00
33	120	F11	79.0002	-0.99976	2645	27/05/2018	14:31:00
34	121	F10	78.99993	-6.00E-05	2591	27/05/2018	20:08:00
35	125	F10	78.99995	2.00E-05	2591	27/05/2018	22:37:00
36	132	FS1	80.28328	2.00005	1921	28/05/2018	21:30:00
37	136	FS1	80.28329	2.00024	1922	28/05/2018	23:45:00
38	145	F8	79.00002	2.00024	2508	29/05/2018	21:42:00
39	149	F8	79.00008	2.00223	2508	29/05/2018	23:42:00
40	158	F9	78.99997	0.99981	2563	30/05/2018	18:37:00
41	159	HGIV	79.04837	4.33207	2458	30/05/2018	22:50:00
42	163	HGIV	79.04835	4.33214	2458	31/05/2018	00:50:00
43	166	F7	78.99997	3.33397	3044	31/05/2018	09:20:00
44	167	F6	79.00003	5.00006	2436	31/05/2018	14:01:00
45	168	F5	79.00013	5.99927	1874	31/05/2018	17:30:00
46	169	F4	79.03329	6.99998	1305	31/05/2018	21:02:00
47	173	F4	79.03328	7.00004	1305	31/05/2018	23:15:00
48	180	F3	79.03335	8.00019	1114	01/06/2018	13:41:00
49	181	F1	79.00026	8.66793	251	01/06/2018	16:17:00
50	182	F0	79.0002	9.07443	197	01/06/2018	17:32:00
51	183	V12	78.97927	9.48171	222	01/06/2018	18:43:00
52	184	F2	79.0333	8.33323	831	01/06/2018	21:09:00
53	188	F2	79.03328	8.33332	831	01/06/2018	23:08:00
54	191	F3B	79.03432	7.49755	1270	02/06/2018	05:02:00
55	192	F4B	79.01661	6.49995	1366	02/06/2018	07:33:00

56	201	KB0	79.03509	10.84316	315	02/06/2018	22:22:00
57	205	KB0	79.03509	10.84303	316	03/06/2018	00:14:00
58	207	KB1	79.02435	10.58379	296	03/06/2018	04:00:00
59	208	KB2	79.00151	10.02739	262	03/06/2018	05:37:00
60	209	V12	78.97966	9.48106	222	03/06/2018	07:06:00
61	218	ST1	77.41672	19.50015	145	04/06/2018	21:23:00
62	223	ST1	77.41674	19.50012	146	04/06/2018	23:03:00
63	230	ST2	77.12503	19.50003	155	05/06/2018	09:42:00
64	231	ST2a	77.125	17.63302	88	05/06/2018	13:03:00
65	232	ST2b	77.12603	18.09495	116	05/06/2018	14:25:00
66	233	ST2c	77.12468	18.54978	64	05/06/2018	15:51:00
67	234	ST2d	77.12487	19.02615	139	05/06/2018	17:08:00
68	235	ST2	77.12502	19.50002	156	05/06/2018	18:25:00
69	236	ST2e	77.125	19.96671	112	05/06/2018	19:48:00
70	237	ST2f	77.12517	20.37023	116	05/06/2018	20:55:00
71	238	ST2g	77.12498	20.74961	88	05/06/2018	22:01:00
72	239	B10	76.00001	10.66649	2260	06/06/2018	21:20:00

Data Acquisition

Data was acquired through Seasave Version 7.22.3.

The following raw data files were generated for each cast:

JR17005_001.bl (a record of bottle firing locations)
JR17005_001.hdr (header file)
JR17005_001.hex (raw data file)
JR17005_001.xmlcon (configuration file)

Where _001 is the cast number (not STNNBR)

SBEProcessing steps

The following processing routines were then run in the Seabird Data Processing software (Seasave Version 7.26.7).

1. **DatCnv**

Input: JR17005_XXX.hex, JR17005_XXX.xmlcon, JR17005_XXX.bl, JR17005_XXX.hdr

Output: JR17005_XXX.cnv, JR17005_XXX.ros

(where XXX refers to the CTD cast number, e.g. 001)

A conversion routine to read in the raw CTD data file (.hex) containing data in engineering units output by the CTD hardware. Calibrations as found in the instrument configuration file (.xmlcon) are applied (with the exception of the CDOM fluorometer where only the raw voltage was required).

Variables output:

0 = scan: Scan Count

1 = latitude: Latitude [deg]
2 = longitude: Longitude [deg]
3 = timeJ: Julian Days
4 = timeS: Time, Elapsed [seconds]
5 = pumps: Pump Status
6 = prDM: Pressure, Digiquartz [db]
7 = t090C: Temperature [ITS-90, deg C]
8 = t190C: Temperature, 2 [ITS-90, deg C]
9 = c0mS/cm: Conductivity [mS/cm]
10 = c1mS/cm: Conductivity, 2 [mS/cm]
11 = sbeox0V: Oxygen raw, SBE 43 [V]
12 = sbeox0Mm/L: Oxygen, SBE 43 [umol/l]
13 = v0: Voltage 0
14 = CStarAt0: Beam Attenuation, WET Labs C-Star [1/m]
15 = CStarTr0: Beam Transmission, WET Labs C-Star [%]
16 = v1: Voltage 1
17 = flC: Fluorescence, Chelsea Aqua 3 Chl Con [ug/l]
18 = v2: Voltage 2
19 = v6: Voltage 6
20 = par: PAR/Irradiance, Biospherical/Licor
21 = v7: Voltage 7
22 = altM: Altimeter [m]
23 = depSM: Depth [salt water, m]

The .ros files were created from the .bl files using a 5 second scan range duration and a scan offset of -2.5 seconds.

The default oxygen Tau correction was applied. The default Seabird correction for oxygen hysteresis was not performed at this stage. The optimal parameters are determined and applied later during Matlab processing steps.

2. **WildEdit**

Input and output: JR17005_XXX.cnv

Removal of pressure (and depth) spikes.

Standard deviations for pass 1: 2
Standard deviations for pass 2: 20
Scans per black: 100
Keep data within this distance of the mean: 0
Exclude scans marked as bad: yes

Wildedit was not applied to the conductivity and temperature because it seemed to result in bad data values of oxygen concentration derived after dynamic corrections (Filter, Align CTD and Cell Thermal Mass) are applied. A Matlab routine similar to Wildedit is therefore applied later to remove spikes in conductivity, salinity and temperature etc.

3. **Filter**

Input and output: JR17005_XXX.cnv

Smoothing of high frequency pressure and depth using a low pass filter. Low pass filter time of 0.15 seconds (as recommended by Seabird).

4. Align CTD

Input and output: JR17005_XXX.cnv

Here conductivity and oxygen values are shifted in time to compensate for sensor time lags.

a. Conductivity

Misalignment between the temperature and conductivity sensors can result in salinity spikes, particularly in sections of the profile that have strong gradients. The deck unit used on this cruises (SBE11 V1) automatically advances the primary conductivity by 1.75 scans (0.073 seconds), but does not advance the secondary conductivity sensor (note that on V2 deck units both the primary and secondary sensors are advanced). When aligned properly salinity spiking will be minimised. The alignment of both sensors was checked using downcast data to ensure the smoothest possible salinity profiles (Figure 2).

The 1.75 scan advance applied automatically to the primary sensor by the deck unit generally produced positive salinity spikes on the downcast indicating that conductivity had been advanced too much. Without any alignment, the secondary sensor produced negative spikes on the downcast, indicating conductivity lagging temperature.

The following conductivity advances were therefore applied in the AlignCTD processing module.

(1) Primary: -0.042 seconds (- 1 scan). Taking into account the default advance of 1.75 scans the overall advance was therefore 0.75 scans.
(2) Secondary: +0.042 seconds (+1 scan)

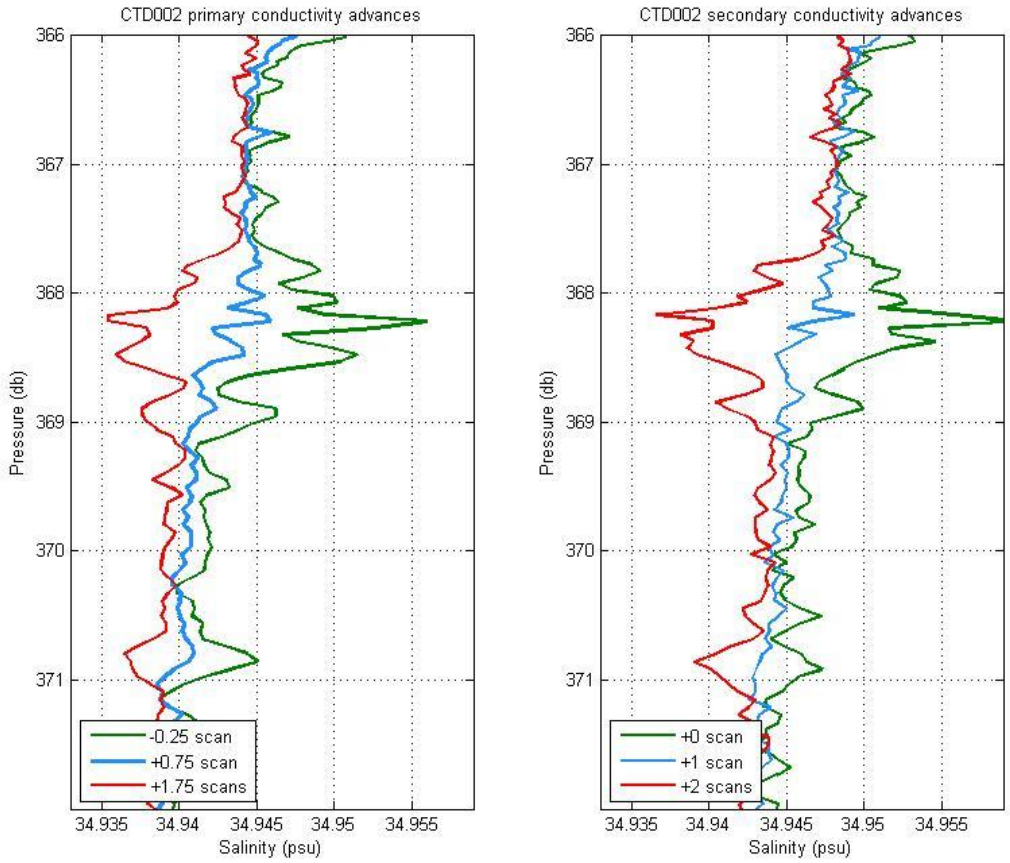


Figure 2. Example of conductivity alignment tests using CTD002. (a) Primary sensor. 1.75 scans (red) applied by the deck unit produced positive spikes. Crudely reversing this advance produced negative spikes (green). A 0.75 scan advance was optimal (blue) and minimised the worst of the salinity spiking throughout the whole profile. (b) Secondary sensor. Without any alignment negative spikes were observed on the downcast indicating that conductivity lagged temperature (green). A 2 scan advance (red) was too much resulting in positive salinity spiking (red). The optimal advance was 1 scan (blue).

b. Oxygen

SBE43 sensors have a typical response time of several seconds, varying with each individual sensor and varying with temperature (longer lag at colder temperatures). Several alignments (0, 2, 4, 6, 8, seconds) were tested on a subsection of casts, using a range of temperature and depths, and two different approaches. Firstly, the oxygen-pressure relationship was assessed by splitting each profile into up and down casts and then averaging into 2 db bins. The absolute value of the oxygen difference (μmol/l) between each corresponding up and down cast bin was computed and the median of these differences taken. Secondly, oxygen was plotted against temperature and the alignment of the up and downcasts assessed by eye. Averaged over the whole water column the median difference between the 2db averaged up and down casts gradually decreased between a 0 and 8 second lag, but was not especially sensitive. Visual inspection of various temperature-salinity plots suggested that alignments of 4, 6 and 8 seconds were all acceptable. We therefore apply the Seabird advance default of 6 seconds to the SBE43 oxygen sensor.

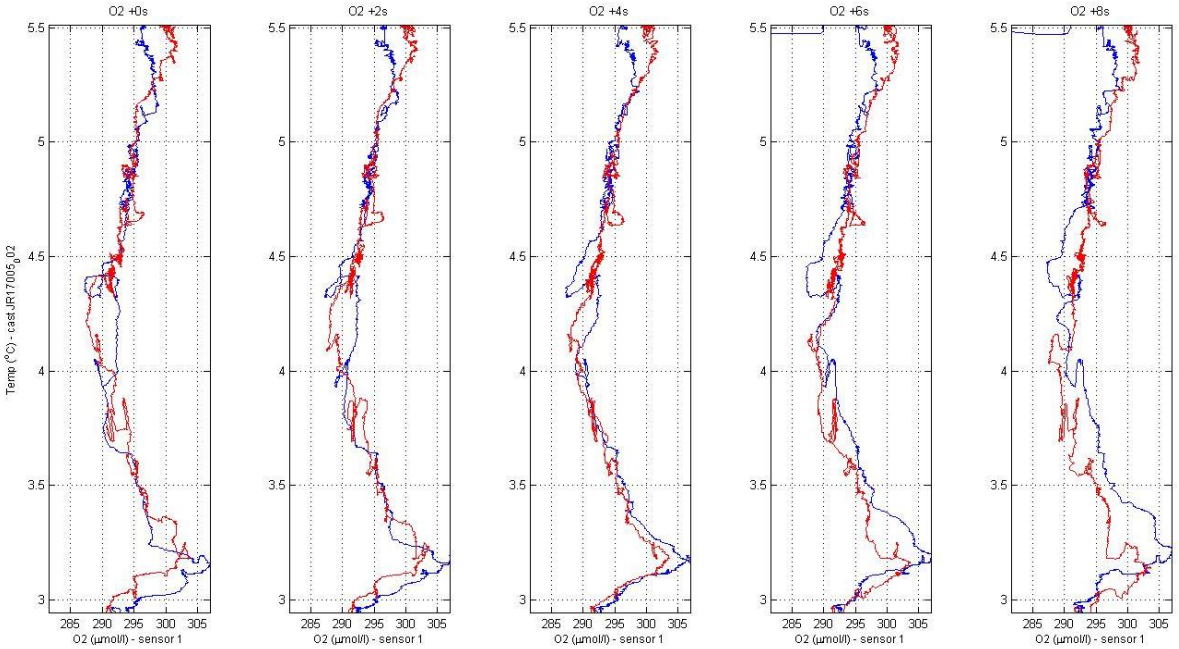


Figure 3. Temperature vs. oxygen concentration for a 0, 2, 4, 6 and 8 second alignment (left to right) of cast 002 in 3-5.5°C temperature water. Blue = downcast. Red = upcast. A 4 second alignment looks optimal here.

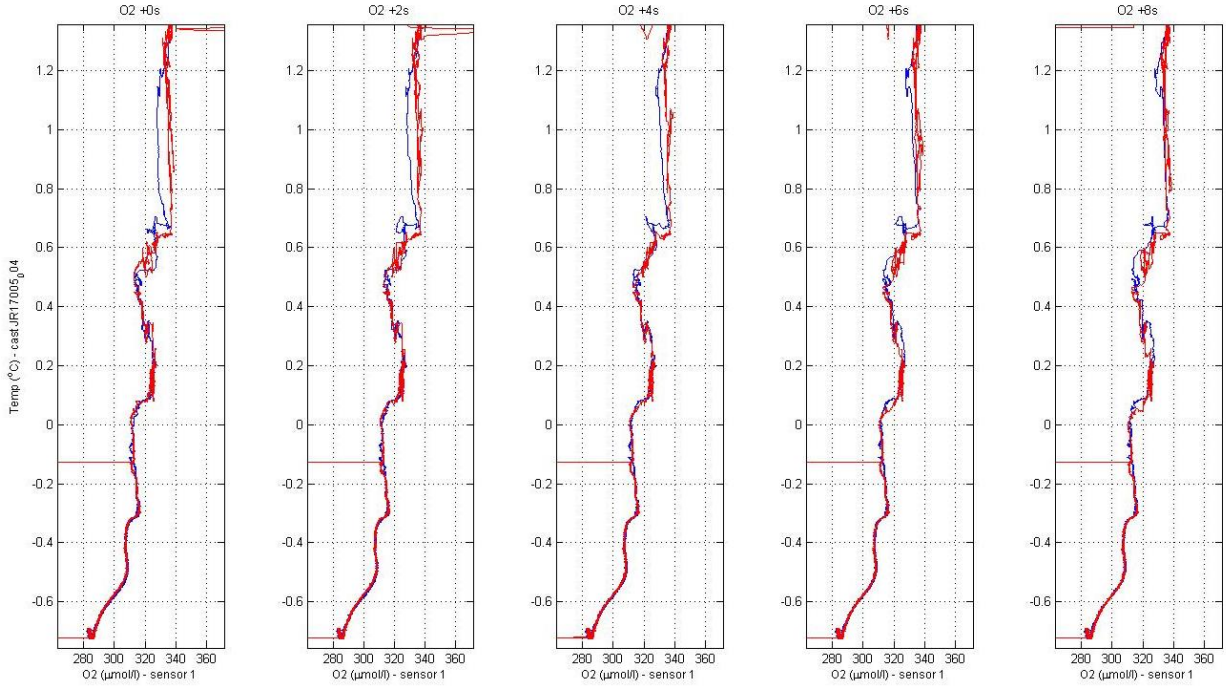


Figure 4. Temperature vs. oxygen concentration for a 0, 2, 4, 6 and 8 second alignment (left to right) of cast 004 (full profile shown). Water temperature ranges between -0.7 and 1.4°C and the alignment is improved with a greater advance (8 seconds producing the best agreement between up and down casts).

5. **CellTM**

Input and output: JR17005_XXX.cnv

Removes the effect of thermal inertia on the conductivity cells. Alpha = 0.03 (thermal anomaly amplitude) and 1/beta = 7 (thermal anomaly time constant) for both cells.

6. **Derive**

Input and output: JR17005_XXX.cnv

After the dynamic corrections have been applied (Filer, Align and CellTM), oxygen, salinity, density and sound speed are derived. Depth is also now calculated using the correct latitude (rather than the 78 N default that was selected under DatCnv)

Derived variables output:

24 = depSM: Depth [salt water, m]
25 = sal00: Salinity, Practical [PSU]
26 = sal11: Salinity, Practical, 2 [PSU]
27 = sigma-é00: Density [sigma-theta, kg/m^3]
28 = sigma-é11: Density, 2 [sigma-theta, kg/m^3]
29 = svCM: Sound Velocity [Chen-Millero, m/s]
30 = svCM1: Sound Velocity, 2 [Chen-Millero, m/s]
31 = sbeox0Mm/L: Oxygen, SBE 43 [umol/l], WS = 2

7. **BottleSum**

Inputs: JR17005_XXX.cnv, JR17005_XXX.bl

Output: JR17005_XXX.btl

Creation of a bottle file (.btl) using a 5 second window centred around the bottle firing times. All DatCnv variables plus derived salinity and oxygen are included. Note that the final bottle files are produced during the Matlab processing steps.

8. **Strip**

Input and output: JR17005_XXX.cnv

Removal of first depth variable created at the DatCnv stage.

9. **BinAvg (1)**

Input: JR17005_XXX.cnv

Output: JR17005_XXX_2hz.cnv

2Hz (0.5 seconds) averaging of all variable

10. **BinAvg (2)**

Input: JR17005_XXX.cnv

Output: JR17005_XXX_LADCP.cnv

1 second averaging for LADCP file

11. AsciiOut

Input: JR17005_XXX_LADCP.cnv

Output: JR17005_XXX_LADCP.asc

Output latitude, longitude, time (seconds), pressure, temperature and salinity for LADCP processing software.

Matlab Processing steps

1. **Create meta data file**

The following information was stripped from the cruise master event log maintained by BODC and used as header information for each CTD cast file.

CRUISE	JR17005
CAST	CTD Cast Number
STNNBR	Event Number (matches bridge log)
DATE	Date of start of cast
TIME	Time of start of cast (in GMT)
LAT	Latitude at the start of the cast
LON	Longitude at the start of the cast
DEPTH	EA600 echo sounder depth at the start of the cast (EM122 in Storfjorden)

2. **Read .cnv files**

The 24Hz and 2Hz .cn files created by the SBEProcessing Software were read into a matlab structure and combined with the meta data information

3. **Correct for deep oxygen hysteresis**

"Under extreme pressure, changes can occur in gas permeable Teflon membranes that affect their permeability characteristics. Some of these changes have long time constants and depend on the sensor's time-pressure history. These slow processes result in hysteresis in long, deep casts"

Seabird Application Note 64-3 (Aug 2014)

Seabird provides a correction algorithm that operates through the entire data profile to correct the oxygen voltage values for permeability as pressure varies. At each measurement, the correction to the membrane permeability is calculated based on the current pressure and how long the sensor spent at previous pressures. The algorithm requires three parameters to be set:
(1) H1, the amplitude of the hysteresis function (default =-0.033, range = -0.02 to -0.05)
(2) H2, the function constant or curvature function (default = 5000)
(3) H3, the time constant for hysteresis in seconds (default=1450, range = 1200 to 2000).
See the SBE application note for full details on the functional form.

Here we attempt to improve on the SeaBird default (H1=-0.033, H2 = 5000, H3 = 1450) by applying a depth varying H3 (increasing time constant with depth). H3 is set to vary from

1200 seconds at the surface to 2000 seconds below 1500 metres (1450 seconds between 1000-1500 m). The improvement that this made over the standard Seabird default was monitored throughout the cruise. The improvement over the default constant value of H3=1450 seconds is minimal, but worth applying nonetheless. Over the entire cruise the median difference between the down and up cast oxygen concentrations was 0.85 µmol/l (Seabird default was 0.95 µmol/l). When the oxygen concentration difference between the down and up casts is expressed as a percentage of the total range in oxygen measured throughout the profile the differences are relatively small (1% of the total range). These differences are also acceptable when compared to the typical standard deviation of 0.8 µmol/l that three triplicate Winkler samples produces.

Table 3. Median difference between full down and up cast oxygen concentrations for all CTD profiles (in µmol/l). Values in brackets express these differences as a percentage of the total oxygen concentration range (variable with each cast).

	SBE default	**JR17005 correction**
Median down-up cast oxygen difference (all casts, full depth)	-0.95 µmol/l (1.48%)	-0.85 µmol/l (1.22%)
Median down-up cast oxygen difference for all casts deeper than 1000 m	-0.91 µmol/l (1.21 %)	-0.73 µmol/l (0.94%)

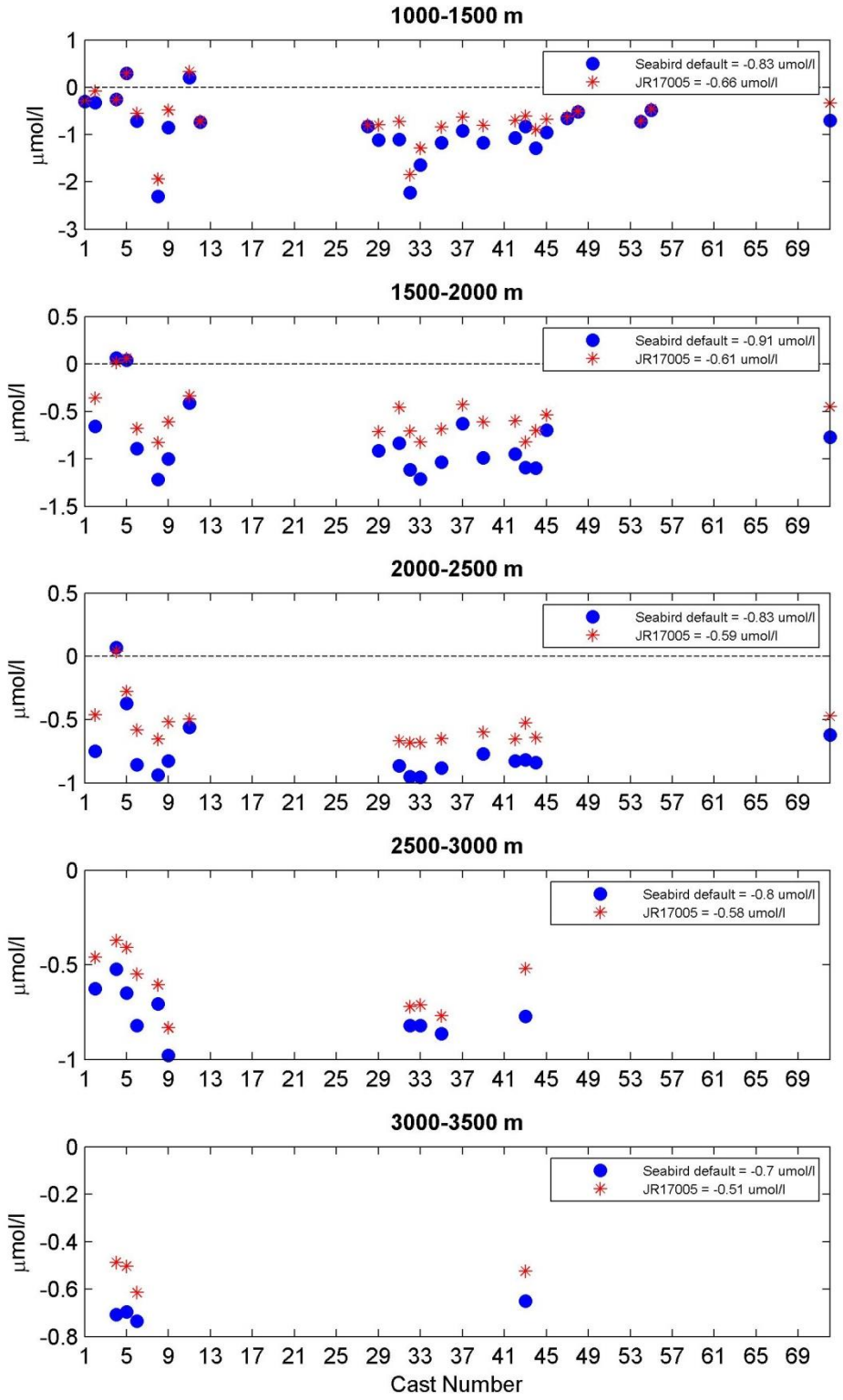


Figure 5. Median down minus up cast difference in oxygen concentration within 500 m depth intervals (below 1000 m) for all JR17005 CTD casts. Over each depth range slight improvements are made.

4. Remove surface soak and out of water readings

The 2Hz pressure, pump status and oxygen data (slowest of all the sensors) were plotted on screen and the start and end of each cast was identified manually. The start was defined as the

shallowest pressure after the initial surface soak (at approximately 10 m), just before the CTD package started it's decent. The end of each cast was selected as the last good oxygen data point. The pump status was plotted to ensure that the pumps were on during the selected time period. The start and end times were saves in a master file and used to crop the full 24Hz profile.

5. **Filter**

A routine similar to WildEdit in the SBE Data Processing was used to automatically de-spike the temperature, conductivity, salinity, density, oxygen and transmission variables. Blocks of data were scanned twice. In the first pass the mean and standard deviation of data in a block are calculated. Any data points within that block that differed from the mean by more than the specified standard deviations were removed. The mean and standard deviation were then recomputed. Any remaining data that differed from the second mean by more than the standard deviations specified for pass 2 were also removed (NaN'd). The block size and number of standard deviations differed for each variable.

Scans per block : 50 to 200
Standard deviations for pass 1 : 2 or 3
Standard deviations for pass 2: 2 or 3

6. **Create bottle files**

The scan number for each bottle firing was extracted from the .bl files and all variables were extracted in 5 second windows centred on the bottle firings. Averages, standard deviations, minima and maxima were all computed and saved.

7. **Split up and downcasts**

The profile was split into up and down casts (based on the maximum pressure record).

8. **Manual de-spiking**

The downcast twin temperatures, twin salinities, oxygen, fluorometer, PAR, beam attenuation and transmission were all further quality controlled in a graphical user interface. Firstly, any spikes not removed by the automatic filter were flagged and removed. Secondly, larger spikes in the CT sensors lasting a few seconds, predominantly in regions of strong density gradients were identified. This is a persistent problem in near surface waters with strong property gradients, particularly where a large CTD package carry large volume Niskin bottles is used. The spikes tend to coincide with a decrease in the decent rate of the CTD package and are therefore likely associated with inefficient flushing of water around the sensors. It is caused by the pitch and roll of the boat, so is accentuated in rough weather. As the decent rate of the CTD package slows on the downcast 'old' water (from above) is pushed back passed the sensors. As the decent rate increases again 'new' water is flushed past the sensors. A similar problem can occur if the veer rate on the CTD winch varies.

On JR17005 the first few hundred metres of each profile was assessed for significant anomalies. Where spikes were identified in the primary (secondary) temperature or conductivity, the matching derived salinity and density values were also removed.

CTD cast 49 suffered particularly within the top 100 m from this. Only 2 of the most prominent anomalies were removed though. The worst was removed during the 1 db averaging.

Shallow casts within Storfjorden (casts 61-71) were all affected by old water being flushed past the sensors. Whilst the most significant anomalies were identified and removed it was impossible to eliminate every instance. Care should be taken not to over interpret these features.

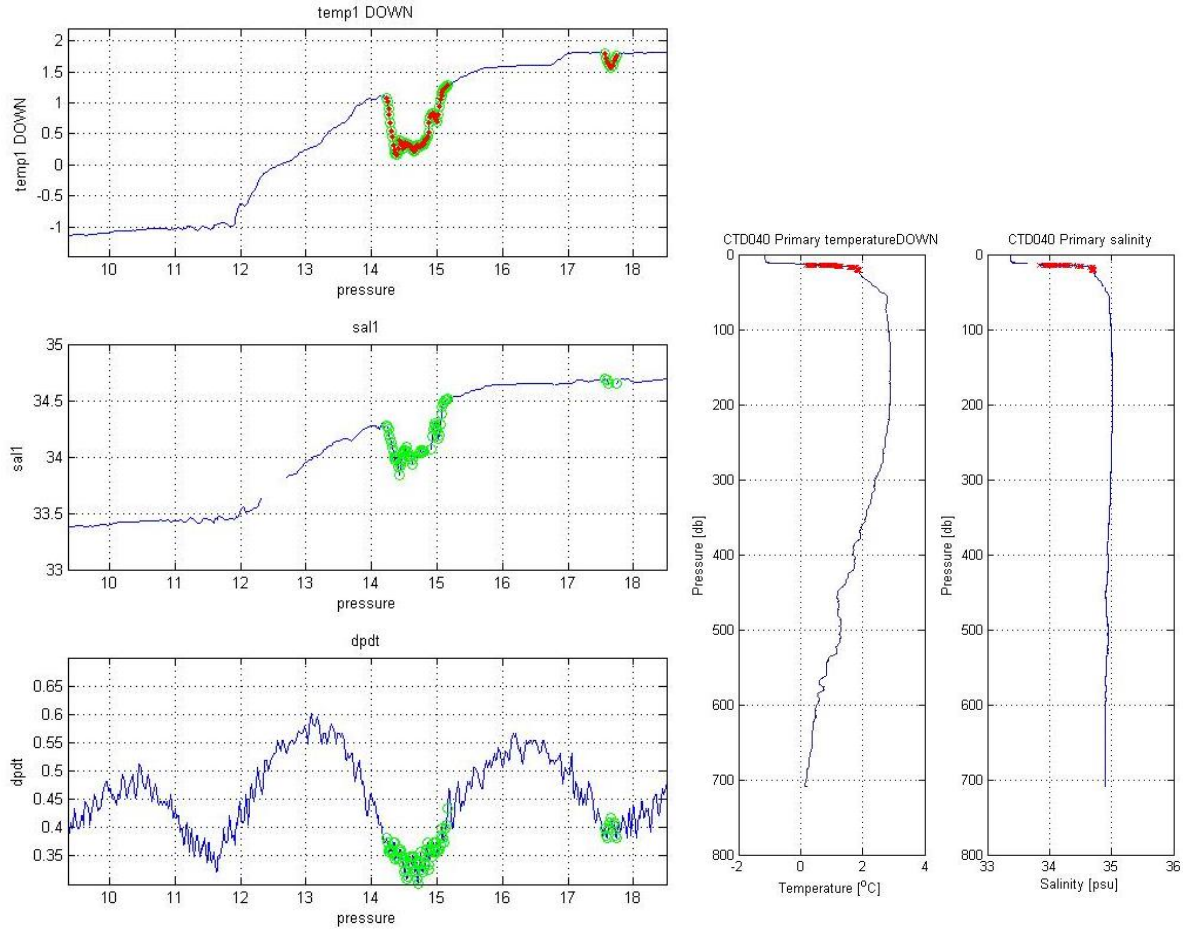


Figure 6: Example of a broad (1 m) spike in the temperature and salinity associated with a decrease in the decent rate of the CTD package as it passes through a sharp gradient in temperature (3°C increase over 6 metres) and salinity. As the CTD package slows colder (and fresher) water from above is pushed back past the sensors again. The section between 14 and 15 db was identified manually and removed from the profile.

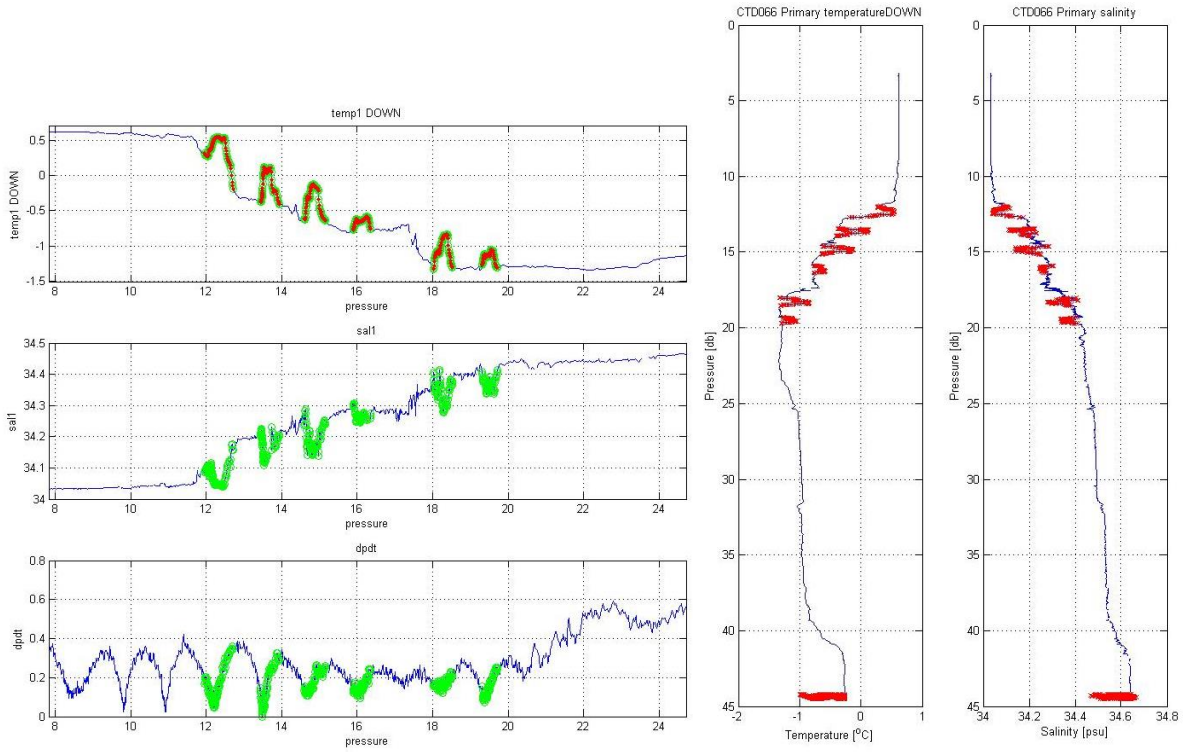


Figure 7: Multiple warm anomalies on CTD cast 66 associated with a decrease in the decent rate of the CTD package and old water being flushed past the sensors. Anomalies manually identified (in red/green) were removed.

9. 1db and 10db averaging

Variables were averaged into 1 db and 10 db bins. Missing or cropped out data was linearly interpolated for bins between the maximum and minimum pressure. No extrapolation was performed at the surface or bottom.

10. Apply oxygen and salinity calibrations

Oxygen and salinity samples were taken from the CTD Niskin bottles to calibrate the respective sensors.

(a) Salinity

A total of 171 salinity samples were taken from Niskin bottles throughout the cruise. Approximately 100 of these were from the top 400 m of the water column from CTD casts along the western side of the F-Line. These were taken specifically for ARISE project partners at the Norwegian Polar Institute. The remaining salinity samples were taken in deeper water to provide more stable calibration samples for the CTD sensors. The salinities of samples taken ranged between 31.49 psu and 35.05 psu.

For each sample the bottle (including the cap and plastic insert) was rinsed 3 times with the Niskin sea water and then filled. The bottle neck (inside and outside), plastic insert and cap were all wiped dry and then the insert and bottle top were fitted. Once a crate of 24 bottles was filled it was rinsed with fresh water and then placed in the same temperature controlled

room as the Autosal (S/N 68959) for 24 hours to acclimate to the laboratory temperature. Further details on the Autosal setup and standardisation can be found in the report provided by NMF technician Dougal Mountfield.

At the start and the end of each crate a standard sea water (SSW) sample was analysed to monitor any drift of the Autosal instrument. For the first crate run (26th May 2018) the Autosal was reading 0.001 psu too high (but still below the instrument specification of 0.002 psu). This offset increased linearly throughout the cruise (Figure 8). Therefore, for each crate the average of the two SSW offsets was used to correct the Autosal reading.

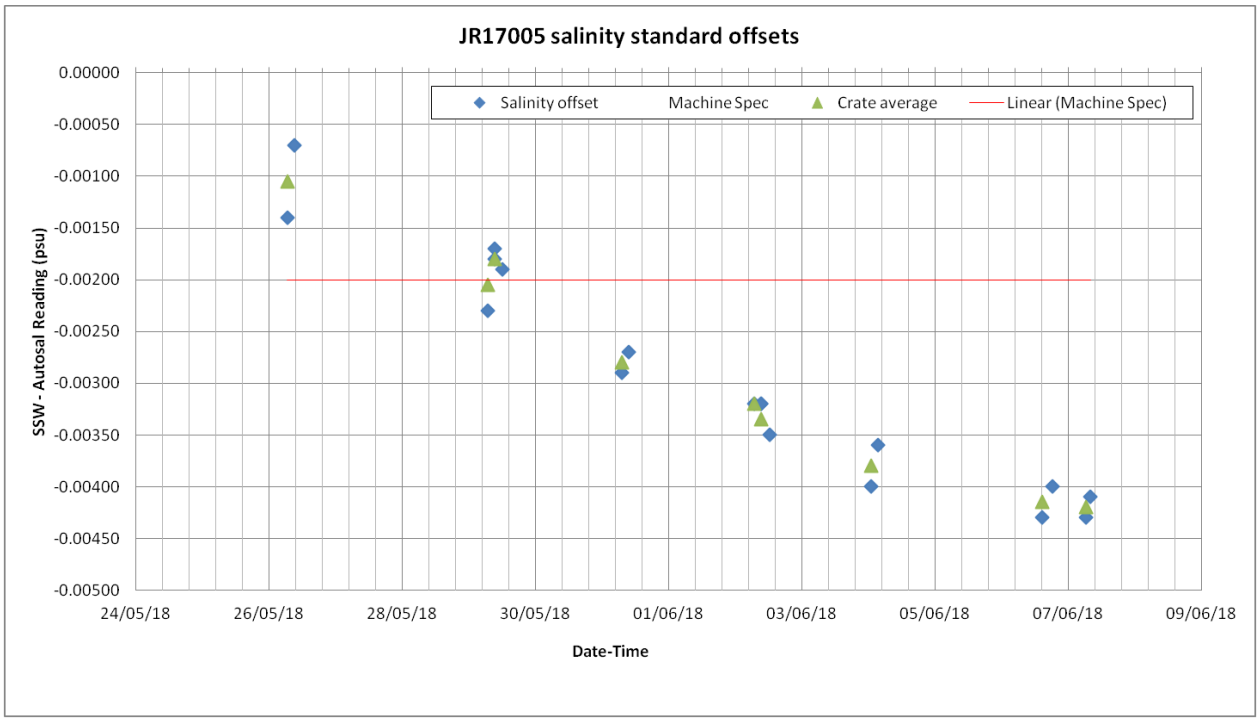


Figure 8 Autosal salinity offset from the seawater standard. Green triangles are the average crate offsets applied to the salinity readings within the associated crate.

The differences between the Autosal salinity and the primary/secondary CTD salinity were calculated for all 171 salinity samples.

A few samples were removed immediately from the calibration because the average salinity recorded by the CTD was more than 1 psu greater than the salinity measured by the Autosal (Cast 21, Niskin bottle 12, 100 m depth, and Cast 26, Niskin bottle 1, 951 m depth). This was mostly likely a result of human error while sampling and/or completing the logs.

The median and standard deviation of the remaining CTD and Autosal salinity differences was calculated for both sensors. All samples with a difference larger than 0.2 standard deviations from the median were excluded. These were predominantly from the top 400 m of the water column where both temperature and salinity gradients were highest. The median offsets were subsequently recalculated.

For sensor 1, 40 out of 144 data points were rejected (27.8%)
For sensor 2, 38 out of 144 data points were rejected (26.4%)

There was no temporal trend so the following constant offsets were applied

Salinity sensor 1 offset: -0.0071 psu (CTD reading too low)
Salinity sensor 2 offset: -0.0034 psu (CTD reading too low)

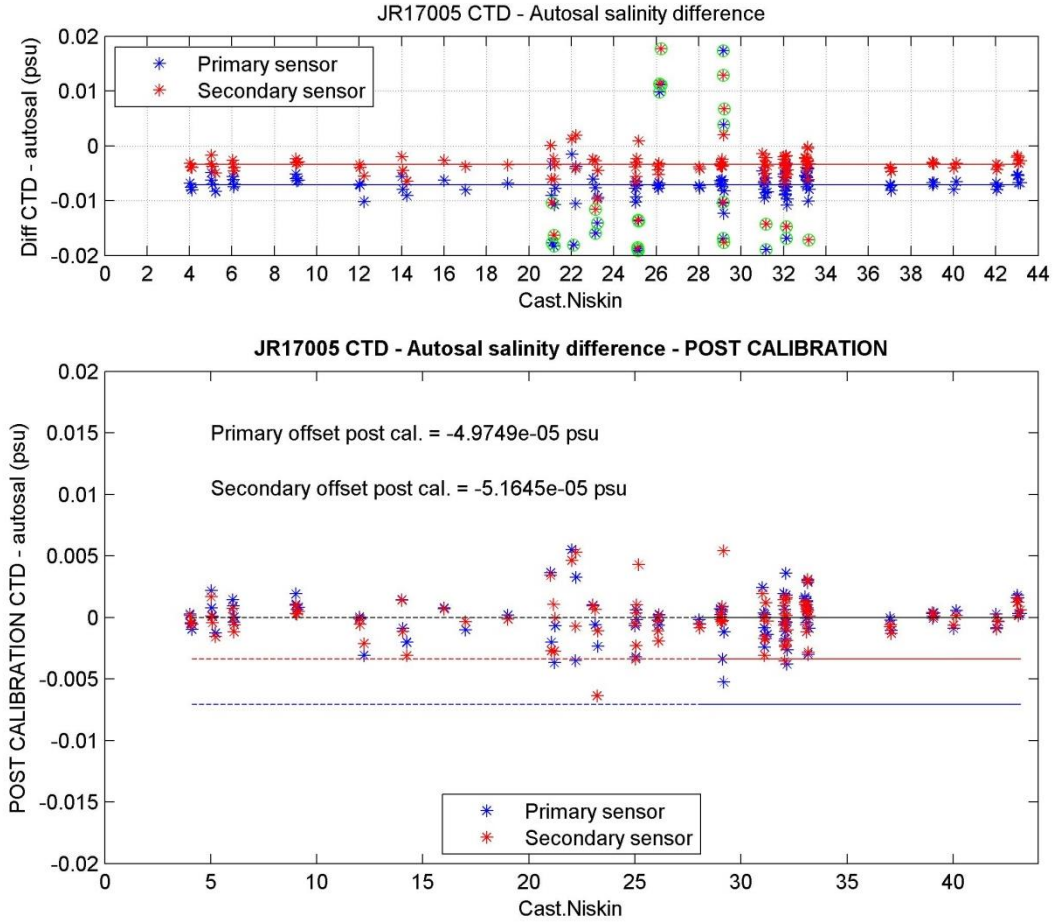


Figure 9. Top. CTD minus Autosal differences for the primary and secondary sensors. Points in green are > 0.2 standard deviations from the median and were discarded. Red and blue lines are the median offsets once outliers in green were removed. **Bottom.** CTD minus Autosal salinity differences once the offsets (dashed red and blue horizontal lines) had been applied.

Once the salinity had been corrected the conductivity and potential density were both recalculated.

(b) Oxygen

The oxygen sensor has been calibrated against Winkler titration samples collected from CTD Niskin bottles (see relevant section of this cruise report for details of sample collection and analysis). Of the 92 measurements available (average values from triplicate samples) those that had a standard deviation greater than 1 umol/l were discarded. This left 70 measurements for the CTD sensor calibration collected from depths between the surface and 3500 m depth.

The offsets between the CTD sensor and the Winkler samples were calculated. The mean offset was -17.08 umol/l (CTD sensor under-reading). A significant trend in offset with depth was identified (Figure 10).

offset_depth = (-0.00098567 x depth) – 15.9029

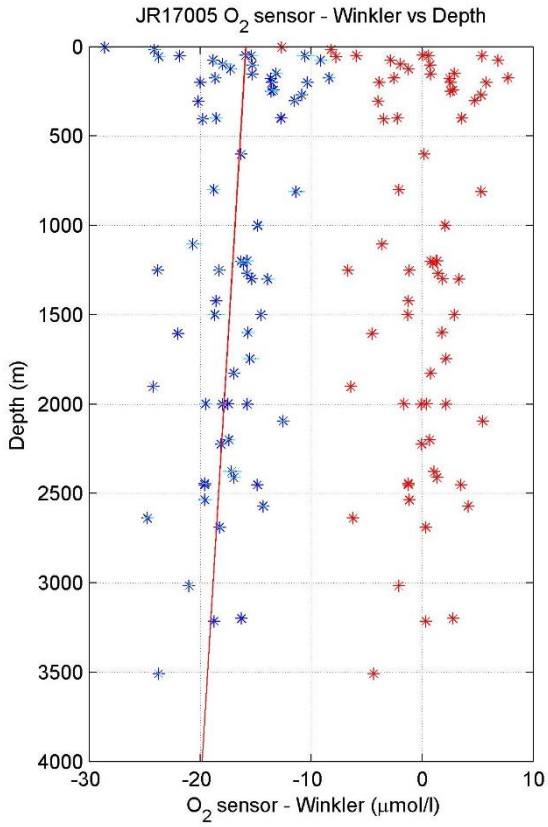


Figure 10. CTD sensor – Winkler sample vs. sample depth (blue) and significant linear trend (red line). Red stars are the offsets after correction.

Although the mean offset following the above depth correction was zero, a significant trend over time was detected when all values were considered (red line in Figure 11). However, there is a 3 day gap in sampling (days 140-143) resulting from the transit time between the end of the NT-line and the start of sampling on the F-line. If the data are split into two separate periods, pre- and post- May 21st 2018 (day 141), a significant linear trend over time is not detected in either of these individual periods. This would suggest that there was either a jump in the offset around May 21st or that no further correction to the data is necessary. The mean offsets (following the depth correction) pre- and post- May 21st 2018 are shown in green in Figure 11. They are -2.9943 and 1.4653 umol/l respectively.

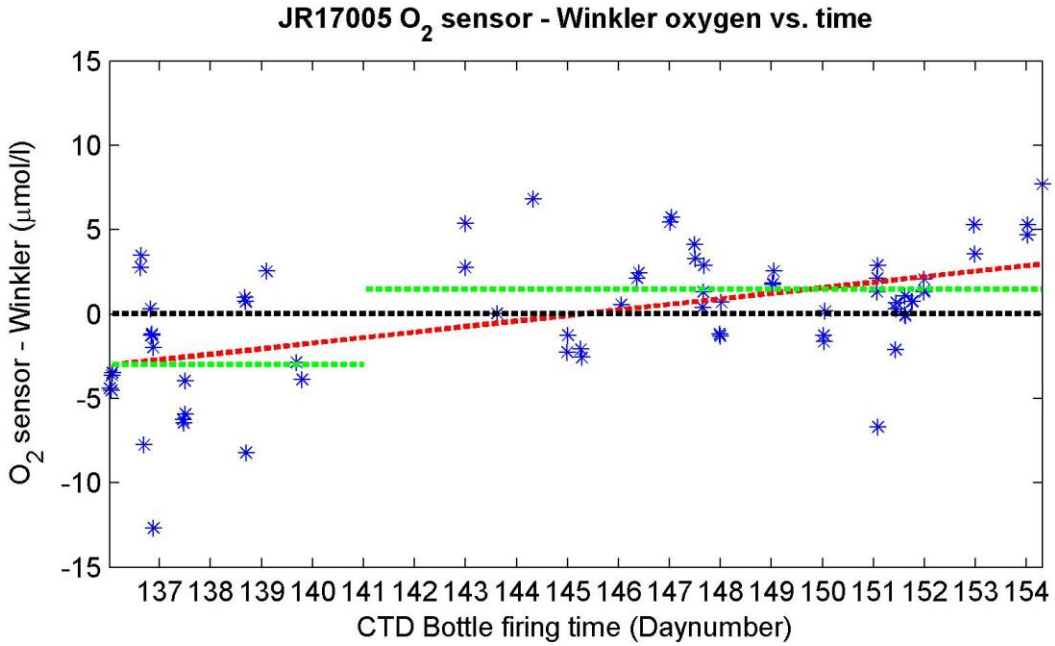


Figure 11. CTD sensor – winkler sample offset vs. time AFTER correction for the depth dependent offset. Red line = linear trend. Green lines = pre- and post May 21st average offsets. Black line = mean (zero) offset.

To establish whether any further correction was needed a comparison to historical data downloaded from the Glodapv2 data base and from two Polarstern cruises (PS100 in 2016 and PS80 in 2012, downloaded from Pangaea) was made. Regardless of whether any further corrections are applied or not, the JR17005 oxygen profiles align well with historical data sets collected in the area. Based on 2016 data collected around the NT-Line and a 2012 transect from the Fram Strait, together with (a) the scatter in CTD-Winkler offsets and (b) the standard deviations of the Winkler sample triplicates, we concluded that any further corrections would not meaningfully improve the quality of the oxygen profiles.

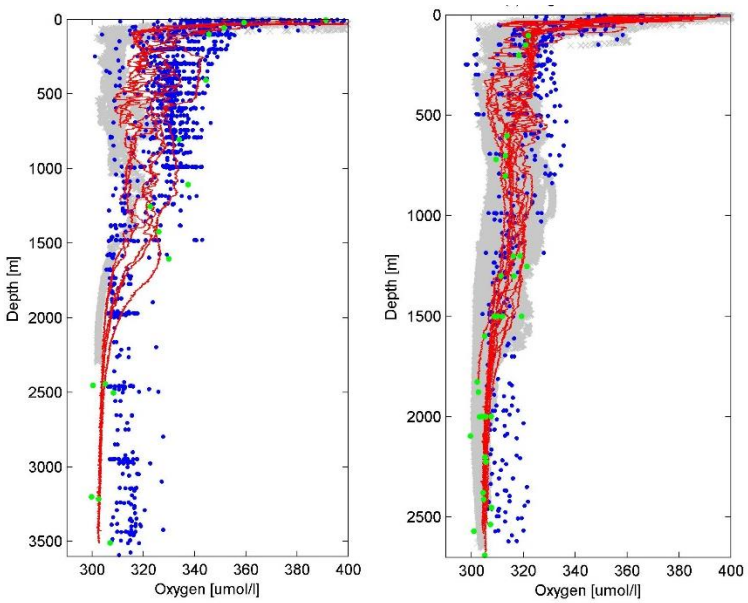


Figure 12. Left. Glodapv2 data (blue dots) and PS100 (2016) data (grey) from near the NT-Line. JR17005 oxygen profiles in red. Winkle samples as green dots. Pre- May 21st 2018. **Right.** Glodapv2 data (blue dots) and PS80 (2012) data (grey) from around the F-Line. JR17005 oxygen profiles in red. Winkler samples as green dots. Post May 21st 2018.

The final calibrated files contain the following variables:

CTDlatitude	Latitude
CTDlongitude	Longitude
CTDjday	Julian Days
CTDpres	Pressure (db)
CTDdepth	Depth (m)
CTDtemp1	Primary temperature (°C)
CTDtemp2	Secondary temperature (°C)
CTDfluor	Chlorophyll-a (mg m^{-3})
CTDatt	Beam Attenuation (1/m)
CTDxmiss	Beam Transmission (%)
CTDpar	PAR/Irradiance (W m^{-2})
CTDaltim	Altimeter (metres above bottom)
CTDcond1	Primary conductivity (mS/cm)
CTDcond2	Secondary conductivity (mS/cm)
CTDsal1	Primary salinity (psu)
CTDsal2	Secondary salinity (psu)
CTDpden1	Potential density from primary sensors (kg m^{-3})
CTDpden2	Potential density from secondary sensors (kg m^{-3})
CTDoxy	Oxygen concentration (µmol/L)

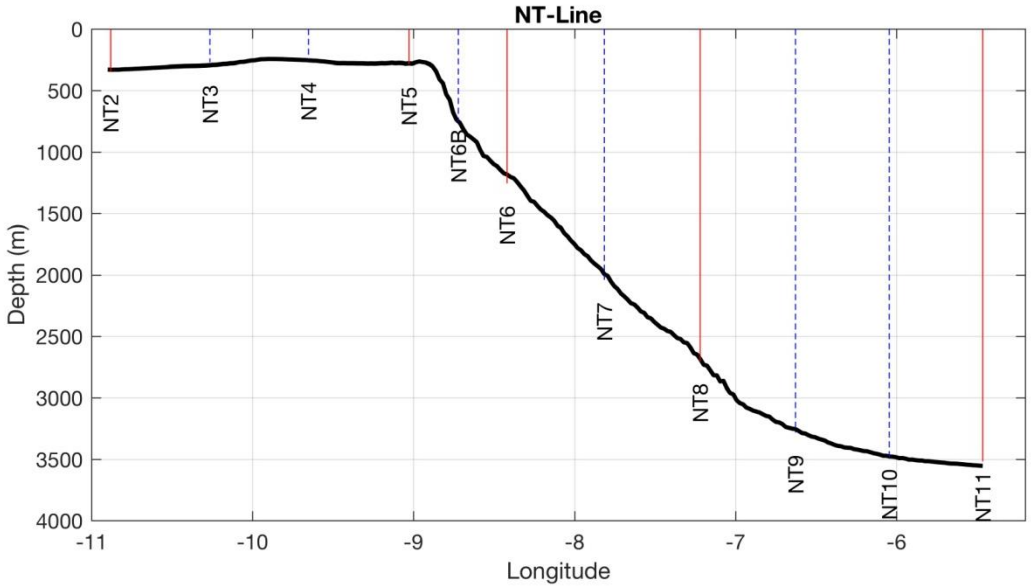


Figure 13. Longitude and depths of CTD casts and full sampling stations (red) along the NT-Line.

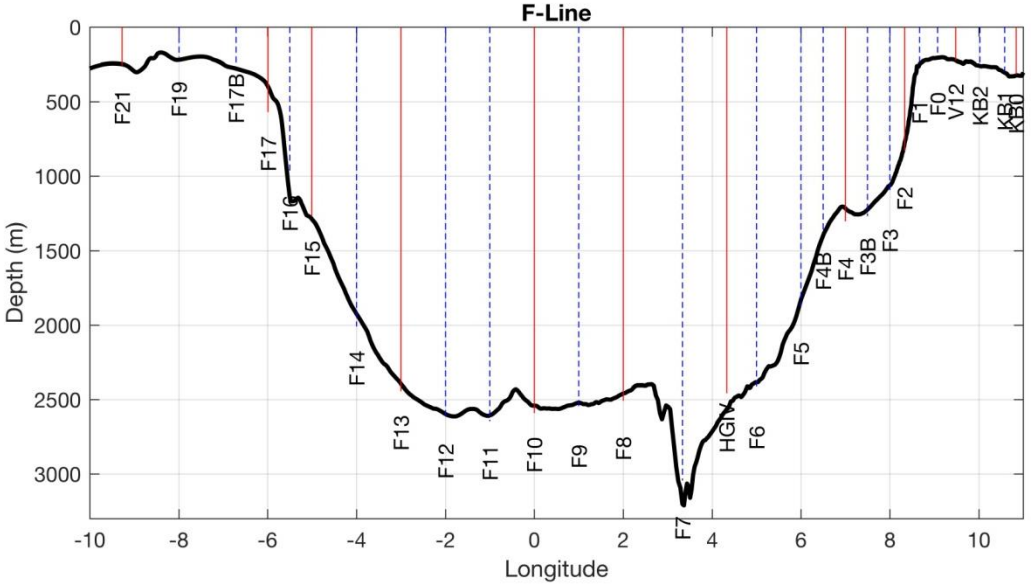


Figure 14. Longitude and depths of CTD casts and full sampling stations (red) along the F-Line.

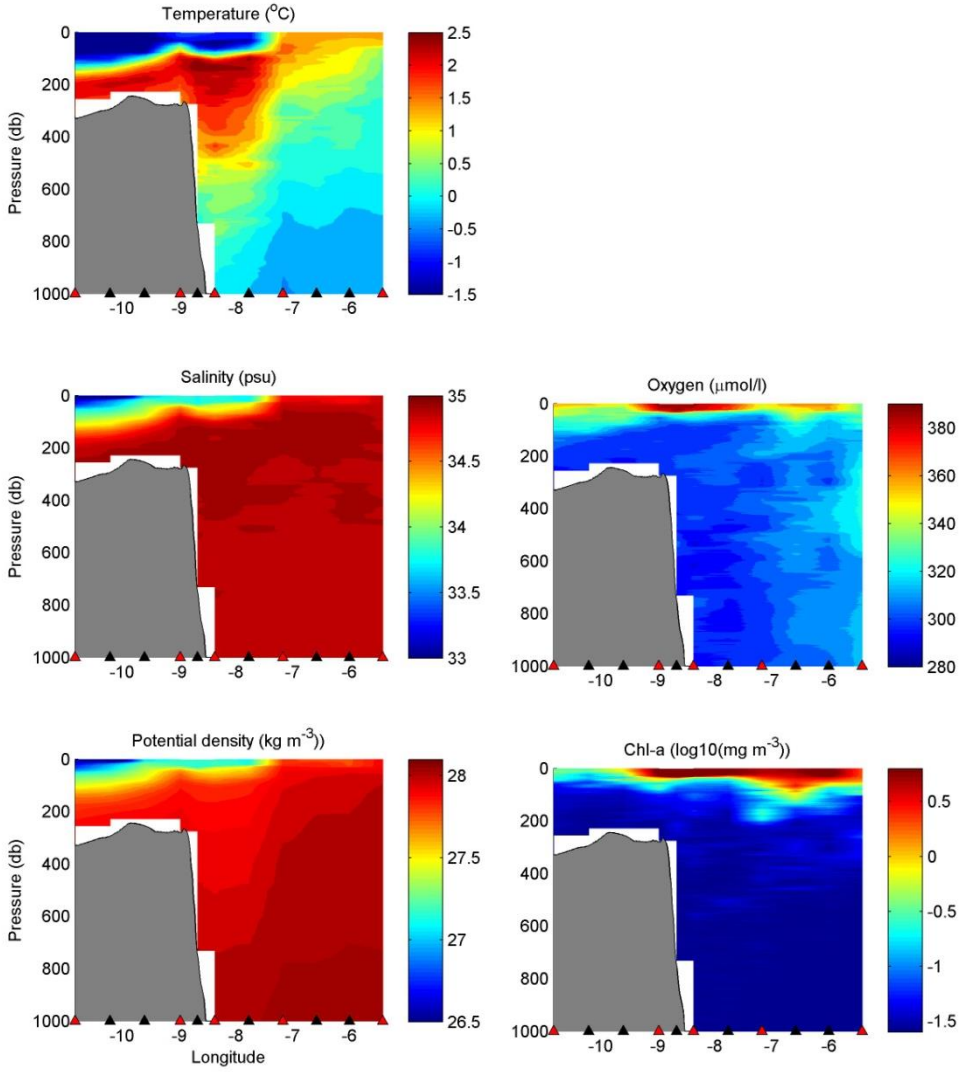


Figure 15. Upper 1000 m of NT-Line CTD transect (UNCALIBRATED)

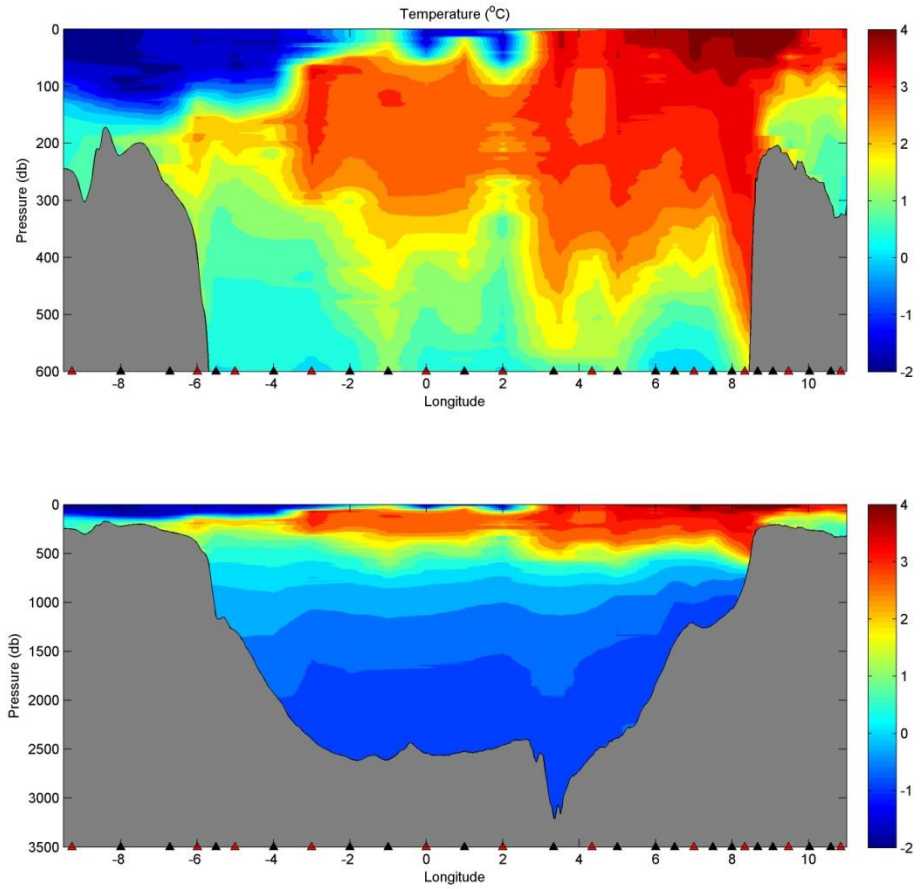


Figure 16. F-Line temperature. Top: Upper 1000 m. Bottom: Full depth.

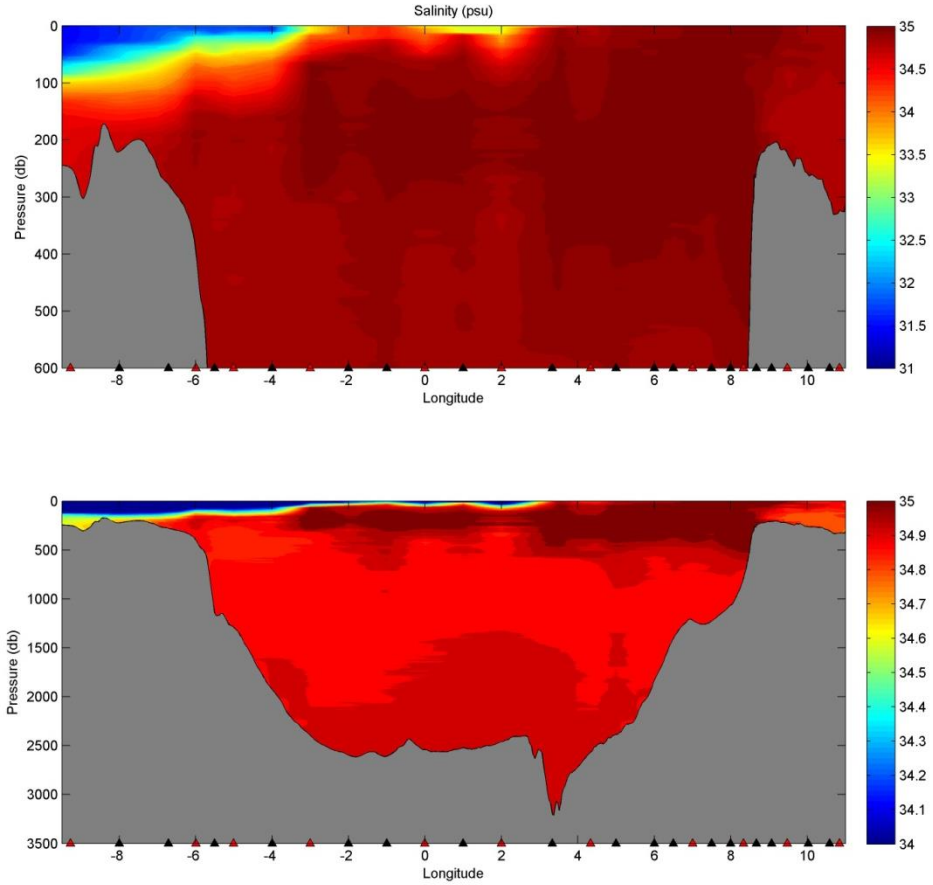


Figure 17. F-Line salinity (un-calibrated). Upper 1000 m. Bottom: Full depth.

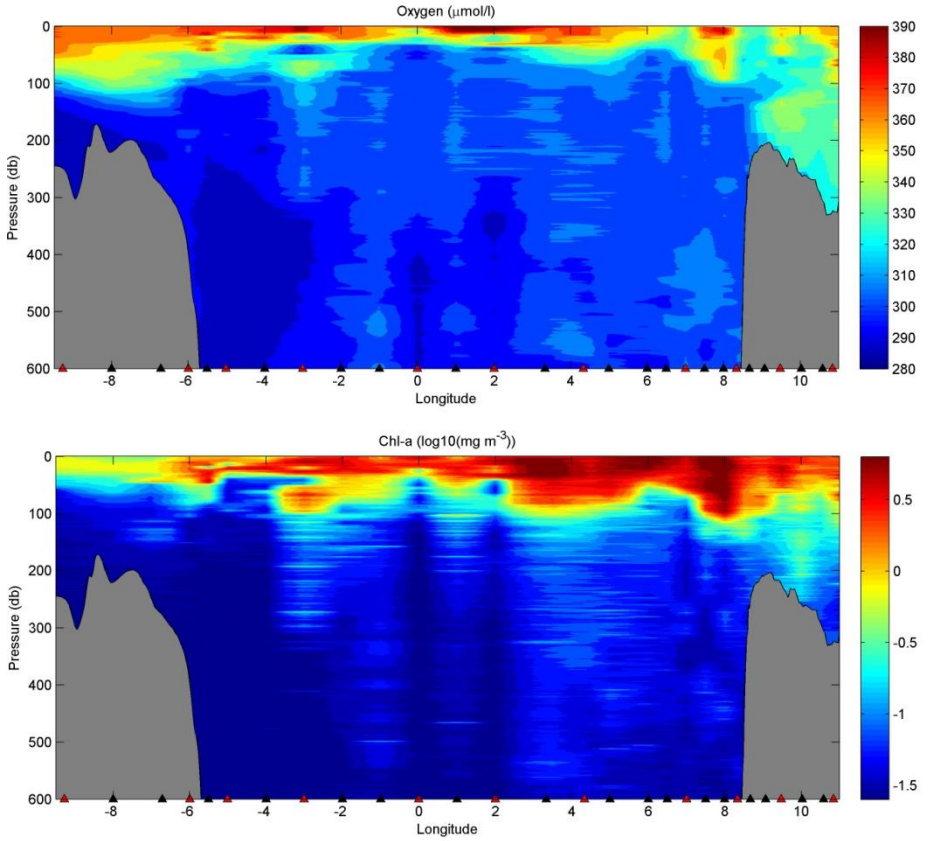


Figure 18. F-Line oxygen and chlorophyll in upper 600 m (un-calibrated)

2.2 Lowered Acoustic Doppler Current Profiler (LADCP)

Jo Hopkins[1] (National Oceanography Centre, Liverpool)

[1]*Data set PI and author*

Data collection

Velocity profiles were collected at all CTD stations. A pair of 300 kHz RDI Workhorse LADCPs were deployed on the CTD frame, one upward looking (S/N 14897) and one downward looking (S/N 15060). The downward looking instrument behaved as a master to the upward looking instrument (the slave).

Configuration: 4 Beam Janus
Beam angle: 20°
Beam Pattern: convex
Configuration
- Time per burst: 2.8 seconds
- Time per ensemble: 1.3 seconds
- Number of depth cells: 25
- Bin size: 8 m
- Narrow bandwidth
- Ambiguity velocity: 400 cm/s

RDI BB-talk software was used to programme and download data from the ADCPs. Just before deployment the following command file was first sent to the slave.

```
WM15              ; water mode 15 (LADCP)

LP1               ; pings per ensemble
TP 00:00.00       ; time between pings
TE 00:00:00.00    ; time per ensemble

LN25              ; number of depth cells
LS0800            ; bin size [cm]
LF0               ; blank after transmit [cm]

WB1               ; narrow bandwidth mode 1 (not sure if required)
LW1               ; narrow bandwidth LADCP mode
LV400             ; ambiguity velocity [cm/s]

SM2               ; slave
SA011             ; wait for pulse before ensemble
SB0               ; disable hardware-break detection on Channel B (ICN118)

EZ0011101
; Sensor source:
;      - manual speed of sound (EC)
;      - manual depth of transducer (ED = 0 [dm])
;      - measured heading (EH)
;      - measured pitch (EP)
;      - measured roll (ER)
;      - manual salinity (ES = 35 [psu])
;      - measured temperature (ET)

EX00100
; coordinate transformation:
```

```
;     - radial beam coordinates (2 bits)
;     - use pitch/roll (not used for beam coords?)
;     - no 3-beam solutions
;     - no bin mapping

CF11101
; Flow control:
;     - automatic ensemble cycling (next ens when ready)
;     - automatic ping cycling (ping when ready)
;     - binary data output
;     - disable serial output
;     - enable data recorder

CK                ; keep params as user defaults (across power failures)
CS                ; start pinging
```

The master was then sent the following commands.

```
      WM15              ; water mode 15 (LADCP)

      TC2               ; ensembles per burst
      LP1               ; pings per ensemble
      TB 00:00:02.80    ; time per burst
      TE 00:00:01.30    ; time per ensemble
      TP 00:00.00       ; time between pings

      LN25              ; number of depth cells
      LS0800                 ; bin size [cm]
      LF0               ; blank after transmit [cm]

      LW1               ; narrow bandwidth LADCP mode
      LV400             ; ambiguity velocity [cm/s]

      SM1               ; master
      SA011             ; send pulse before each ensemble
      SB0               ; disable hardware-break detection on Channel B
                        (ICN118)
      SW5500            ; wait .5500 s after sending sync pulse
      SI0               ; # of ensembles to wait before sending sync pulse

      EZ0011101
      ; Sensor source:
      ;     - manual speed of sound (EC)
      ;     - manual depth of transducer (ED = 0 [dm])
      ;     - measured heading (EH)
      ;     - measured pitch (EP)
      ;     - measured roll (ER)
      ;     - manual salinity (ES = 35 [psu])
      ;     - measured temperature (ET)

      EX00100
      ; coordinate transformation:
      ;     - radial beam coordinates (2 bits)
      ;     - use pitch/roll (not used for beam coords?)
      ;     - no 3-beam solutions
      ;     - no bin mapping

      CF11101
      ; Flow control:
      ;     - automatic ensemble cycling (next ens when ready)
```

```
      ;     - automatic ping cycling (ping when ready)
      ;     - binary data output
      ;     - disable serial output
      ;     - enable data recorder

      CK                ; keep params as user defaults (across power
failures)
      CS                ; start pinging
```

Raw data was saved using the file naming convention JR17005_XXXM.000 and JR17005_XXXS.000 where XXX refers to the CTD cast number and ‘S’ or ‘M’ to the slave or master ADCP.

Data processing and preliminary observations

Each cast was processed using the LDEO version IX.13 software, a package that implements the velocity inversion method for LADCP processing, originally developed by Martin Visbeck. Setup details can be found in ‘*A. M. Thurnherr, How to Process LADCP Data With LDEO Software, Jan 17th 2018*’. Raw data from each LADCP file was combined with 1 second averaged temperature, salinity and pressure from the corresponding CTD cast to provide accurate information on the vertical velocity of the frame through the water, and with 1 second navigation data (longitude and latitude) to calculate the frames exact position and to constrain its motion using a drag model. The exact geographical location of the station is also used to calculate the magnetic declination.

Preliminary north-south and east-west velocities produced by the LDEO software from casts along the Fram Strait (F-line) are shown in Figure 1 below, but should be treated with caution. Firstly, on a significant number of casts a large compass deviation error warning was produced (varying between 10 and 30 degrees). This needs to be investigated. Secondly, the velocities, especially at depth, need to be checked against geostrophic profiles calculated from the CTD data. The data quality is likely to degrade with depth as the number of scatterers in deep water decreases (see low target strength in Figure 2). The error velocities increase with depth, again highlighting the deterioration in data quality towards the centre of the basin.

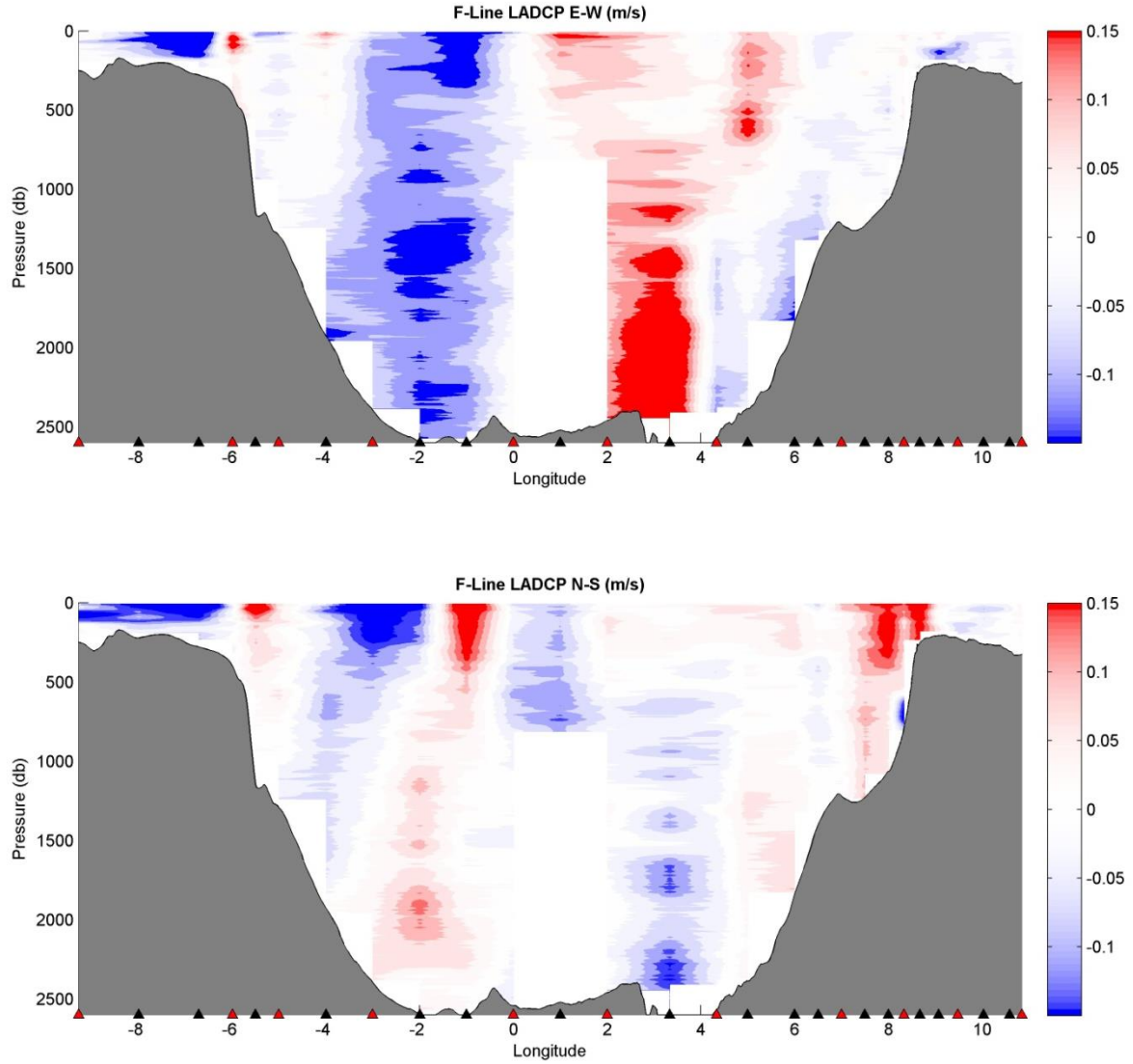


Figure 1. Preliminary east-west (top) and north-south (bottom) velocity profiles from the ADCP across the Fram Strait.

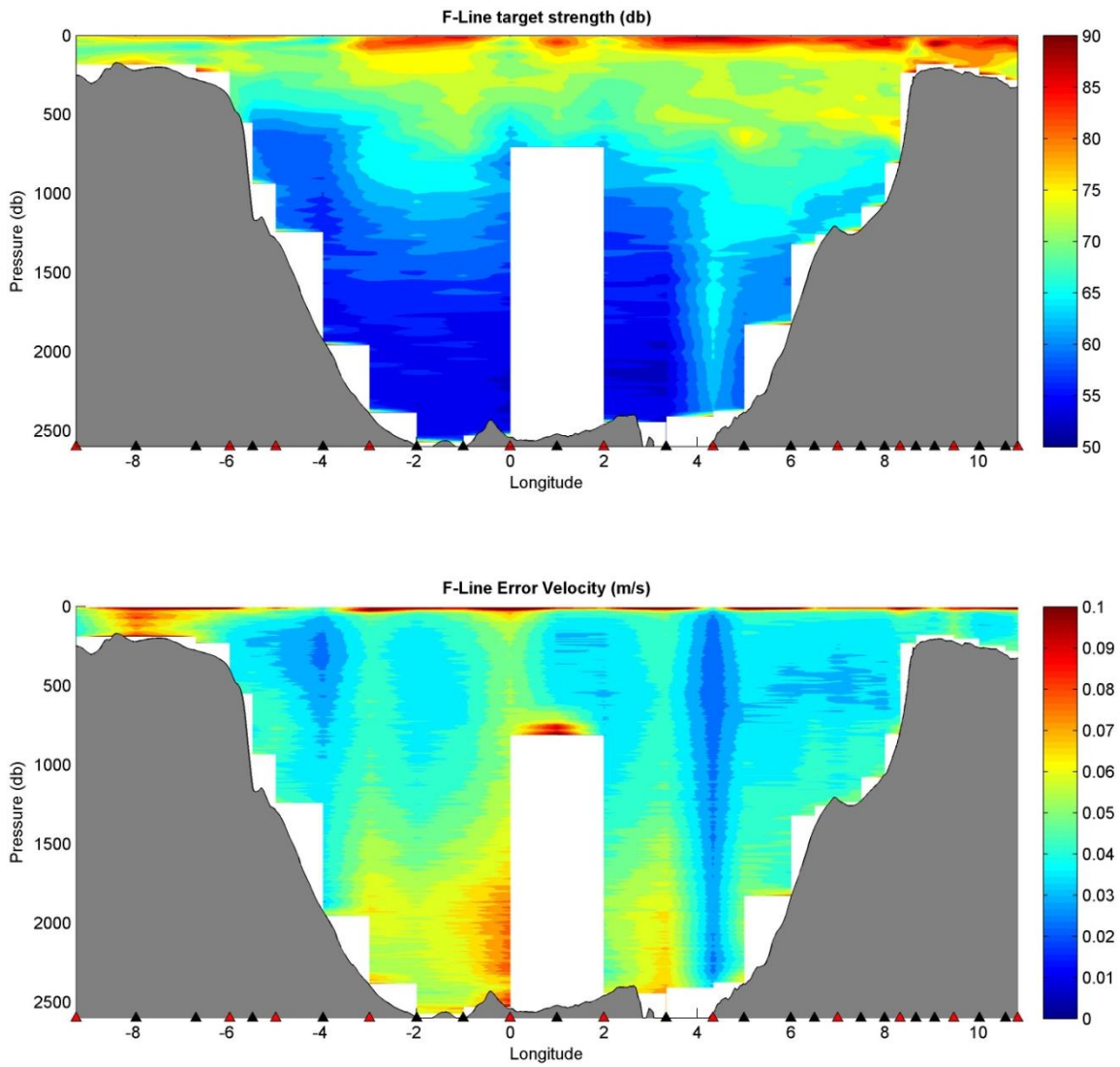


Figure 2. Target strength of the downward looking LADCP (top) and the error velocity (bottom) across the Fram Strait.

2.3 Underway navigation, sea surface hydrography and meteorology

Aidan Hunter, University of Strathclyde

This section describes data acquisition and processing during JRC17005, summarising navigational, bathymetric, meteorological and sea surface hydrographic data.

Overview of instruments and data streams

The oceanlogger system recorded sea surface properties and most meteorological measurements. Measurements of wind, depth and position were stored in separate (anemometer, EA600 and Seatex GPS) streams. Each data stream was stored as a *.ACO* file with an associated *.TPL* file listing variable names. All data streams that have been extracted and processed are listed in Table 1. The oceanlogger data steam recorded measurements at an average frequency of 0.2 Hz; all other data streams recorded at an average frequency of 1 Hz. Small variations in recording frequency were accounted for during data processing.

Table 1. Data streams processed and plotted within this report.

Instrument	Parameter	Unit
Oceanlogger	airtemp1	Celsius
	humidity	%RH
	par	umol/s/m2
	tir	W/m2
	airtemp2	Celcius
	humidity2	%RH
	par2	umol/s/m2
	tir2	W/m2
	baro	hPa
	baro2	hPa
	tstemp	Celcius
	conductivity	S/m
	salinity	psu
	sound velocity	m/s
	chlorophyll	mg/l
	flow rate	l/min
	sstemp1	Celsius
	sstemp2	Celsius

	transmittance	0< tr <1
Anemometer	Wind direction	degrees
	Wind speed	m/s
EA600 (EM122)	Depth	m
Seatex	Latitude	degrees
	Longitude	degrees

Data processing

Each data set was processed by filtering noise and erroneous measurements, and then applying per-minute medians to generate smoothed data and smaller file sizes. Measurements taken in days before the first sampling event (13/05/2018) were omitted from the analyses. All processed data were combined into a single *.csv* file. All data processing was conducted using *R*, and all *R* scripts have been made available. The scripts have been written to process the data and generate plots and *.csv* files of cleaned data by simply opening *R* in the appropriate directory and typing 'source('run.R')'.

Navigation and bathymetry

Seatex positional data were thinned by calculating per-minute medians of latitude and longitude using *R* script 'seatex_lat_lon.R'.

EA600 bathymetry data were particularly noisy and contained many obviously spurious measurements of zero, or near-zero, depths. These data were processed by first removing measurements of depths less than 10 m, which were considered spurious. Three separate filters were then applied sequentially to smooth the bathymetry data. Moving medians and moving standard deviations were calculated over 2000 s time intervals, and measurements beyond 1.1 times the standard deviation were omitted. This was repeated with an interval of 300 s, removing measures beyond 1.5 times the standard deviation; and again with interval size 120 s, removing measures beyond 1.5 times the standard deviation. The first of these filters had to be applied separately to each day of data due to RAM limitations. The smoothed data were then thinned by calculating per-minute medians. This cleaning process used *R* script 'EA600_traceplots.R'. The swath navigational system was in use from 5/6/18, and the EM122 echo-sounder interfered with EA600 measurements. Bathymetry measurements were taken from the EM122 whenever both systems were in use.

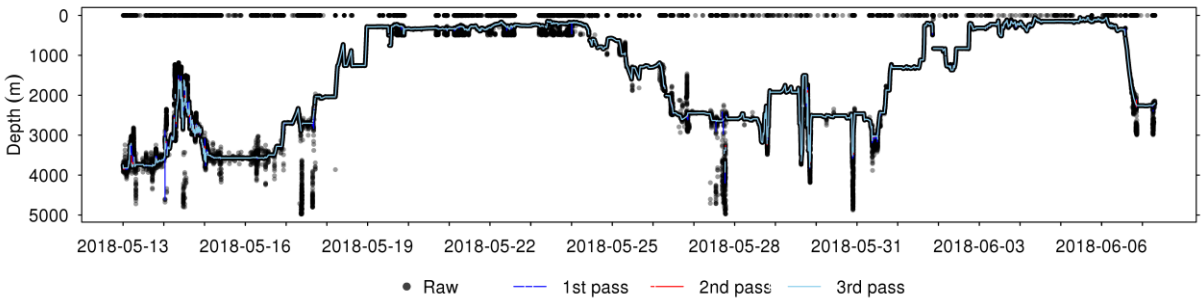


Fig. 1. Raw and filtered EA600 echo-sounder data.

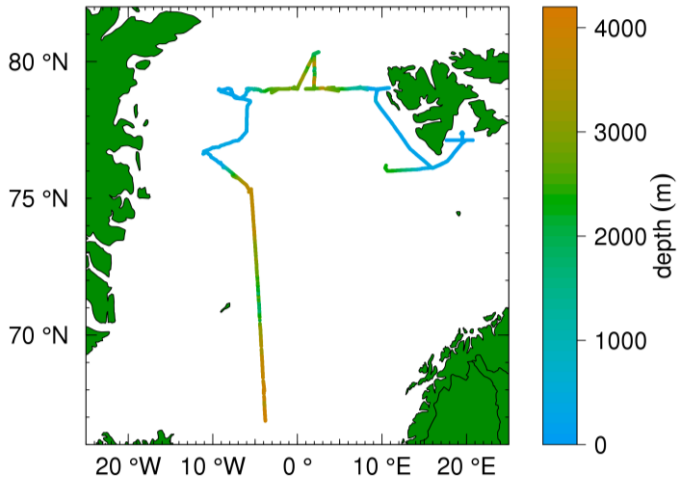


Fig. 2. The JRC17005 cruise track coloured to indicate depth measured by the EA600.

Oceanlogger data

Oceanlogger data consisted of both meteorological and sea surface measurements. The sea surface measurements were collected via the ship's underway system which, due to blockages, only provided data in regions with relatively little sea ice. Only sea surface

measurements recorded when the flow rate through the underway was between 0.4 and 0.7 l/min were retained (this range was deemed appropriate after inspection of an underway flow rate histogram). Sea surface measurements 20 minutes prior to, and 20 minutes after, periods of underway inactivity were also omitted as they often appeared spurious. Beyond this stage of cleaning, both the sea surface and meteorological data were treated identically.

The data were smoothed by applying two filters. First, moving medians and moving standard deviations were calculated over time intervals of 600 s, and measurements beyond 1.5 times the standard deviation were omitted. The second filter repeated the process with an interval size of 300 s, again removing points beyond 1.5 times the standard deviation. The smoothed oceanlogger data were then thinned by calculating per-minute medians. This cleaning process used *R* script 'oceanlogger_traceplots.R'. (Approximately 50 minutes of oceanlogger data were lost during 1/6/18.)

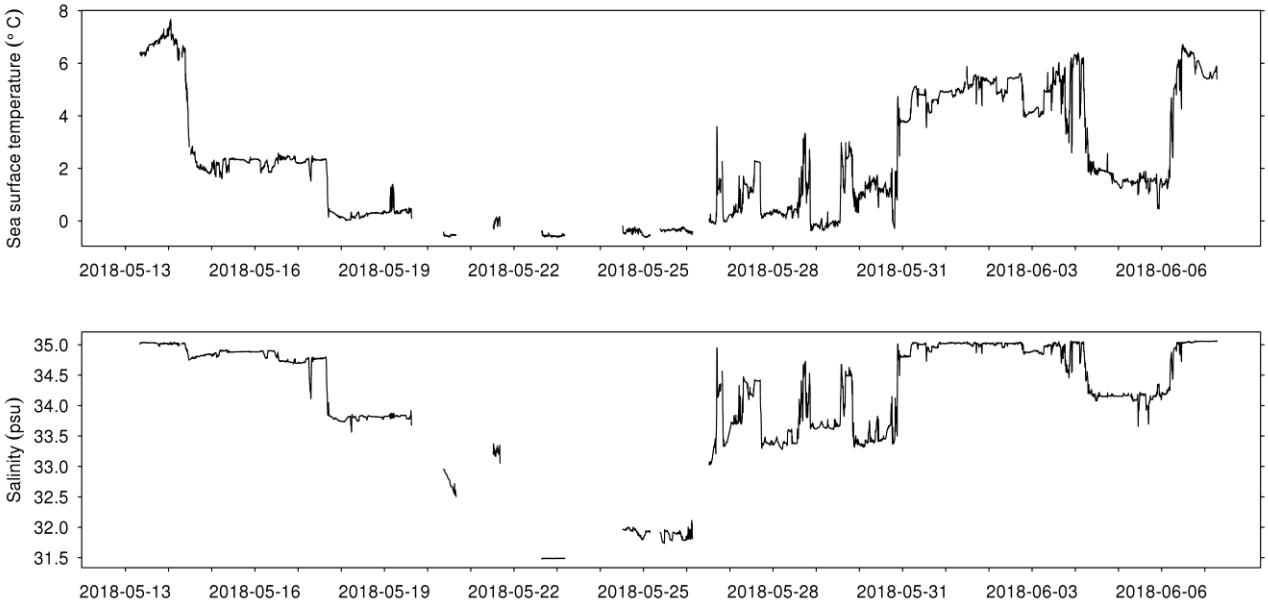


Fig. 3. Processed sea surface temperature and salinity oceanlogger measurements. Gaps in the data correspond to periods of underway inactivity, usually caused by sea ice.

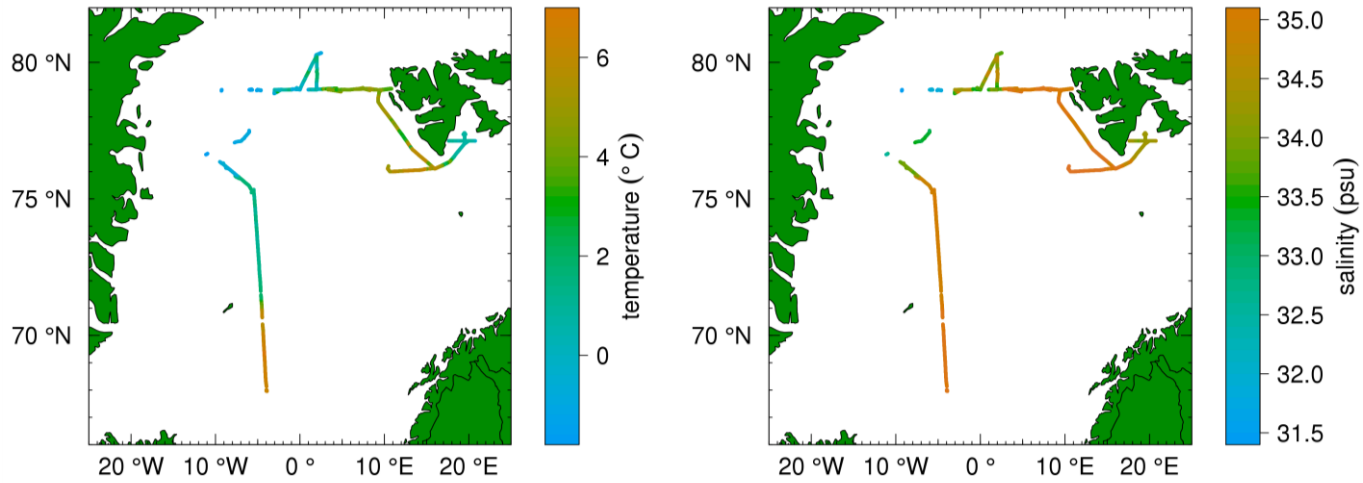


Fig. 4. Sea temperature and salinity measurements varying over the JRC17005 cruise course.

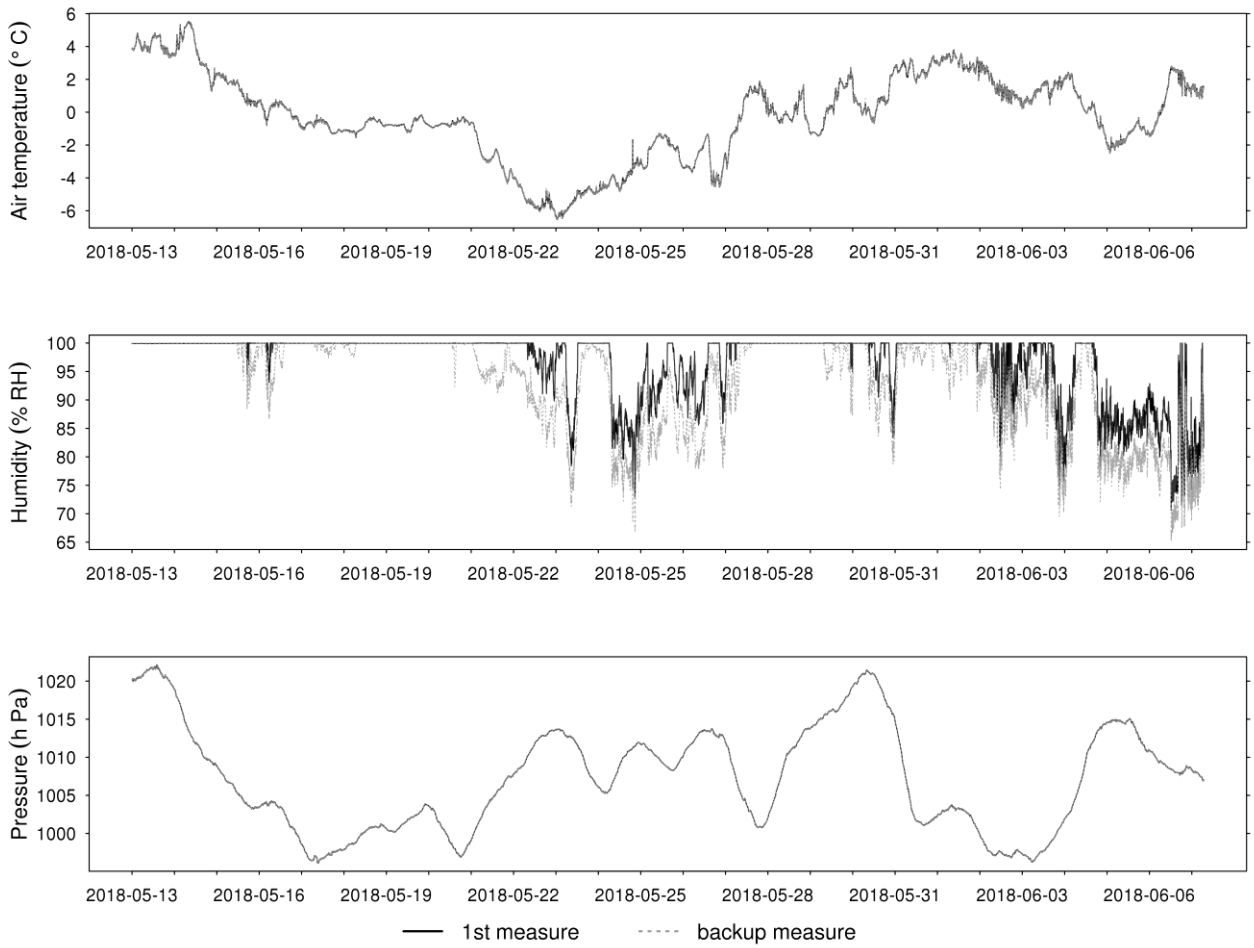


Fig. 5. Processed air temperature, humidity and air pressure measurements.

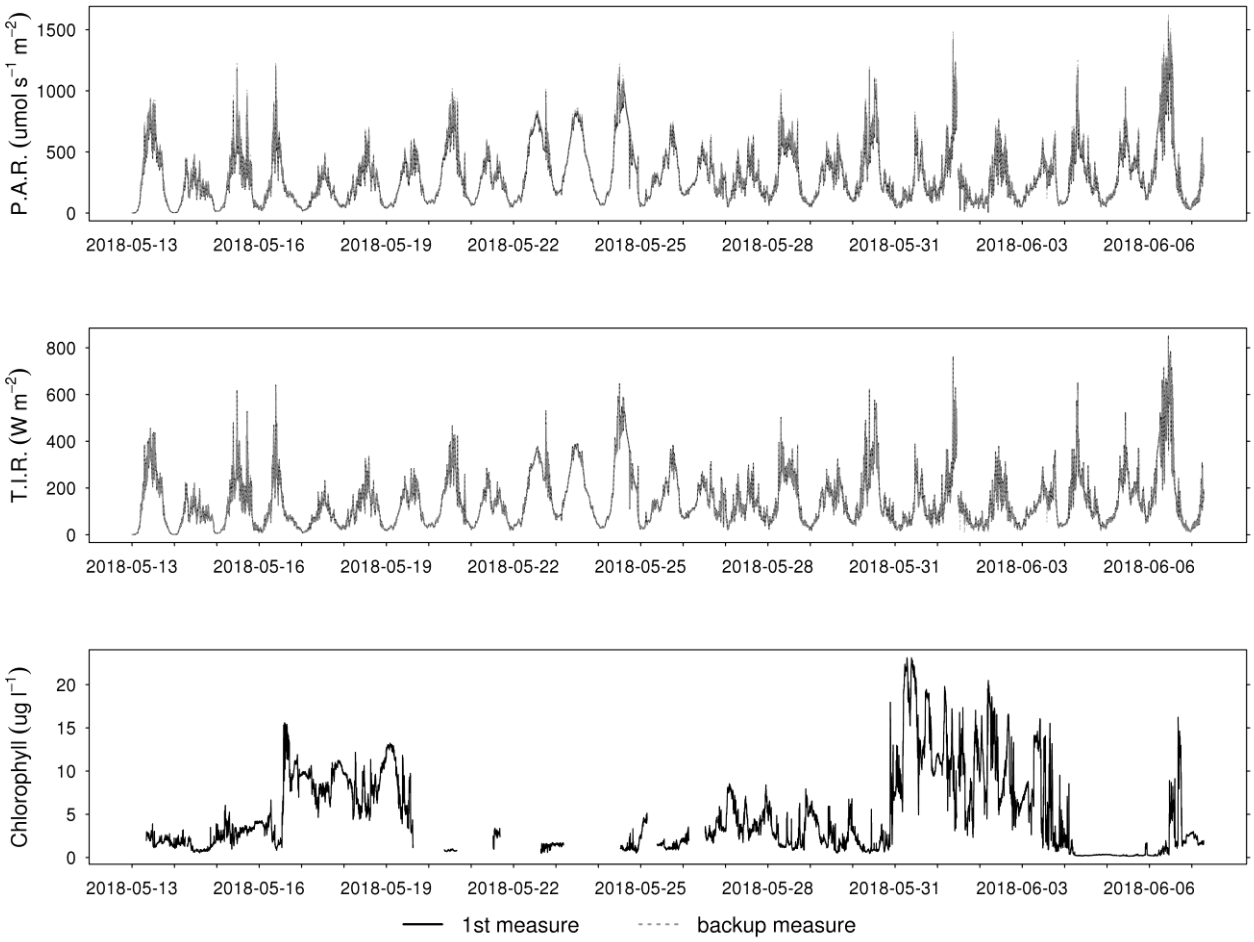


Fig. 6. Processed P.A.R., T.I.R and chlorophyll concentration measurements.

Anemometer data

Anemometer data were smoothed by calculating moving medians and moving standard deviations over 120 s time intervals, then omitting measurements beyond 1.5 times the standard deviation. The data were then thinned by calculating per-minute medians. This process was applied to wind speed and wind direction measurements using *R* script 'anemometer_traceplots.R'

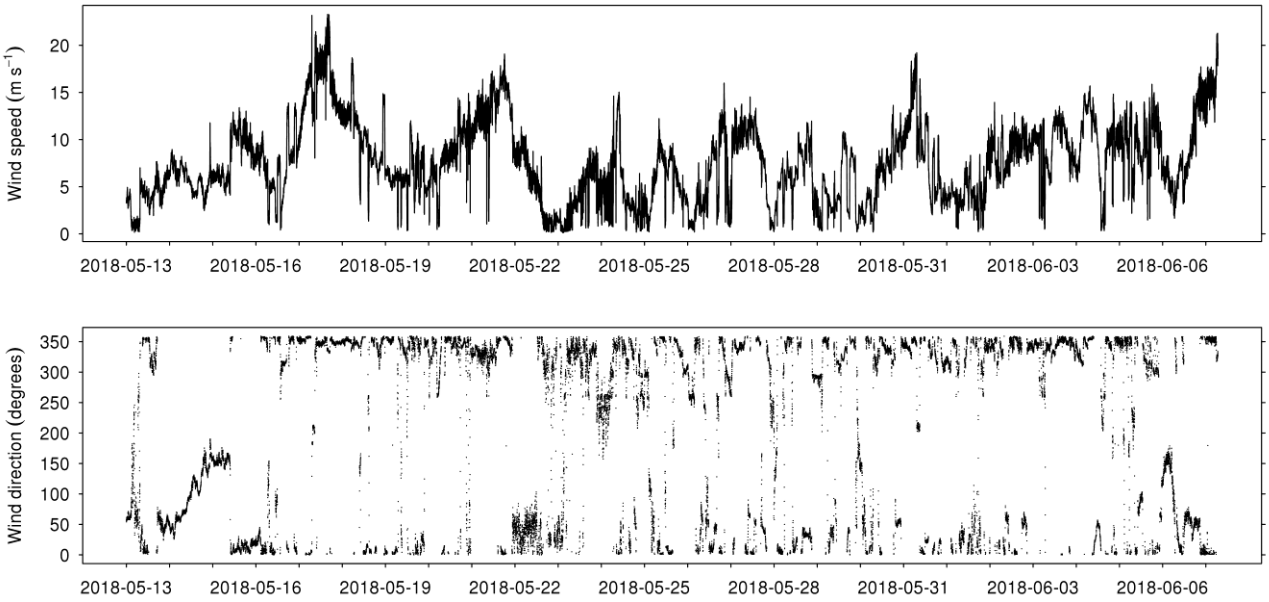


Fig. 7. Processed wind speed and wind direction measurements.

Calibration

Salinity and sea surface temperature will be calibrated against underway salinity bottle samples and CTD temperature and salinity measurements after the cruise.

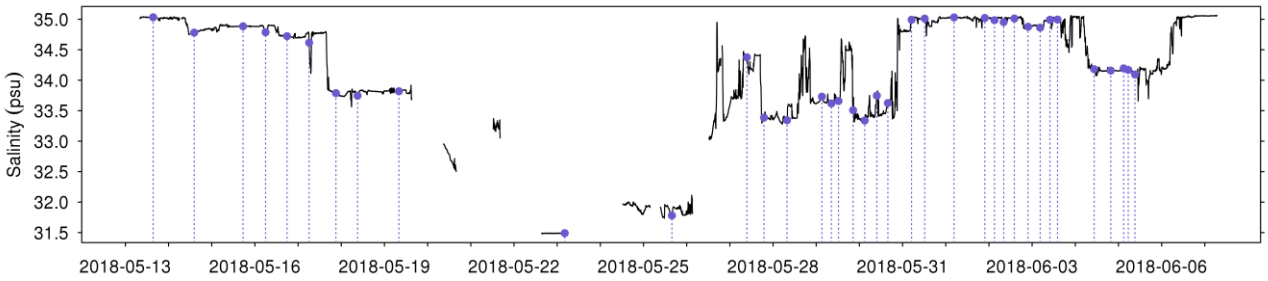


Fig. 8. Underway salinity data with discrete bottle sampling events highlighted in blue.

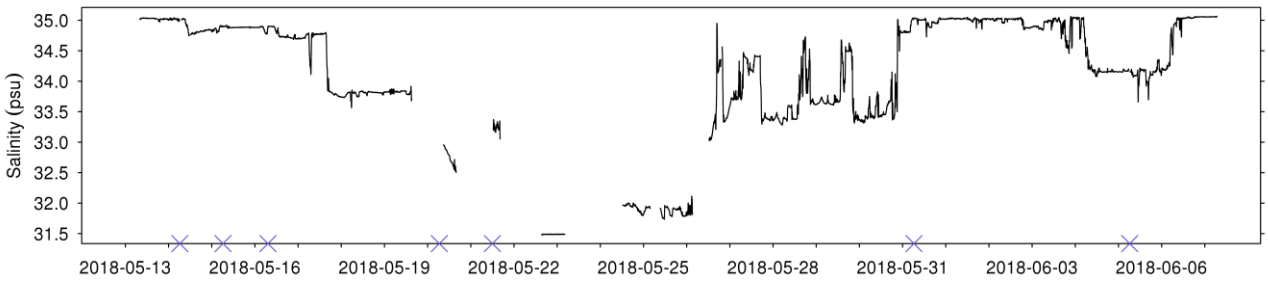


Fig. 9. Salinity data with underway cleaning times indicated by crosses.

2.4 Vessel-Mounted Acoustic Doppler Current Profiler (VMADCP)

Jo Hopkins[1] (National Oceanography Centre, Liverpool)

[1]*Data set PI and author*

Instrument description

The 75 kHz RD Ocean Surveyor (model 71A-1029-00) fitted into the ships 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.

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) and backed up to the local PC hard drive (C:\ADCP_Data_Secondary\JR17005) .

The cruise track during JR17005 was primarily planned to be in deep water. We therefore ran a broadband water tracking command file for the majority of the cruise (saved as *JR BroadBand WaterTrack 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.

After finishing the F-Line on the 3rd June 2018 the JCR headed towards the southern tip of Svalbard and sailed up into Storfjorden to complete an extra station and transect. A new bottom tracking, broadband setup file was used for these few days (not through K-sync). Broadband profiling was set

to 100 x 8 m bins, with a blanking distance of 8 m (saved as *JR 500m BottomTrack 8mBins NotThruSSU.txt*).

Table 1. Record of the dates and times of the files recorded as they were opened (O) and closed (C).

Filename	O/C	Date-Time (GMT)	Day	Command File	Notes
JR17005004	O	09/05/2018 18:26	129	JR 500m BottomTrack 8mBins NotThruSSU	Narrowband Ping as fast as possible
	C	11/05/2018 07:33			
JR17005005	O	11/05/2018 07:33	131	JR 500m BottomTrack 8mBins NotThruSSU	Narrowband Ping as fast as possible
	C	11/05/2018 14:28			
JR17005006	O	11/05/2018 14:29	131	JR NarrowBand WaterTrack 16mBins NOTThruSSU	Narrowband 3 second pings Entering Faroe-Shetland Channel
	C	11/05/2018 16:39			Error reading command file - too many header lines – system returned to default with bottom track
JR17005007	O	11/05/2018 16:39	131	JR BroadBand WaterTrack 16mBins NOTThruSSU	Broadband 3 second pings
	C	11/05/2018 17:44			Error reading command file - too many header lines – system returned to default with bottom track
JR17005008 to JR17005009					Errors in command files – too much header info. and/or lines too long
JR17005010	O	11/05/2018 17:54	131	JR BroadBand WaterTrack 16mBins NOTThruSSU	Broadband 3 second pings Corrected command file – no errors on sending
	C	12/05/2018 07:38	132		
JR17005011	O	12/05/2018 07:39	132	JR NarrowBand WaterTrack 16mBins NOTThruSSU	Narrowband 3 second pings Corrected command file – no errors on sending
	C	12/05/2018 11:45			
JR17005012	O	12/05/2018 12:21		JR NarrowBand WaterTrack 16mBins NOTThruSSU	
	C	12/05/2018 13:51			
JR17005013	O	12/05/2018 13:52		JR BroadBand WaterTrack 16mBins NOTThruSSU	Broadband 3 second pings At 08:30 GMT 13/05/2018 transducers were turned on . At 11:40 GMT the echo sounder was firing at all frequencies.

					Ship on station at 07:38 GMT
	C	13/05/2018 13:31	133		
JR17005014	O	13/05/2018 13:34	133	JR BroadBand WaterTrack 16mBins ThruSSU	Updated PC clock at 13:33 BroadBand 2 second pings triggered by K-Sync Acoustics all offset by 2 seconds – OS75 approx every 6 seconds – Sophie Fielding suggested not ideal
	C	13/05/2018 16:26			
JR17005015	O	13/05/2018 16:34	133	JR BroadBand WaterTrack 16mBins ThruSSU	Broadband 2 sec ping Ping as fast as possible in VMDas setup tab All acoustics pinging together every 2 seconds
	C	13/05/2018 19:16			
JR17005016	O	13/05/2018 19:16	133	JR BroadBand WaterTrack 16mBins ThruSSU	Broadband 2 sec ping Ping as fast as possible in VMDas setup tab
	C	14/05/2018 09:53	134		
JR17005017	O	14/05/2018 09:53	134	JR BroadBand WaterTrack 16mBins ThruSSU	Broadband 2 sec ping Ping as fast as possible in VMDas setup tab
	C	15/05/2018 10:27	135		Stopped on station at FN11
JR17005018	O	15/05/2018 10:28	135		Started on FN11, just before first megacorer deployment
	C	17/05/2018 08:11	137		
JR17005019	O	17/05/2018 08:11	137		Started while at NT8
	C	19/05/2018 06:51	139		Stopped at NT5
JR17005020	O	19/05/2018 06:51	139		Started at NT5
	C	21/05/2018 08:10	141		
JR17005021	O	21/05/2018 08:10	141		Back tracking along NT Line to head north towards F-Line
	C	24/05/2018 08:11	144		At F17
JR17005022	O	24/05/2018 08:11			At F17
	C	27/05/2018 17:21	147		Leaving F11
JR17005023	O	27/05/2018 17:21	147		Leaving F11 and en-route to F10
	C	29/05/2018 18:20	149		VMDas crashed
JR17005024	O	29/05/2018	149	JR BroadBand WaterTrack 16mBins ThruSSU	Re-started – en-route to F8
	C	01/06/2018 19:34	152		Closed at F0. Heading back towards F2
JR17005025	O	01/06/2018 19:34	152		Closed as heading south towards Storfjorden
	C	03/06/2018 22:15	154		
JR17005029	O	03/06/2018 22:35	154	JR 500m BottomTrack 8mBins NotThruSSU.txt	Switched to a bottom tracking file (not through K-Sync) for work in Storfjorden

					Broadband, 8m bins, Bottom Tracking
	C	04/06/2018 19:47	155		Closed while at ST1
JR17005030	O	04/06/2018 19:47			Opened at ST1
	C	06/06/2018 20:52	157		Closed upon arrival at B10

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.

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.

Calibrations

For data recorded before 3rd June, we used a water tracking calibration to determine the misalignment angle and amplitude (Figure 1). Upper and lower reference depths were set to 150-300 m. The following files, all recorded when in deep water were used for the calibration 13-19 and 22-23.

The values used in the final processing of files 13-25 were:

Misalignment angle = 1.4154 degrees

Amplitude = 1.017994

A bottom track calibration was possible when working south of Svalbard on the shelf and in Storfjorden (files 29 and 30).

The values used in the final processing of files 29 and 30 were:

Misalignment angle = 1.3020 degrees

Amplitude = 1.009797

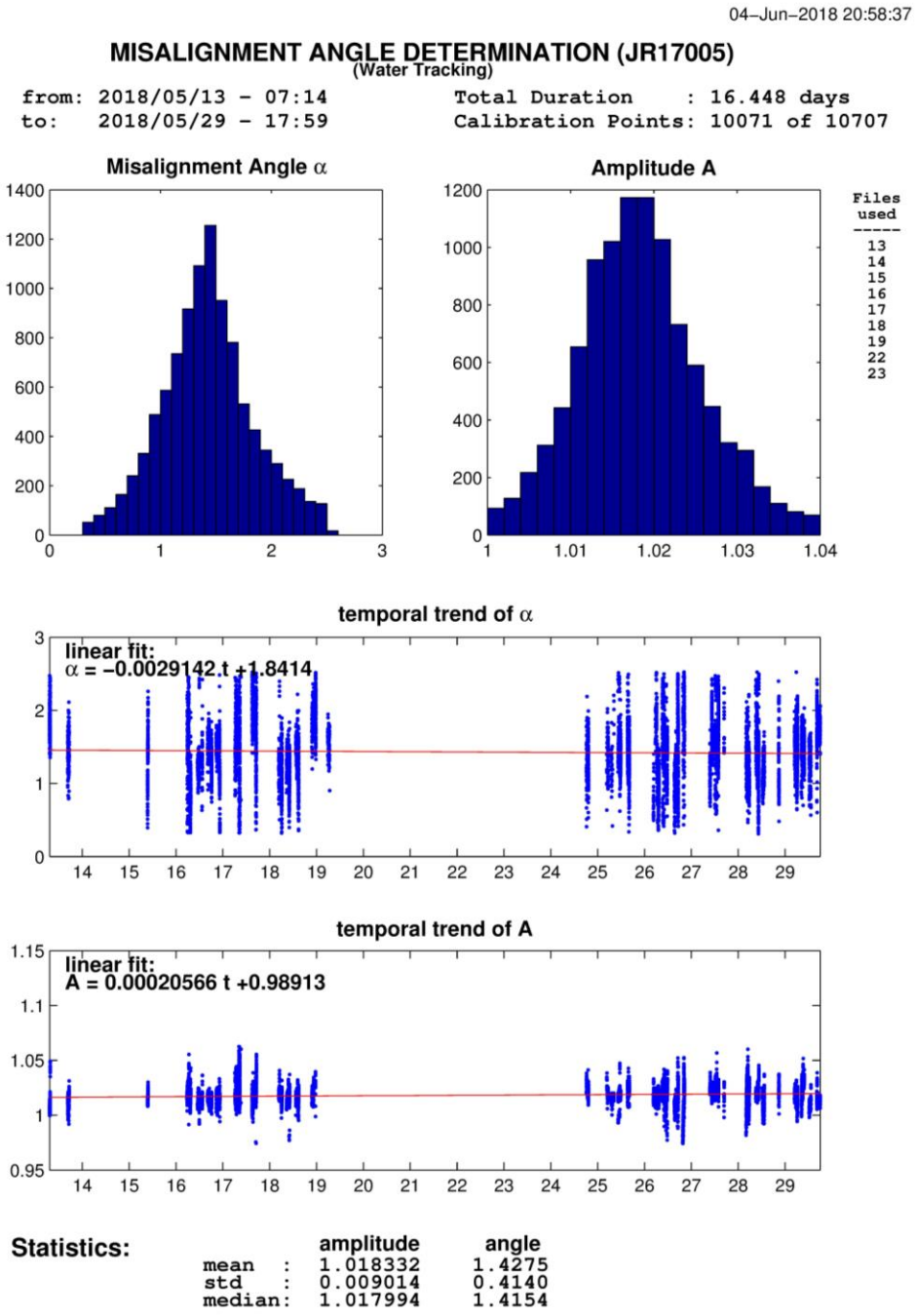


Figure 1. Determination of the misalignment angle and amplitude correction when running in water tracking mode.

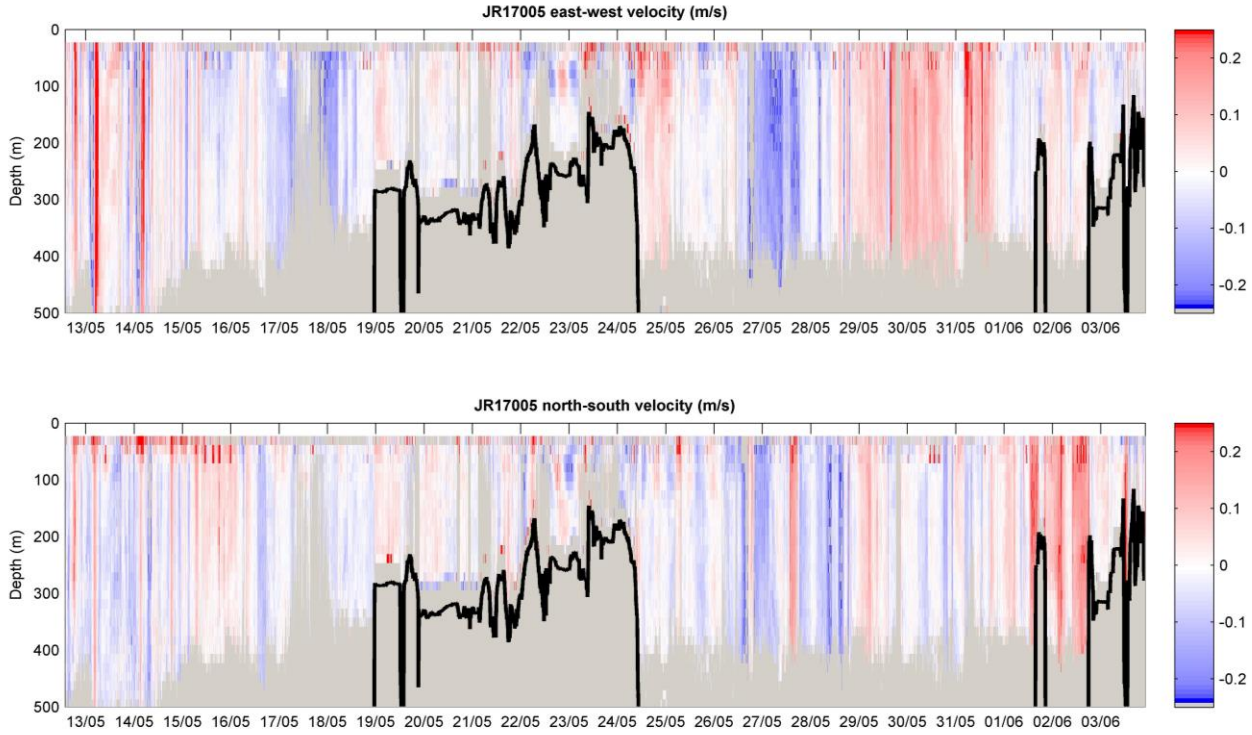


Figure 2. East-West and North-South velocities between 13th May 2018 and 3rd June 2018 (water tracking, 16 m bins). Black line is bathymetry extracted from the EA600.

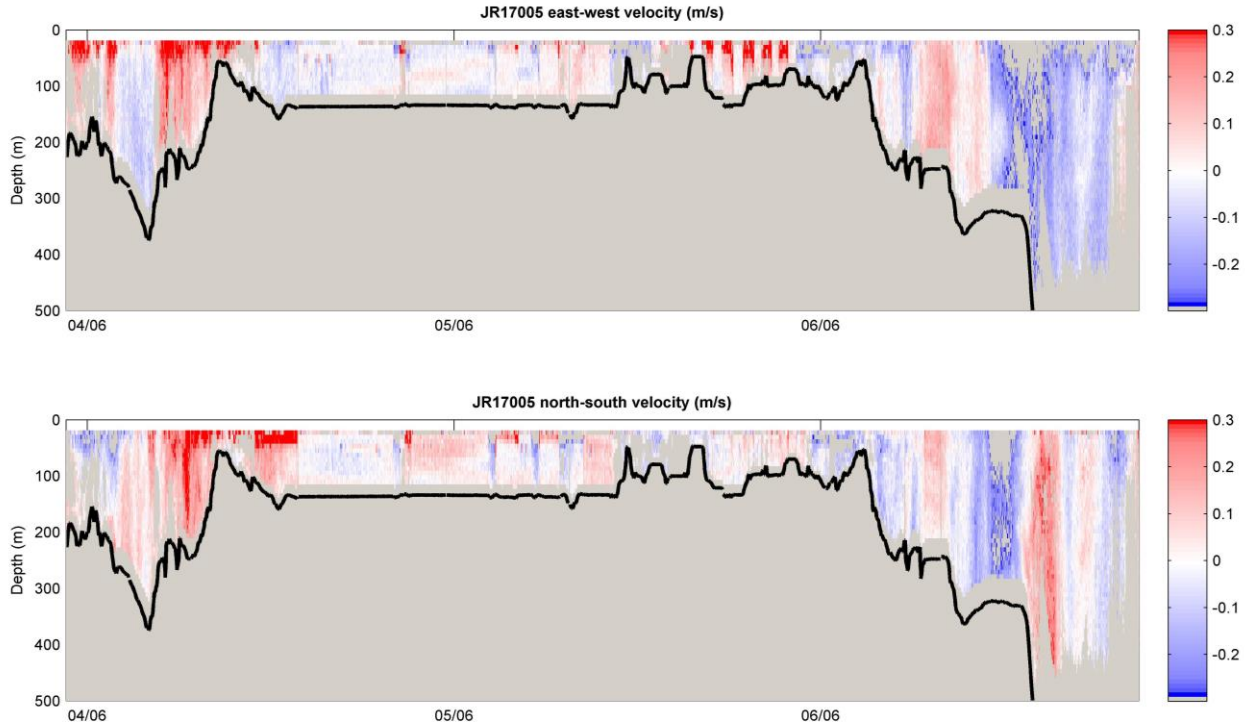


Figure 3. East-West and North-South velocities between 4th and 7th June (bottom tracking, 8 m bins). South of Svalbard and in Storfjorden.

2.5 Data availability

Hopkins J.; Brennan D.; Abell R.; Sanders R.W.; Mountifield D. (2018). CTD data from NERC Changing Arctic Ocean Cruise JR17005 on the RRS James Clark Ross, May-June 2018. British Oceanographic Data Centre - Natural Environment Research Council, UK. doi:10.5285/84988765-5fc2-5bba-e053-6c86abc05d53.

Hunter A.; **Hopkins J**. (2020). Routine underway measurements from fixed sensor arrays collected during May-June 2018 as part of ARISE, Changing Arctic Ocean cruise JR17005. British Oceanographic Data Centre, National Oceanography Centre, NERC, UK. doi:10/dpjr.

3. Oxygen

Aims/Objectives

To analyse the oxygen content of seawater throughout the water column at multiple depths and stations, in order to provide a calibration for the oxygen sensor on the CTD.

Sample Methology

Sample methodologies followed those of Langdon (2010). Seawater was collected in triplicate from the CTD via a 30cm length of silicon tubing into volume calibrated glass bottles. The deepest sample was collected first to avoid 'outgasing' as the sample warms up. The bottle was rinsed to bring the glass to the same temperature as the seawater and at least three bottle volumes were allowed to flow through the bottle before the sample was taken. The bottles were slowly filled ensuring no air bubbles were introduced to the sample. Samples were 'fixed' immediately on deck by addition of 8M Sodium hydroxide, 4M Sodium iodide and 3M Manganese sulphate solutions and the fixing temperature was recorded. Stoppers were placed in the bottles before shaking to allow thorough mixing before an incubation period of half an hour.

Processing Methology

The samples were shaken a second time before being allowed to thermally equibrillate to the controlled lab temperature. Once incubated the samples were processed using a voltametric Automated Winkler Titration Instrument. Prior to analysis of unknown samples, the thiosulphate used in the titration was standardised using an in-house KIO3 standard and a commercially available reference standard produced by Osil, UK. 5M Sulphuric acid was added to the sample and placed on a stirrer before titration with ~0.1M Sodium Thiosulphate. Results were obtained providing the oxygen content of the sample in µmols/litre.

Instrument Details

Metrohm 848 Titrino plus fitted with a platinum electrode.

Results

Event	Station	CTD Cast	Aprox Depth (m)	Niskin Bottle	DO1(umol /l)	DO2(umol /l)	DO3(umol /l)
13	**NT11**	**4**	**3570**	**1**	**307.0851102**	**306.7384929**	**-999**
13	**NT11**	**4**	**2500**	**3**	**309.1531202**	**-999**	**307.2810535**
13	**NT11**	**4**	**1600**	**5**	**-999**	**329.7113443**	**329.925668**
13	**NT11**	**4**	**1100**	**6**	**338.199512**	**336.721707**	**337.1371231**
13	**NT11**	**4**	**400**	**8**	**343.9014547**	**344.5899021**	**344.4933521**
13	**NT11**	**4**	**15**	**22**	**358.3118853**	**358.0307131**	**361.633517**

19	**NT10**	**5**	**3200**	**2**	**299.656934**	**-999**	**-999**
19	**NT10**	**5**	**2450**	**4**	**-999**	**-999**	**300.2676444**
19	**NT10**	**5**	**800**	**10**	**336.7988621**	**-999**	**331.0535819**
19	**NT10**	**5**	**50**	**21**	**351.5444984**	**350.6873591**	**351.964155**
20	**NT9**	**6**	**3266**	**1**	**302.4102254**	**-999**	**-999**
20	**NT9**	**6**	**2540**	**4**	**304.5501819**	**305.0800808**	**305.3938586**
20	**NT9**	**6**	**1420**	**8**	**325.7652789**	**326.0331984**	**325.8914043**
20	**NT9**	**6**	**1250**	**9**	**322.9741586**	**322.0997924**	**322.4765553**
20	**NT9**	**6**	**100**	**19**	**346.5366333**	**344.6173292**	**345.3932312**
20	**NT9**	**6**	**5**	**24**	**391.8831392**	**391.0125406**	**390.7650553**
27	**NT8**	**9**	**2638**	**1**	**-999**	**309.8686457**	**310.6238819**
27	**NT8**	**9**	**1900**	**3**	**311.8538345**	**-999**	**312.1216713**
27	**NT8**	**9**	**300**	**11**	**322.5900066**	**322.7263114**	**322.7717886**
27	**NT8**	**9**	**50**	**18**	**331.1359894**	**331.0533357**	**330.8663243**
35	**NT6**	**12**	**1212**	**1**	**309.0746973**	**310.0001843**	**309.9290312**
35	**NT6**	**12**	**530**	**6**	**308.4279061**	**310.7768008**	**309.4155973**
35	**NT6**	**12**	**150**	**13**	**316.6657985**	**316.6862863**	**317.0192986**
35	**NT6**	**12**	**15**	**22**	**409.5941806**	**409.6084831**	**408.8097373**
42	**NT5**	**14**	**150**	**2**	**314.9514361**	**315.6450247**	**314.4104382**
42	**NT5**	**14**	**15**	**21**	**409.1181904**	**411.9412822**	**410.5845984**
51	**NT4**	**16**	**225**	**1**	**-999**	**316.8000923**	**318.6630071**
51	**NT4**	**16**	**75**	**6**	**352.3629147**	**351.7743735**	**351.6987224**
52	**NT3**	**17**	**200**	**2**	**321.0572993**	**320.9867717**	**321.163581**
52	**NT3**	**17**	**35**	**9**	**364.6813828**	**367.3848716**	**367.7030007**
58	**NT2**	**19**	**275**	**3**	**-999**	**320.7974036**	**325.0725927**

58	**NT2**	**19**	**46**	**19**	**380.8515353**	**-999**	**382.4447385**
72	**F21**	**21**	**242**	**2**	**300.3549623**	**300.9453071**	**-999**
72	**F21**	**21**	**50**	**16**	**376.8629162**	**375.0843184**	**376.5204229**
76	**F19**	**22**	**183**	**2**	**-999**	**306.6281433**	**309.2162953**
76	**F19**	**22**	**50**	**16**	**373.2217702**	**372.4857172**	**373.0930894**
77	**F17b**	**23**	**200**	**4**	**303.538**	**306.05**	**304.528**
77	**F17b**	**23**	**75**	**14**	**352.429**	**353.175**	**353.868**
89	**F17**	**25**	**400**	**3**	**312.245**	**313.564**	**313.16**
89	**F17**	**25**	**125**	**10**	**314.563**	**313.289**	**313.372**
91	**F16**	**26**	**800**	**3**	**313.744**	**314.992**	**314.805**
91	**F16**	**26**	**175**	**12**	**317.408**	**318.004**	**317.21**
103	**F15**	**28**	**1200**	**2**	**307.891**	**310.125**	**310.868**
103	**F15**	**28**	**450**	**6**	**303.123**	**302.272**	**304.982**
103	**F15**	**28**	**50**	**18**	**346.171**	**346.075**	**347.106**
105	**F14**	**29**	**1750**	**2**	**305.411**	**306.532**	**305.024**
105	**F14**	**29**	**1000**	**5**	**308.649**	**310.465**	**312.211**
105	**F14**	**29**	**175**	**13**	**309.134**	**-999**	**309.365**
114	**F13**	**31**	**2100**	**2**	**299.954**	**299.273**	**299.149**
114	**F13**	**31**	**720**	**6**	**308.572**	**308.458**	**310.936**
114	**F13**	**31**	**200**	**11**	**317.783**	**317.986**	**318.395**
119	**F12**	**32**	**2570**	**1**	**300.494**	**301.098**	**301.009**
119	**F12**	**32**	**2000**	**2**	**302.083**	**305.578**	**304.426**
119	**F12**	**32**	**1300**	**3**	**315.644**	**316.59**	**316.658**
120	**F11**	**33**	**2000**	**2**	**-999**	**-999**	**305.233**
120	**F11**	**33**	**1200**	**4**	**318.322**	**318.611**	**319.218**
120	**F11**	**33**	**800**	**6**	**312.769**	**314.683**	**311.677**
120	**F11**	**33**	**150**	**11**	**321.525**	**320.497**	**320.617**
125	**F10**	**35**	**2536**	**1**	**-9999**	**306.754**	**307.595**
125	**F10**	**35**	**1500**	**5**	**311.713**	**310.995**	**312.649**
125	**F10**	**35**	**700**	**8**	**315.136**	**312.193**	**311.89**
125	**F10**	**35**	**100**	**14**	**321.598**	**321.671**	**322.493**
136	**FS1**	**37**	**1879**	**1**	**302.249**	**304.165**	**301.119**
136	**FS1**	**37**	**1600**	**2**	**304.39**	**305.617**	**305.001**
136	**FS1**	**37**	**1300**	**3**	**311.386**	**310.99**	**311.24**
136	**FS1**	**37**	**200**	**10**	**318.375**	**318.027**	**318.42**
149	**F8**	**39**	**2454**	**1**	**307.629**	**307.54**	**307.822**
149	**F8**	**39**	**2000**	**2**	**307.218**	**308.259**	**307.112**
149	**F8**	**39**	**1500**	**3**	**309.153**	**309.497**	**311.351**
149	**F8**	**39**	**600**	**7**	**313.541**	**313.921**	**313.404**
163	**HG-IV**	**42**	**2411**	**1**	**305.262**	**304.082**	**304.402**
163	**HG-IV**	**42**	**2000**	**2**	**302.962**	**303.148**	**302.757**

163	**HG-IV**	**42**	**1500**	**3**	**308.933**	**308.501**	**308.583**
163	**HG-IV**	**42**	**1250**	**4**	**321.06**	**321.199**	**321.528**
166	**F7**	**43**	**3016**	**1**	**-9999**	**307.649**	**307.204**
166	**F7**	**43**	**2700**	**3**	**304.716**	**305.442**	**304.932**
166	**F7**	**43**	**2220**	**5**	**305.713**	**304.682**	**305.05**
167	**F6**	**44**	**2379**	**2**	**303.477**	**305.338**	**304.426**
167	**F6**	**44**	**2225**	**4**	**305.369**	**305.115**	**306.062**
167	**F6**	**44**	**2000**	**5**	**305.222**	**305.094**	**305.776**
168	**F5**	**45**	**1826**	**1**	**301.968**	**302**	**302.522**
168	**F5**	**45**	**1500**	**2**	**318.994**	**320.421**	**318.449**
168	**F5**	**45**	**1200**	**3**	**315.716**	**316.694**	**315.755**
173	**F4**	**47**	**1269**	**1**	**301.823**	**302.284**	**302.342**
173	**F4**	**47**	**1200**	**2**	**303.909**	**304.819**	**303.554**
173	**F4**	**47**	**1000**	**3**	**306.851**	**307.113**	**306.178**
188	**F2**	**53**	**811**	**1**	**299.755**	**300.624**	**301.436**
188	**F2**	**53**	**400**	**7**	**317.594**	**317.445**	**317.487**
205	**KBO**	**57**	**302**	**2**	**335.913**	**335.415**	**335.453**
205	**KBO**	**57**	**280**	**3**	**339.165**	**339.578**	**338.705**
209	**V12**	**60**	**211**	**2**	**339.941**	**337.963**	**339.514**
209	**V12**	**60**	**175**	**8**	**341.855**	**342.896**	**342.652**

References

Langdon, C. Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique. IOCCP Report No. 14, ICPO Publication Series No. 134. V1, 2010.

4. Water column biogeochemistry

4.1 Nutrient analysis

Richard Abell
The Scottish Association for Marine Science

The principle water column dissolved nutrients, ammonium, phosphate, silicate (reactive silica), total oxidised nitrogen (TON) and nitrate were measured in 535 samples collected from 34 CTD casts.

Methodology

Samples were collected in 50ml acid cleaned polythene vials from the CTD rosette using 200 um nylon filter to remove large plankton and zooplankton. Samples were always analysed within 16 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, phosphate and silicate were prepared at the home laboratory 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 calibration standard solutions were prepared in volumetric flasks using OSIL Low Nutrient Sea Water as a dilution matrix, (OSIL, http://www.osil.co.uk, Batch LNS 26, Salinity 35 psu). The accuracy of these in-house standards was confirmed by cross reference with OSIL nutrient standard solutions; phosphate 0.8% at 1uM, ammonium 1.8% at 2uM, silicate 2.2% at 5 uM and nitrate + nitrite 1.5% at 5 uM.

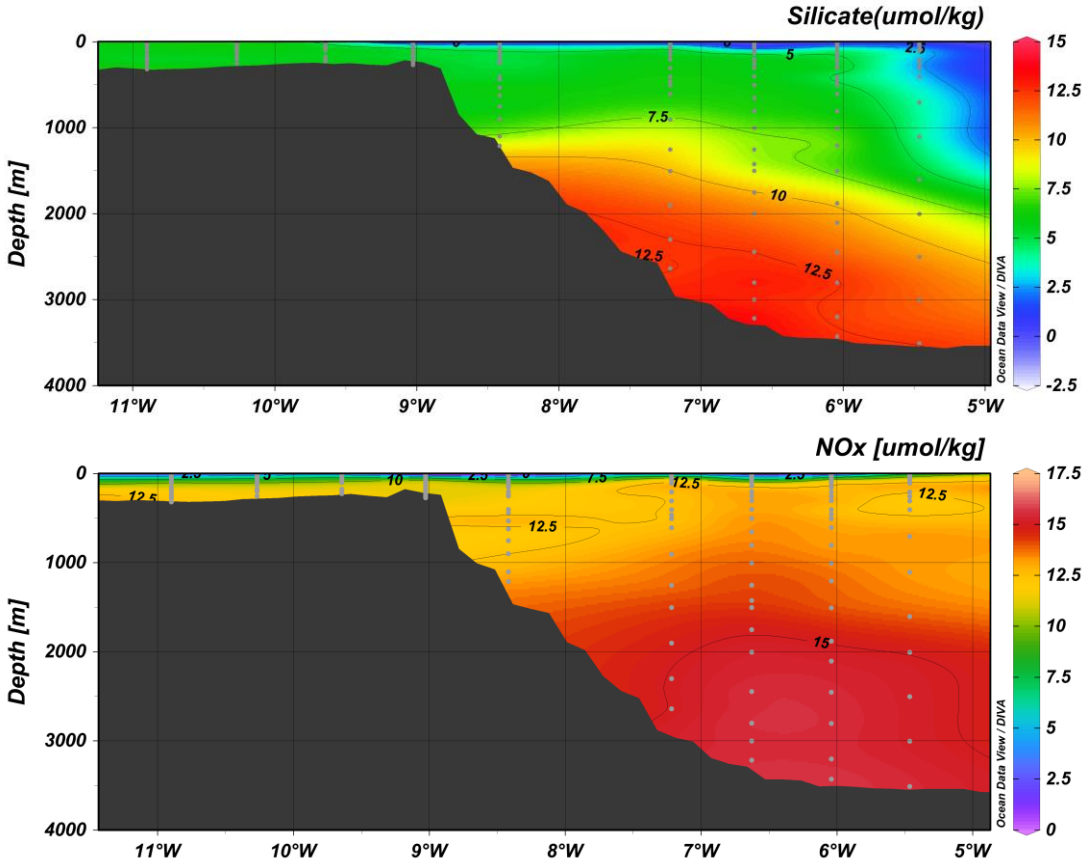
All samples were measured twice, in triplicate. The first analysis measured nitrite and then the remaining four nutrients were measured in a separate run. An OSIL LNSW seawater and five additional calibration standards were diluted daily to encompass the sample concentration range, with the top standard targeted to be 10-20% greater than the most concentrate sample. Calibration was followed by a KANSO seawater reference material and then drift standards of LNSW and a calibration standard measured throughout the unknown sequence of samples and bracketed at the end of the sequence. Analytical drift of the calibration (typically <5%) and increasing in blank were both small relative to the sample concentrations. In addition, a filtered sample of deep water was collected and frozen. This sample was prepared to further monitor inter-run performance. Based on the recovery of this and the KANSO standard, three CTD casts (F5, F4 and F3) were back 'corrected' off line

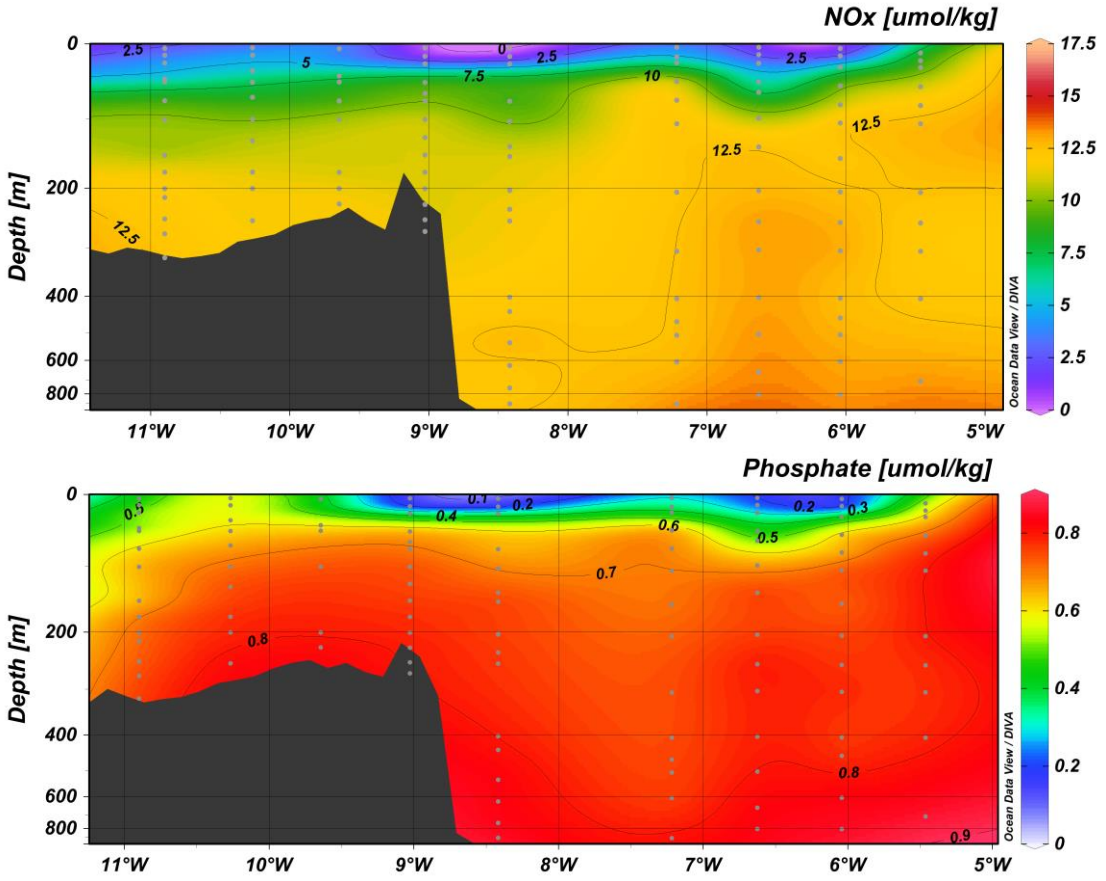
due to high phosphate concentrations found up to 20% higher than KANSO reference value and deep water phosphate concentrations. The error that caused this over estimation was not clear but likely an erroneous dilution of the primary phosphorous standard. The other nutrients measured in this block were not affected. Recovery of the KANSO reference material was better than 5% as shown in Table 1.

	Reference value uM	Measured uM	Std dev. uM (n = 28)	**Recovery (%)**
Phosphate	0.457	0.458	0.03	**100.2**
Silicate	14.277	14.053	0.5	**98.4**
Nitrate + Nitrite	5.635	5.888	0.3	**104.5**

Results overview.

Figure 1, Selected data from the first 'NT' transect.




NOx [umol/kg]
Depth [m]
0
200
400
600
800
11°W
10°W
9°W
8°W
7°W
6°W
5°W
17.5
15
12.5
10
7.5
5
2.5
0
Ocean Data View / DIVA
Phosphate [umol/kg]
0.8
0.6
0.4
0.2
0
0.9

4.2 CDOM analysis

Torgeir Blaesterdalen (Norwegian Polar Institute)

Aims and objectives

CDOM samples were collected for characterization of marine dissolved organic matter. Oxygen isotopes (also referred to as $\delta^{18}O$) are collected to determine isotope ratios of $\delta^{18}O$ and $\delta^{16}O$ to assess the concentration of meteoric water and sea-ice meltwater in the water column.

Sample methodology

Oxygen isotopes were sampled and the vials sealed with Parafilm. The samples were put in refrigerator container on deck (i.e. the “Reefer container”).

CDOM were filtered using a Millipore Durapore capsule with a 0.22 µm filter mesh. Samples were stored in amber glass vials in the Reefer container.

Additional to the CDOM samples, an ECO Fluorometer from WETLabs were mounted on the CTD frame for measuring CDOM.

Both $\delta^{18}O$ and CDOM were sampled at the target depths 5, 15, 25, 50, 75, 100, 150, 200, 250, 400 m and one at the seabed. $\delta^{18}O$ and CDOM samples were collected at 28 and 15 stations, respectively.

Both d18O and CDOM will be analysed ashore.

4.3 Phytoplankton, baterioplankton, protists and biogeochemical components

Elaine Mitchell (SAMS)

1. Introduction

Aim: To collect water samples from three transects travelling north up the West coast of Greenland, into the ice covered water and then East across the Fram Strait to Svalbard during the early summer period of May - June. Main environmental CTD casts were sampled for 6 depths within the top 200m to link biogeochemistry with the biological activity of Phytoplankton also collected with the Main CTD deployments at surface and chlorophyll maximum depths. To link these findings with the other biogeochemistry sample analysis and the zooplankton collections and experiments, specifically copepod activity within the top 200m of the water column.

Samples for Fatty acids and pigments were collected from two set depths from the main CTD and also from a selection of the smaller intermediate CTD stations also at two set depths.

Objectives:

- To assess the phytoplankton community structure at two set depths at each main station and selected intermediate stations to estimate biomass along the three transects via microscopy.
- To assess various chemical components of the main CTD sampling along the three transects at six depths within the top 200m for fluorescence and POC, and at two set depths for fatty acids and pigments.
- To assess samples for fatty acids and pigments at the selected intermediate CTD stations.
- To estimate concentrations of bacterioplankton and smallest protists along the three transects at six depths within the top 200m using flow-cytometry.

2. Methods

2.1 Sampling Main CTD

Seawater was collected from six depths from a standard environmental CTD cast as close to midnight as possible. Sampling depths were selected based on the chlorophyll.a readings obtained from the downcast of the CTD. A surface, chlorophyll maximum and deep sample (maximum 200m depth) were selected with three other depths within this range selected to provide a representative range of samples and to include any unusual readings.

The water was collected from the designated CTD bottle using silicone tubing which was directed into a 10 litre carboy. Approximately 8 litres of water was collected from each depth into a colour/depth coded carboy. The carboy was covered in a thick black bag to minimise the impact of daylight on the samples whilst they awaited processing. The carboys were then left in the CTD annex which remained open and close to air temperature – which was never far from the sea surface temperature - until filtering could begin, the annex also provided shelter from the snow and rainfall. The silicone tubing and carboys were acid washed and x3 milli Q water rinsed at the end of each collection to ensure they were clean for the next station.

2.2 Sampling Main CTD and intermediate CTD – Fatty acids & pigments

Seawater was collected from two depths, surface and the chlorophyll maximum, both of which were determined from the downcast of the CTD.

For the Main CTD stations 7 litres was collected at the surface depth, 5 litres for fatty acid analysis and 2 litres for pigment analysis. At the chlorophyll maximum depth 5 litres was collected for fatty acid analysis alone.

It was decided that as the pigment analysis is to be used alongside satellite imagery data, only the surface depth would be seen by the satellite so samples were not taken for the deeper chlorophyll maximum depths.

For the intermediate stations an extra 0.5 litre was collected at each depth to allow for samples for phytoplankton and coccolithophores to be taken to compliment the fatty acid and pigment analysis at these sites.

Samples were collected from the designated CTD bottle using silicone tubing into 10L carboys, the carboys were not blacked out as the samples were processed straight away after collection.

2.3 Filtrations

1. **Fluorescence/ Chl.a** – between 1-3L of water from each of the 6 depths was filtered through an ashed 47mm GF/F filter, these samples were duplicated and the filters were placed into individually labelled sterile 15ml centrifuge tubes. On completion of filtration the tubes were placed into a labelled zip lock bag and placed into the -20ºC freezer. The filtration rig was flushed with milli Q water between uses.

2. **POC** – between 0.1-1L of water from each of the six depths was filtered through an ashed 25mm GF/F filter, these samples were duplicated and the filters were placed into individually labelled sterile 2ml eppindorff tubes. On completion of filtration the tubes were placed into a labelled zip lock bag and placed into the -20ºC freezer. The filtration rig was wiped over with milli Q water between uses and the glass filtration units and measuring cylinders were all acid washed and milli Q rinsed between stations.

3. **Fatty acids** – up to a maximum of 5 litres of water for each of the two depths (surface & chlorophyll maximum) was filtered through ashed 47mm GF/F filters and placed into a labelled glass 7ml vial. 6mls of Chloroform:Methanol mix was added to the glass vial before it was placed in a box in the -80ºC freezer. On certain occasions more than one filter was required and not all of the 5 litres was filtered. In these cases a note has been made of the number of filters and the total volume filtered for each depth. Carboys and rig rinsed with milli Q between samples.
4. **Pigments** - up to a maximum of 2 litres of water for surface water sample was filtered through an ashed 25mm GF/F filters and placed into a labelled 2ml Cryovial which was placed in a box in the -80ºC freezer. On certain occasions more than one filter was required and not all of the 2 litres was filtered. In these cases a note has been made of the number of filters and the total volume filtered. Carboys and rig rinsed with milli Q between samples.

2.4 Other samples

Samples were also taken at each main CTD for:

1. **Flow cytometry** – samples were taken for each of the 6 depths in duplicate. 4ml of sample was fixed with 180µl of Glutaraldehyde (1% final concentration) in 5ml cryovial tubes. These samples were placed in the fridge for 24hrs to allow the fixative to fully penetrate the cells before the samples were snap frozen in liquid nitrogen and stored in boxes at -80ºC.
2. **Phytoplankton taxonomy** – for surface and chlorophyll maximum depths 400ml of sample was fixed with 4mls of Lugol's iodine (1% final concentration) and stored in 500ml glass amber bottles at 5ºC.
3. **Coccolithophore samples** – for surface and chlorophyll maximum depths 400ml of sample was fixed with 10mls of 37% Formaldehyde (1% final concentration) and stored in 500ml brown Nalgene bottles at 5ºC.

Samples were also taken at specified intermediate stations for:

1. **Phytoplankton taxonomy** – for surface and chlorophyll maximum depths 250ml of sample was fixed with 2.5ml Lugol's iodine (1% final concentration) and stored in 250ml clear plastic bottles at 5ºC.
2. **Coccolithophore samples** – for surface and chlorophyll maximum depths 250ml fixed with 5mls of 37% Formaldehyde (1% final concentration) and stored in 250ml clear plastic bottles at 5ºC.

All of these samples will undergo analysis back at SAMS.

Evt No.	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
013	15/05/18	23:24			Station NT11	75.2013 N	5.2785 W	3000	CTD 004	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 100m, 150m.	Elaine
019	16/05/18	13:43			Station NT10	75.2928 N	6.0280 W	3200	CTD 005	Intermediate station. Depths sampled 5m, 15m.	Elaine
020	16/05/18	18:41			Station NT9	75.3854 N	6.3765 W	3200	CTD 006	Intermediate station. Depths sampled 5m, 15m.	Elaine
027	17/05/18	10:07			Station NT8	75.4765N	7.1316 W	2700	CTD 009	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 100m, 150m.	Elaine
035	18/05/18	15:33			Station NT6	76.06135 N	8.2514 W	1200	CTD 012	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
042	19/05/18	02:09			Station NT5	76.1534 N	9.0170 W	280	CTD 014	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
051	19/05/18	16:03			Station NT4	76.2455 N	9.3913 W	230	CTD 016	Intermediate station. Depths sampled 5m, 43m.	Elaine
052	19/05/18	18:47			Station NT3	76.34097 N	10.15893 W	270	CTD 017	Intermediate station. Depths sampled 5m, 15m.	Elaine
057	20/05/18	17:56			Station NT2	76.42918 N	10.52519 W	340	CTD 019	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 46m, 100m, 150m.	Elaine
072	22/05/18	23:28			Station F21	78.58905 N	9.16478 W	250	CTD 021	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 100m.	Elaine
076	23/05/18	14:17			Station F19	79.00149 N	7.5956 W	180	CTD 022	Intermediate station. Depths sampled 5m, 15m.	Elaine
077	24/05/18	07:05			Station F17b	78.39945 N	6.42520 W	230	CTD 023	Intermediate station. Depths sampled 5m, 45m.	Elaine

Evt No.	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
089	24/05/18	23:33			Station F17	78.59985 N	5.59476 W	570	CTD 025	Main CTD for Observations. Depths sampled – 5m, 10m, 25m, 50m, 100m, 150m.	Elaine
091	25/05/18	05:43			Station F16	79.00012 N	5.29993 W	940	CTD 026	Intermediate station. Depths sampled 5m, 42m.	Elaine
103	26/05/18	00:10			Station F15	78.58892 N	5.01251 W	1250	CTD 028	Main CTD for Observations. Depths sampled – 5m, 15m, 22m, 50m, 75m, 150m.	Elaine
105	26/05/18	07:38			Station F14	78.54836 N	3.59657 W	2000	CTD 029	Intermediate station. Depths sampled 5m, 22m.	Elaine
114	26/05/18	23:15			Station F13	78.59789 N	2.59977 W	2400	CTD 031	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
119	27/05/18	10:53			Station F12	78.59987 N	1.59792 W	2630	CTD 032	Intermediate station. Depths sampled 5m, 15m.	Elaine
125	27/05/18	22:37			Station F10	78.59995 N	0.0000 W/E	2590	CTD 035	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
136	28/05/18	23:44			Station FS1	80.16996 N	2.0000 E	1900	CTD 037	Main CTD for Observations. Depths sampled – 5m, 10m, 25m, 50m, 75m, 150m.	Elaine
149	29/05/18	23:42			Station F8	79.00004 N	2.00125 E	2500	CTD 039	Main CTD for Observations. Depths sampled – 5m, 15m, 35m, 50m, 75m, 150m.	Elaine
163	31/05/18	00:50			Station HGIV	79.02900 N	4.19925 E	2400	CTD 042	Main CTD for Observations. Depths sampled – 5m, 12m, 25m, 50m, 75m, 150m.	Elaine
166	31/05/18	09:22			Station F7	79.0000 N	3.20023 E	3000	CTD 043	Intermediate station. Depths sampled 5m, 20m.	Elaine
168	31/05/18	17:29			Station F5	79.00007 N	5.59953 E	1850	CTD 045	Intermediate station. Depths sampled 5m, 15m.	Elaine

173	31/05/18	23:15			Station F4	79.019952 N	7.0000 E	1300	CTD 047	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
188	01/06/18	23:06			Station F2	79.01997 N	8.20005 E	830	CTD 053	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
205	03/06/18	00:14			Station KB0	79.02104 N	10.50580 E	310	CTD 057	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine
209	03/06/18	07:06			Station V12	78.58778 N	9.28851 E	220	CTD 060	Main CTD for Observations. Depths sampled – 5m, 15m, 25m, 50m, 75m, 150m.	Elaine

Table 4.3.1 List of sampled stations including depths

Samples analysed for Phytoplankton enumeration & identification
May - June 2018

SURFACE

These locations are all main stations, intermediate phytoplankton samples not analysed at Dave.P's request

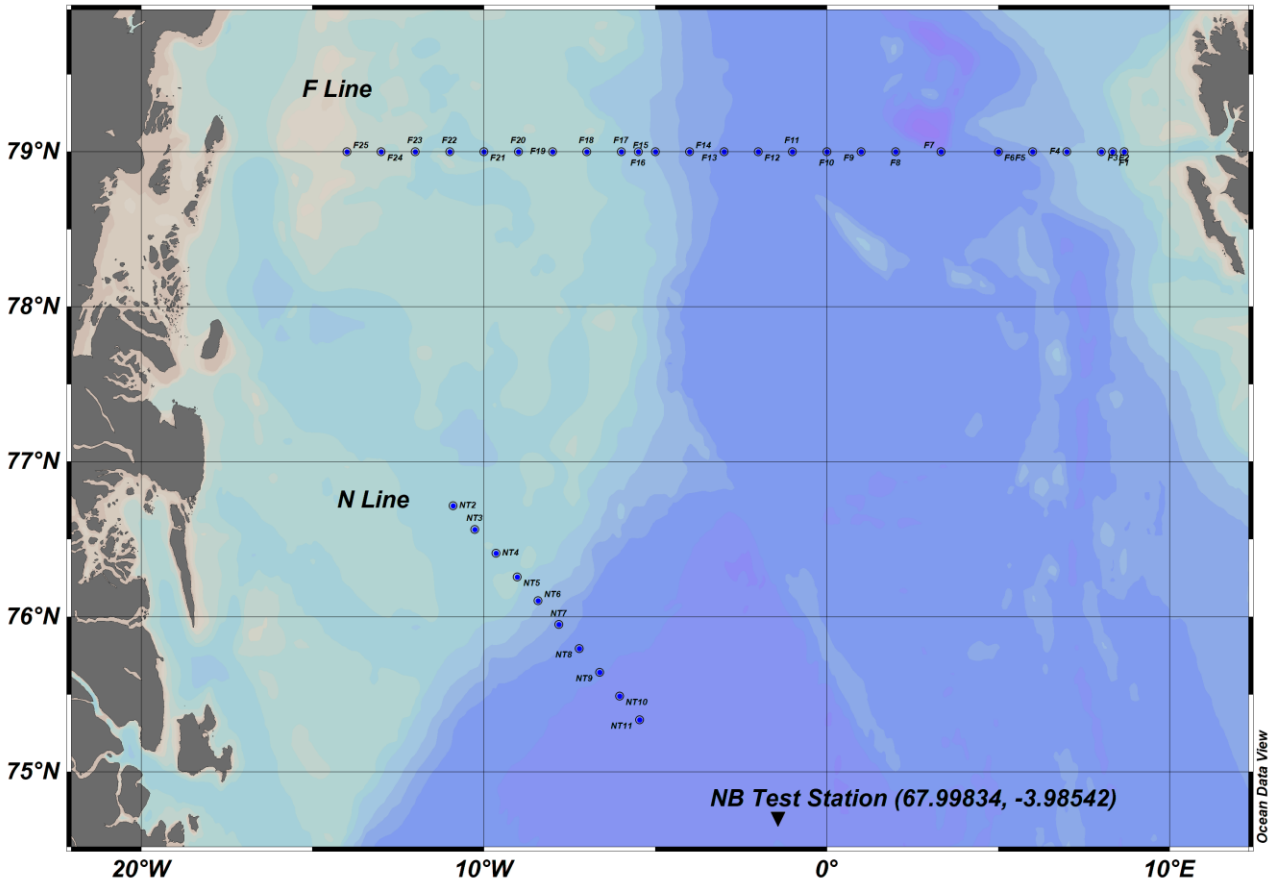
Location	CTD	Event	Depth	Date	Latitude	Longtitude	Vol. settled	Bottle type	Original sample vol.	Vol.Lugols' iodine added to original sample	Final concentration of Lugol's iodine	Enumeration	Identification	C:N ratio	Biomass
NT11	4	13	5m	16/05/2018	75.2013 N	5.2785 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT8	9	27	5m	17/05/2018	75.4765N	7.1316 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT6	12	35	5m	18/05/2018	76.06135 N	8.2514 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT5	14	42	5m	19/05/2018	76.1534 N	9.0170 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT2	19	57	5m	20/05/2018	76.42918 N	10.52519 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F21	21	72	5m	22/05/2018	78.58905 N	9.16478 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F17	25	89	5m	24/05/2018	78.59985 N	5.59476 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F15	28	103	5m	26/05/2018	78.58892 N	5.01251 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F13	31	114	5m	26/05/2018	78.59789 N	2.59977 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F10	35	125	5m	27/05/2018	78.59995 N	0.0000 W/E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
FS1	37	136	5m	28/05/2018	80.16996 N	2.0000 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F8	39	149	5m	29/05/2018	79.00004 N	2.00125 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
HGIV	42	163	5m	31/05/2018	79.02900 N	4.19925 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F4	47	173	5m	31/05/2018	79.019952 N	7.0000 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F2	53	180	5m	01/06/2018	79.01997 N	8.20005 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
KB0	57	205	5m	03/06/2018	79.02104 N	10.50580 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
V12	60	209	5m	03/06/2018	78.58778 N	9.28851 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√

Chl. max

These locations are all main stations, intermediate phytoplankton samples not analysed at Dave.P's request

Location	*CTD*	*Event*	*Depth*	*Date*	Latitude	Longtitude	*Vol. settled*	Bottle type	Original sample vol.	Vol.Lugols' iodine added to original sample	Final concentration of Lugol's iodine	Enumeration	Identification	C:N ratio	Biomass
NT11	4	13	25m	16/05/2018	75.2013 N	5.2785 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT8	9	27	25m	17/05/2018	75.4765N	7.1316 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT6	12	35	15m	18/05/2018	76.06135 N	8.2514 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT5	14	42	15m	19/05/2018	76.1534 N	9.0170 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
NT2	19	57	15m	20/05/2018	76.42918 N	10.52519 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F21	21	72	15m	22/05/2018	78.58905 N	9.16478 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F17	25	89	10m	24/05/2018	78.59985 N	5.59476 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F15	28	103	22m	26/05/2018	78.58892 N	5.01251 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F13	31	114	25m	26/05/2018	78.59789 N	2.59977 W	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F10	35	125	15m	27/05/2018	78.59995 N	0.0000 W/E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
FS1	37	136	10m	28/05/2018	80.16996 N	2.0000 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F8	39	149	15m	29/05/2018	79.00004 N	2.00125 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
HGIV	42	163	12m	31/05/2018	79.02900 N	4.19925 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F4	47	173	25m	31/05/2018	79.019952 N	7.0000 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
F2	53	180	15m	01/06/2018	79.01997 N	8.20005 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
KB0	57	205	15m	03/06/2018	79.02104 N	10.50580 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√
V12	60	209	15m	03/06/2018	78.58778 N	9.28851 E	50ml	Amber glass	400ml	4mls	1%	√	√	√	√

Table 4.3.2: Lugols samples analysed


F Line
N Line
79°N
78°N
77°N
76°N
75°N
20°W
10°W
0°
10°E
NB Test Station (67.99834, -3.98542)
Ocean Data View

4.4 Water column biogeochemistry: nutrients and isotopes

Robyn Tuerena (UoE), Louisa Norman (UoL), Camille de la Vega (UoL), Celeste Kellock (UoE)

Background and objectives

Samples were taken for analysis of the concentration and isotopic composition of macronutrients and particulate organic matter at a total of 19 'super' stations across the Fram Strait (plus an extra 23 stations for nitrate isotopes). The specific aim of the ARISE project was to target key water masses and gateways for delivery and export of N and C in the Fram Strait via a series of transects covering the inflow of the Atlantic water and the outflow of Arctic water. These measurements will be paired with food web tracer measurements of 15N, 13C and 15N amino acids (15N-AA) from POM and will be used to set a spatial and seasonal baseline for the isoscape in this region.

Sampling strategy/instrument description

CTD sampling

Samples were taken from the CTD rosette for d15N and d18O isotopes of nitrate, d15N of ammonium and dissolved organic nitrogen, d30Si of silicic acid, and the concentration and d13C of dissolved inorganic carbon. In addition, samples for particulate biogenic silica (PBS) were taken from the chlorophyll max at every 'super' station. These samples were taken alongside samples measured onboard for macronutrient concentrations (nitrate, nitrite, ammonium, phosphate, silicic acid). Samples for d15N-NO3 were taken by the ARISE team at all biogeochemistry stations. Samples for [DIC], d13C-DIC, d15N-NH4, d15N-DON, and d30Si were taken at all super stations.

SAPS sampling

In addition to the sampling for d15N and 13C of POM from the CTD rosette, samples for 15N-AA in POM were taken using four standalone in-situ pumps (SAPS) at 16 stations. The four depths were selected to correspond with the CTD POM sampling at depths between the surface and 200 m.

Methods/Processing/*Calibrations*

ARISE

N and Si Isotopes

At every biogeochemistry station (42 casts), d15N-NO3 samples were collected. For the super stations (19 casts), d15N-DON, d15N-NH4 and Si isotope samples were also collected.

N isotope samples were taken from the Niskin bottles into acid cleaned carboys after gas and nutrient samples. Carboys were rinsed three times with the appropriate water before collecting the sample. Samples were filtered within 2 hrs of collection through pre-combusted 47mm GF/F filters using a glass filtration rig. The glassware and acid-cleaned sample bottles were rinsed with sample prior to collection of d15N-DON, d15N-NO3 and d15N-NH4 and the filter was changed for each new sample. d15N-DON and d15N-NO3 samples were closed with a screw cap, placed in zip lock bags, labelled and stored in a -20 freezer. NH4 samples were acidified to pH 2-3 in a fume hood with 6M trace-metal clean HCl before being placed in two ziplock bags, labelled and stored in a -20 freezer.

N isotope sampling strategy

d15N-NO3: Full profile

d15N-NH4: 3 depths, chlorophyll max and two below

d15N-DON: Upper 200m (typically 9 depths)

Full Si isotope samples were taken directly from the Niskin bottles into the sample bottles using an Acropak 500 0.4 micron capsule filter attached to the Niskin using acid-cleaned tygon tubing. Water from the Niskin was allowed to flow through the tubing and Acropak capsule to rinse prior to rinsing (x3) and filling of the sample bottles. Samples were taken to the lab and acidified to pH 2-3 using 6M trace-metal clean HCl in the fume hood. The samples were sealed with screw caps, parafilmed, placed in two ziplock bags and labelled. All samples were stored in the dark (black bag and in a closed crate) at ambient laboratory temperature.

DIC and d13C-DIC

Full profiles were taken at eight stations (see sampling strategy section). Samples for the analysis of d13C-DIC and [DIC] were taken directly after the oxygen samples. Using acid clean tubing, water was taken from the Niskin bottle directly into 250 mL borosilicate glass reagent bottles and 30 mL amber soda-lime glass bottles for DIC and d13C-DIC, respectively. The DIC bottles were allowed to overflow one full volume and the d13C-DIC bottles two volumes to rinse. DIC and d13C-DIC samples were placed in a fume hood and a volume of 6 mL (DIC) or 60 µL (d13C-DIC) was removed to provide headspace. Samples were then preserved with 50% v/v saturated HgCl2 using100 µL for the DIC samples and 30 µL for the d13C-DIC samples. The DIC samples were then sealed with an Apiezon L greased glass stopper, secured with electrical tape and inverted three times to mix. The 30 mL d13C-DIC bottles were sealed with screw caps and parafilm. Samples were stored at 4°C and will be stored at a stable temperature prior to analysis at the University of Edinburgh.

Particulate Biogenic Silica

Whilst on station, water was collected for the determination of particulate biogenic silica from the chlorophyll max. Four to 6 L of water was filtered through a 47 mm polycarbonate filter (0.8 µm) using an acid-cleaned polycarbonate filtration unit. Filters were then folded in half, wrapped in combusted foil, and placed in a labelled ziplock bag. Samples were stored at -20ºC.

All ARISE samples detailed above will be returned to the home laboratory (University of Edinburgh) for analysis.

Particulate organic matter (POM)

Samples for d15N and d13C POM were taken from the CTD rosette at depths corresponding to the above described dissolved isotope samples. At stations deeper than 300 m six to eight depths were sampled together with two or three depths between 300 m and the bottom. Full profiles were taken at stations > 300 m (Table 3). Samples were collected from the Niskin bottles in acid-clean 5 L carboys pre-rinsed with seawater from the underway system. After collection, the samples were placed in the dark and taken to the laboratory for filtering. The seawater was filtered through a 25 mm GF/F filter until a good colour was evident at which point the filtration was stopped and the volume of water filtered recorded. The filters were placed in combusted foil-lined petri dishes and placed in a -80ºC freezer for 24 hrs prior to storage at -20ºC.

SAPS sampling

15N-AA of Particulate organic matter (POM)

Each SAPS filter head was loaded with an acid-cleaned 52 µm nylon mesh circle, to filter larger particles, and a pre-combusted 293 mm GF/F filter. The SAPS were then deployed at selected depths (Table 3) and set to pump for one hour. Upon recovery, the volume pumped was recorded and the filter heads allowed to drain of water. The 52 µm mesh was rinsed with ultrapure water (milli-q) and the particles collected for further filtration on to a 47 mm pre-combusted GF/F filter. Where samples had a very dense particle loading that would saturate the 47 mm GF/F filter, a proportion of the material rinsed from the mesh was filtered and the volume recorded. The 47 mm filters were placed in combusted foil-lined petri dishes and placed in a -80ºC freezer for 24 hrs prior to storage at -20ºC. The 293 mm filters were removed from the filter head, folded in four, wrapped in pre-combusted foil, bagged and placed in a -80ºC freezer for 24 hrs prior to storage at -20ºC.

Both the POM sampled from the CTD and the 15N-AA POM from the SAPS will be analysed at the home laboratory (University of Liverpool).

Data quality notes/ problems

Samples collected

Table 1. N isotope, Si isotope, [DIC], d13C-DIC, and 15N and 13C POM samples collected for ARISE.

EVENT	CTD	STATION	LATITUDE	LONGITUDE	BOTTOM (m)	DATE	DEPTHS (m)
411	59	**1**	70'45.000	19'59.871	190	07/08/2017	10, 27, 50, 80, 140, 182
6	2	**2**	71'41.997	19'39.961	256	08/07/2017	10, 25, 45, 80, 120, 150, 200, 250
374	55	**3**	72'37.985	19'15.012	366	05/08/2017	10, 25, 40, 70, 160, 280, 340, 360
18	3	**4**	73'22.069	18'55.081	470	09/07/2017	10, 37, 50, 75, 100, 150, 300, 460*
365	52	**5**	74'21.989	18'09.979	119	04/08/2017	8, 25, 38, 50, 75, 108
32	4	**6**	75'10.994	17'32.003	141	10/07/2017	8, 20, 45, 60, 100, 130
357	48	**7**	76'00.009	16'50.012	319	03/08/2017	6, 28, 50, 100, 140, 200, 250, 309
47	5	**8**	76'21.986	16'39.930	45	11/07/2017	5, 10, 18, 25, 30, 35, 41
68	11	**9**	75'59.999	13'40.013	1028	13/07/2017	10, 15, 25, 50, 75, 150, 250, 400*, 525, 700*, 900, 1017*
57	9	**10**	76'00.000	10'40.000	2259	12/07/2017	10, 15, 35, 50, 100, 250, 375, 500, 600*, 750, 1000*, 1250*, 1500, 1750*, 2249*
78	14	**11**	76'22.000	21'00.110	231	14/07/2017	3, 15, 27, 50, 80, 120, 180, 210, 222
90	16	**12**	75'30.000	26'00.106	134	15/07/2017	10, 15, 25, 30, 37, 53, 62, 129
105	17	**13**	74'28.000	30'00.015	355	16/07/2017	5, 15, 30, 40, 70, 105, 175, 245, 324, 344*
296	38	**14**	76'29.965	30'17.225	296	30/07/2017	3, 22, 40, 48, 75, 120, 180, 200, 269, 279
147	19	**15**	78'12.861	30'00.045	330	19/07/2017	0.5*, 3, 15, 34, 70, 110, 175, 190**
186	20	**16**	80'09.012	29'54.760	276	22/07/2017	5, 15, 30, 60, 120, 200, 268, 278
235	23	**17**	81'24.117	29'30.625	290	25/07/2017	5, 17, 25, 40, 70, 120, 150*, 180, 271, 281
248	27	**18**	81'43.681	29'51.866	2812	26/07/2017	10, 45, 60, 90, 150, 280, 490, 650, 750, 900, 1200, 1800, 2400, 2760
283	34	**32**	78'50.067	23'50.399	172	29/07/2017	5, 23, 35, 50, 100, 150, 159
290	37	**34**	77'19.971	29'59.943	185	29/07/2017	10, 30, 65, 80, 120, 140, 175
329	40	**35**	75'29.996	30'00.044	362	31/07/2017	5, 18, 30, 50, 100, 200, 300, 348
349	42	**36**	75'06.000	28'04.230	330	01/08/2017	10, 30, 50, 80, 150, 200, 290, 317
351	44	**37**	75'56.975	28'34.697	54	02/08/2017	5, 20, 30, 40, 45

353	46	**38**	76'11.378	18'53.591	236	02/08/2017	5, 20, 30, 50, 100, 150, 175, 218, 228

Table 3. 15N-AA of POM sample collected for ARISE. Volume pumped by the SAPS ranged from 111L and 1287L. The depths highlighted in red indicate occasions when the SAPS either failed to pump or became blocked with debris (i.e. jellyfish) that impeded the flow. In these cases the filters were discarded.

event	station	Latitude	Longitude	Bottom (m)	Date	Depths (m)
10	B2	71°42'N	19°40'E	256	8-Jul-17	10, **25**, 45, 230
21	B4	73°22'N	18°55'E	476	9-Jul-17	10, 37, **75**, 300
36	B6	75°11'N	17°32'E	145	10-Jul-17	8, 20,45, **100**
50	B8	76°22'N	16°40'E	45	11-Jul-17	10, 18, 35
61	B10	76°N	10°40'E	2500	12-Jul-17	10, 15, **35**, 250
73	B9	76°N	13°40'E	1000	13-Jul-17	10, 15, 25, 250
81	B11	76°22'N	21°E	230	14-Jul-17	15, 27, 50, 180
95	B12	75°30'N	26°E	135	15-Jul-17	10, 15, 37, 62
108	B13	74°30'N	30°E	363	16-Jul-17	5, 15, 30, 70
150	B15	78°30'N	30°E	330	18-Jul-17	15, 34, 70, 175
189	B16	80°06'N	30°E	278	22-Jul-17	5, 15, 30, 200
238	B17	81°24'N	29°30'E	292	25-Jul-17	5, 17, 40, 120
250	B18	81°44'N	29°51'E	2812	26-Jul-17	10, 45, 60, **280**
299	B14	76°30'N	30°30'E	290	30-Jul-17	3, 48, **75**, 269
360	B7	76°N	16°50'E	319	3-Aug-17	6, 28, 50, 250
368	B5	74°22'N	18°10'E	118.4	4-Aug-17	8, 25, 38, 108
377	B3	72°38'N	19°15'E	370	5-Aug-17	10, 25, 40, 340
414	B1	70°46'N	20°E	190	7-Aug-17	10, 27, **50**, 140

Results

Nutrient concentration data are available in the relevant section of this cruise report. No isotopic data are available yet as analysis will take place in UK laboratories.

5. Net deployments

Geraint Tarling, Vicky Fowler, Carwyn Davies, Bjørg Apeland, Aisling Smith, Dan Mayor, Elliott Price, Sara Reed

MOCNESS deployments during JR17005

The MOCNESS has a mouth opening area of 1 m2 and contains 9 x 330 um meshed nets. It was nominally trawled at between 2 and 3 knots. The angle of the net in the water was logged throughout the deployment to determine the effective mouth opening area. The device also contained a flow meter (to measure effective distance travelled through the water), temperature and salinity probes. The system was operated through the BAS Down Wire Net Monitor (DWNM) system.

In open ocean regions, the maximum depth of the deployments was 1000 m (although some earlier trawls went to 1200 m), with net 1 being open during the downward trajectory and nets 2 to 9 incremented during the upward haul, splitting the water column into 125 m depth intervals. Where the sea-bed was shallower, the maximum depth was between 50 to 100 m above the bottom, and a smaller number of nets were open and closed during the upward trajectory so that each depth increment was between 50 and 100 m depth. The net was paid out between 20 and 30 m per minute. Hauling in was between 10 and 25 m per minute.

Two MOCNESS deployments were made per station, one shortly following the other, mostly separated by around 60 to 90 minutes by Bongo net hauls. The majority of hauls were carried out in the morning with a small number in the early afternoon. The catches of the first deployment were used for picking out animals (mainly *Calanus* spp and *Metridia* spp) for biochemical and physiological analysis (lipid, CHN, respiration). The remainder of these catches were not retained. The catches of the second deployment were volumetrically split from graduated buckets after thorough mixing. One half was preserved in 96% Ethanol, the other half in 4% formalin.

Some early deployments were unsuccessful, traced to a cable connecting the DWNM to the stepper motor. Towards the end of the cruise, there were some further problems with the stepper motor, which was thoroughly serviced through the refilling of oil and the milling of shaft holes to allow greater freedom in rotation. Subsequent hauls were successful.

Bucket 4 was lost on Event 15. There were no other losses of cod-ends or samples.

Deployments are listed in Table 5.1

Fig. 1. MOCNESS codends being lifted over the stern ramp prior to deployment (left); MOCNESS net fully cocked at the start of a deployment (right)

Time	Latitude(seatex-gga - seatex-gga-lat)	Longitude(seatex-gga - seatex-gga-lon)	Water depth(ea600 - ea600-depth)	Event(Built In - Integer)	Net number(Built In - Integer)	Open depth(Built In - Integer)	Close depth(Built In - Integer)	Catch fate(Built In - String)
05/06/2018 06:41	77.39513	19.42424	149.68	229	Net recovered			
05/06/2018 06:31	77.39044	19.41281	149.65	229	5	25	5	1/2 ethanol, 1/2 formalin
05/06/2018 06:21	77.38607	19.40157	149.54	229	4	50	25	1/2 ethanol, 1/2 formalin
05/06/2018 06:10	77.38093	19.38982	149.53	229	3	75	50	1/2 ethanol, 1/2 formalin
05/06/2018 05:59	77.3757	19.37635	150.37	229	2	100	75	1/2 ethanol, 1/2 formalin
05/06/2018 05:49	77.37021	19.36531	148.15	229	1		100	1/2 ethanol, 1/2 formalin
05/06/2018 05:43	77.36685	19.35754	148.11	229	Net deployed			
05/06/2018 03:50	77.39472	19.42389	150.42	226	Net recovered			
05/06/2018 03:36	77.3869	19.40487	149.47	226	5	25	5	Picked, not retained
05/06/2018 03:26	77.38184	19.39124	150.26	226	4	50	25	Picked, not retained
05/06/2018 03:17	77.37729	19.37864	149.59	226	3	75	50	Picked, not retained
05/06/2018 03:06	77.37141	19.36446	148.83	226	2	100	75	Picked, not retained
05/06/2018 02:56	77.36608	19.35101	150.79	226	1	0	100	
05/06/2018 02:54	77.365	19.34878	147.08	226	Net deployed			
03/06/2018 10:06	78.9659	9.55385	235.68	213	Net recovered			
03/06/2018 09:58	78.97004	9.53202	230.96	213	5	35	20	test only
03/06/2018 09:56	78.97004	9.53202	230.96	213	4	50	35	test only
03/06/2018 09:53	78.97119	9.52586	230.56	213	4	65	50	test only
03/06/2018 09:51	78.97195	9.52185	228.78	213	3	70	65	test only
03/06/2018 09:49	78.97271	9.51785	228.06	213	2	10	70	test only
03/06/2018 09:40	78.97646	9.49818	223.26	213	1		10	
03/06/2018 09:39	78.97695	9.49569	223.28	213	Net deployed			

02/06/2018 03:15	78.98849	8.27157	863.45	190	Net recovered			
02/06/2018 02:51	78.99769	8.25119	890.01	190	Net deployed			
01/06/2018 09:39	79.06651	7.44748	1283.92	178	Net recovered			
01/06/2018 09:28	79.06321	7.418	1290.81	178	9	125	5	Failed to trigger
01/06/2018 09:17	79.06012	7.38779	1298.04	178	8	250	125	Failed to trigger
01/06/2018 09:07	79.05753	7.3609	1299.44	178	7	375	250	Failed to trigger
01/06/2018 08:56	79.05475	7.32938	1301.03	178	6	500	375	Failed to trigger
01/06/2018 08:46	79.05253	7.30183	1309.24	178	5	625	500	Failed to trigger
01/06/2018 08:37	79.05098	7.2776	1310.76	178	4	750	625	Failed to trigger
01/06/2018 08:26	79.04921	7.25062	1314.73	178	3	875	750	Failed to trigger
01/06/2018 08:15	79.0474	7.22171	1320.1	178	2	1000	875	Failed to trigger
01/06/2018 07:08	79.03531	7.03756	1314.74	178	1		1000	
01/06/2018 07:07	79.0351	7.03443	1313.51	178	Net deployed			
01/06/2018 05:07	79.05574	7.4346	1286.64	175	Net recovered			
01/06/2018 04:56	79.05403	7.40342	1291.32	175	9	125	5	Picked, not retained
01/06/2018 04:45	79.05249	7.37315	1293.25	175	8	250	125	Picked, not retained
01/06/2018 04:35	79.05125	7.3452	1303.04	175	7	375	250	Picked, not retained
01/06/2018 04:24	79.04985	7.31255	1303.83	175	6	500	375	Picked, not retained
01/06/2018 04:14	79.04872	7.28117	1310.05	175	5	625	500	Picked, not retained
01/06/2018 04:05	79.04767	7.25371	1314.73	175	4	750	625	Picked, not retained
01/06/2018 03:55	79.0462	7.22538	1319.36	175	3	875	750	Picked, not retained
01/06/2018 03:45	79.04492	7.20042	1326.75	175	2	1000	875	Picked, not retained
01/06/2018 02:40	79.03468	7.01724	1310.94	175	1		1000	Picked, not retained
01/06/2018 02:36	79.03385	7.00585	1307.51	175	Net deployed			
31/05/2018 07:05	78.9362	4.82361	2619.59	165	Net recovered			
31/05/2018 06:55	78.93974	4.79831	2616.28	165	9	125	5	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 06:44	78.94291	4.76748	2613.84	165	8	250	125	1/2 picked, 1/4 ethanol, 1/4 formalin

31/05/2018 06:34	78.94557	4.7386	2609.97	165	7	375	250	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 06:24	78.94803	4.70785	2606.57	165	6	500	375	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 06:11	78.95123	4.66609	2604.44	165	5	650	500	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 06:02	78.95346	4.63599	2605.02	165	4	750	650	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 05:51	78.956	4.60004	2603.38	165	3	875	750	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 05:41	78.95847	4.56552	2603.95	165	2	1000	875	1/2 picked, 1/4 ethanol, 1/4 formalin
31/05/2018 04:35	78.98325	4.36949	2617.2	165	1		1000	Not retained
31/05/2018 04:34	78.98372	4.36598	2619.16	165	Net deployed			
30/05/2018 09:52	79.00705	1.6456	2543.25	154	Net recovered			
30/05/2018 09:41	79.00899	1.67294	2540.01	154	9	125	5	1/2 or 1/4 preserved in formalin, 1/2 or 1/4 ethanol, check label
30/05/2018 09:31	79.01035	1.69805	2538.33	154	8	250	125	1/2 Ethanol, 1/2 Formalin
30/05/2018 09:19	79.00866	1.72692	2537.37	154	7	375	250	1/2 Ethanol, 1/2 Formalin
30/05/2018 09:09	79.00652	1.75076	2538.21	154	6	500	375	1/2 Ethanol, 1/2 Formalin
30/05/2018 08:59	79.00466	1.77359	2538.08	154	5	625	500	1/2 Ethanol, 1/2 Formalin
30/05/2018 08:49	79.00314	1.79741	2536.3	154	4	750	625	1/2 Ethanol, 1/2 Formalin
30/05/2018 08:39	79.00232	1.8189	2533.44	154	3	875	750	1/2 Ethanol, 1/2 Formalin
30/05/2018 08:30	79.00169	1.83705	2531.22	154	2	1000	875	1/2 Ethanol, 1/2 Formalin

30/05/2018 07:31	78.99975	1.9784	2510.05	154	1		1000	Not retained
30/05/2018 07:29	78.99974	1.98445	2509.61	154	Net deployed			
30/05/2018 05:31	79.00729	1.59365	2551.95	151	Net recovered			
30/05/2018 05:19	79.00664	1.62591	2545.9	151	9	125	5	Picked, not retained
30/05/2018 05:09	79.00591	1.65477	2542.63	151	8	250	125	Picked, not retained
30/05/2018 04:59	79.00529	1.68248	2542.16	151	7	375	250	Picked, not retained
30/05/2018 04:49	79.00447	1.7082	2542.98	151	6	500	375	Picked, not retained
30/05/2018 04:38	79.00359	1.73691	2542.69	151	5	625	500	Picked, not retained
30/05/2018 04:27	79.00282	1.77045	2540.44	151	4	750	625	Picked, not retained
30/05/2018 04:18	79.0023	1.79764	2536.69	151	3	875	750	Picked, not retained
30/05/2018 04:09	79.00187	1.81889	2533.6	151	2	1000	875	Picked, not retained
30/05/2018 03:07	79.00013	1.98081	2510.36	151	Net deployed		1000	
29/05/2018 09:10	80.34588	2.47723	1796.35	139	Net recovered			
29/05/2018 08:56	80.33996	2.4349	1811.62	139	9	125	5	Preserved 1/2 or 1/4 in formalin, 1/2 or 1/4 in ethanol, check label
29/05/2018 08:46	80.3358	2.40422	1822.27	139	8	250	125	Preserved 1/2 in formalin, 1/2 in ethanol.
29/05/2018 08:34	80.33074	2.3664	1842.35	139	7	375	250	Preserved 1/2 in formalin, 1/2 in ethanol.
29/05/2018 08:24	80.32661	2.33599	1857.76	139	6	500	375	Preserved 1/2 in formalin, 1/2 in ethanol.
29/05/2018 08:14	80.32266	2.30629	1869.93	139	5	625	500	Preserved 1/2 in formalin, 1/2 in ethanol.
29/05/2018 08:04	80.31887	2.27781	1879.66	139	4	750	625	Preserved 1/2 in formalin, 1/2 in ethanol.

29/05/2018 07:54	80.31534	2.25102	1888.39	139	3	875	750	Preserved 1/2 in formalin, 1/2 in ethanol.
29/05/2018 07:44	80.31169	2.22461	1894.35	139	2	1000	875	Preserved 1/2 in formalin, 1/2 in ethanol.
29/05/2018 06:34	80.2861	2.02257	1920.07	139	Net deployed		1000	
29/05/2018 05:37	80.34094	2.50404	1764.2	138	Net recovered			
29/05/2018 05:27	80.33697	2.46737	1787.02	138	9	125	5	Picked, not retained
29/05/2018 05:17	80.33302	2.4311	1801.13	138	8	250	125	Picked, not retained
29/05/2018 05:07	80.32907	2.39663	1814.8	138	7	375	250	Picked, not retained
29/05/2018 04:57	80.32515	2.36372	1831.77	138	6	500	375	Picked, not retained
29/05/2018 04:47	80.32132	2.33222	1847.2	138	5	625	500	Picked, not retained
29/05/2018 04:37	80.31783	2.30211	1861.39	138	4	750	625	Picked, not retained
29/05/2018 04:27	80.31448	2.27204	1871.3	138	3	875	750	Picked, not retained
29/05/2018 04:16	80.31078	2.23906	1881.85	138	2	1000	875	Picked, not retained
29/05/2018 03:06	80.28528	2.01913	1919.44	138	Net deployed		1000	
28/05/2018 09:47	79.06363	-0.36537	2612.58	130	Net recovered			
28/05/2018 09:37	79.06034	-0.34507	2616.69	130	9	125	5	1/2 or 1/4 preserved in formalin, 1/2 or 1/4 preserved in ethanol, check label
28/05/2018 09:27	79.05683	-0.32342	2619	130	8	250	125	1/2 preserved in formalin, 1/2 preserved in ethanol
28/05/2018 09:16	79.05277	-0.29923	2621.93	130	7	375	250	1/2 preserved in formalin, 1/2 preserved in ethanol
28/05/2018 09:07	79.04942	-0.28043	2622.72	130	6	500	375	1/2 preserved in formalin, 1/2 preserved in ethanol

28/05/2018 08:56	79.04548	-0.25834	2617.83	130	5	625	500	1/2 preserved in formalin, 1/2 preserved in ethanol
28/05/2018 08:46	79.0416	-0.23718	2608.61	130	4	750	625	1/2 preserved in formalin, 1/2 preserved in ethanol
28/05/2018 08:35	79.0371	-0.21476	2604.71	130	3	875	750	1/2 preserved in formalin, 1/2 preserved in ethanol
28/05/2018 08:25	79.03297	-0.19539	2600.25	130	2	1000	875	1/2 or 1/4 preserved in formalin, 1/2 or 1/4 preserved in ethanol, check label
28/05/2018 07:12	79.00295	-0.02541	2592.86	130	Net deployed		1000	
28/05/2018 04:48	79.02486	-0.57063	2467.54	127	Net recovered			
28/05/2018 04:38	79.02316	-0.53288	2460.65	127	9	125	5	Picked, not retained
28/05/2018 04:27	79.02149	-0.49172	2460.46	127	8	250	125	Picked, not retained
28/05/2018 04:17	79.02011	-0.45522	2476.74	127	7	375	250	Picked, not retained
28/05/2018 04:06	79.01842	-0.41612	2501.81	127	6	500	375	Picked, not retained
28/05/2018 03:55	79.01672	-0.37853	2527.48	127	5	625	500	Picked, not retained
28/05/2018 03:45	79.01533	-0.34466	2541.25	127	4	750	625	Picked, not retained
28/05/2018 03:34	79.01387	-0.30894	2551.15	127	3	875	750	Picked, not retained
28/05/2018 03:22	79.01245	-0.27141	2560.42	127	2	1000	875	Picked, not retained
28/05/2018 02:09	79.00182	-0.03903	2591.39	127	Net deloyed		1000	
26/05/2018 21:03	78.99941	-2.99933	2443.09	109	Net recovered			
26/05/2018 19:50	78.99175	-2.7258	2520.81	109	9	125	5	1/2 or 1/4 preserved in formalin, 1/2 or 1/4 ethanol, check label
26/05/2018 19:40	78.99176	-2.68902	2402.62	109	8	250	125	1/2 Ethanol, 1/2 Formalin

26/05/2018 19:30	78.99112	-2.64788	2537.96	109	7	375	250	1/2 Ethanol, 1/2 Formalin
26/05/2018 19:20	78.99082	-2.60747	2548.37	109	6	500	375	1/2 Ethanol, 1/2 Formalin
26/05/2018 19:08	78.99243	-2.56269	2550.65	109	5	625	500	1/2 Ethanol, 1/2 Formalin
26/05/2018 19:00	78.99394	-2.52964	2554.45	109	4	750	625	1/2 Ethanol, 1/2 Formalin
26/05/2018 18:49	78.99594	-2.49042	2558.2	109	3	875	750	1/2 Ethanol, 1/2 Formalin
26/05/2018 18:39	78.99708	-2.4552	2564.32	109	2	1000	875	1/2 Ethanol, 1/2 Formalin
26/05/2018 17:33	79.00205	-2.22116	2597.54	109	Net deployed		1000	
26/05/2018 16:01	78.86851	-3.04673	2510.1	108	Net recovered			
26/05/2018 15:51	78.87744	-3.04265	2506.34	108	9	125	5	Picked, not retained
26/05/2018 15:39	78.88819	-3.03648	2506.54	108	8	250	125	Picked, not retained
26/05/2018 15:29	78.89704	-3.031	2501.94	108	7	375	250	Picked, not retained
26/05/2018 15:17	78.90752	-3.02339	2498.4	108	6	500	375	Picked, not retained
26/05/2018 15:05	78.91787	-3.01507	2494.91	108	5	625	500	Picked, not retained
26/05/2018 14:55	78.92682	-3.00644	2494.93	108	4	750	625	Picked, not retained
26/05/2018 14:45	78.93409	-3.00389	2491.39	108	3	875	750	Picked, not retained
26/05/2018 14:33	78.94262	-3.00214	2486.35	108	2	1000	875	Picked, not retained
26/05/2018 13:11	79.00003	-2.99975	2443.59	108	Net deployed		1000	
25/05/2018 15:36	78.98449	-4.63639	1562.59	95	Net recovered			
25/05/2018 15:25	78.98528	-4.66726	1540.62	95	9	125	5	1/2 or 1/4 preserved in formalin, 1/2 or 1/4 ethanol, check label
25/05/2018 15:15	78.98604	-4.69657	1520.38	95	8	250	125	1/2 Ethanol, 1/2 Formalin
25/05/2018 15:05	78.98702	-4.7267	1501.74	95	7	375	250	1/2 Ethanol, 1/2 Formalin

25/05/2018 14:45	78.98945	-4.787	1467.36	95	5	625	500	1/2 Ethanol, 1/2 Formalin
25/05/2018 14:36	78.99047	-4.81239	1447.09	95	4	750	625	1/2 Ethanol, 1/2 Formalin
25/05/2018 14:26	78.99229	-4.83745	1431.51	95	3	875	750	1/2 Ethanol, 1/2 Formalin
25/05/2018 14:17	78.99451	-4.859	1418.82	95	2	1000	875	1/2 Ethanol, 1/2 Formalin
25/05/2018 13:19	79.0013	-5.00949	1315.4	95	Net deployed		1000	
25/05/2018 11:14	78.97194	-4.63544	1570.54	92	Net recovered			
25/05/2018 11:04	78.97382	-4.66332	1547.58	92	9	125	5	Picked, not retained
25/05/2018 10:54	78.97561	-4.69242	1526.72	92	8	250	125	Picked, not retained
25/05/2018 10:44	78.97726	-4.72033	1503.31	92	7	375	250	Picked, not retained
25/05/2018 10:33	78.97913	-4.75101	1482.93	92	6	500	375	Picked, not retained
25/05/2018 10:23	78.98095	-4.77986	1463.25	92	5	625	500	Picked, not retained
25/05/2018 10:13	78.98251	-4.80669	1447.75	92	4	750	625	Picked, not retained
25/05/2018 10:02	78.98421	-4.83529	1426.43	92	3	875	750	Picked, not retained
25/05/2018 09:52	78.98573	-4.86229	1405.24	92	2	1000	875	Picked, not retained
25/05/2018 08:43	78.99929	-5.06454	1274.86	92	Net deployed		1000	
24/05/2018 19:00	78.9941	-5.65343	833.08	83	Net recovered			
24/05/2018 18:59	78.99463	-5.65439	833.23	83	9	25	5	Test only, no sample taken
24/05/2018 18:57	78.99569	-5.65629	833.44	83	8	50	25	Test only, no sample taken
24/05/2018 18:55	78.99673	-5.65818	835.98	83	7	70	50	Test only, no sample taken
24/05/2018 18:54	78.99725	-5.65914	837.81	83	6	100	70	Test only, no sample taken
24/05/2018 18:52	78.99827	-5.66121	839.44	83	5	150	100	Test only, no sample taken

24/05/2018 18:48	79.00039	-5.66591	840.54	83	4	200	150	Test only, no sample taken
24/05/2018 18:45	79.0022	-5.67019	841.8	83	3	250	200	Test only, no sample taken
24/05/2018 18:43	79.00345	-5.67304	841.12	83	2	300	250	Test only, no sample taken
24/05/2018 18:23	79.0136	-5.70302	833.26	83	Net deployed		300	
24/05/2018 15:12	79.01744	-5.74137	0	81	Net recovered			
24/05/2018 14:47	79.00359	-5.76818	0	81	5	125	5	Failed to trigger
24/05/2018 14:39	78.99965	-5.77925	747.81	81	4	250	125	Failed to trigger
24/05/2018 14:31	78.99628	-5.79115	733.04	81	3	375	200	Failed to trigger
24/05/2018 14:00	78.98379	-5.84215	664.9	81	2	500	375	Failed to trigger
24/05/2018 13:50	78.9847	-5.85477	660.94	81	Net deployed	0	500	
24/05/2018 11:55	79.01604	-5.83544	735.48	78	Net recovered			
24/05/2018 11:43	79.01053	-5.86164	705.98	78	5	125	5	Most likely triggered - picked
24/05/2018 11:32	79.00444	-5.87957	680.95	78	4	250	125	Failed to trigger
24/05/2018 11:22	78.99879	-5.89055	658.63	78	3	375	250	Failed to trigger
24/05/2018 11:12	78.99322	-5.89814	641.6	78	2	500	375	Failed to trigger
24/05/2018 10:42	78.9764	-5.87677	616.66	78	Net deployed		500	
19/05/2018 08:30	76.30672	-9.07577	281.17	45	Net recovered			
19/05/2018 08:12	76.29494	-9.06462	278.12	45	5	50	5	Preserved 1/8 sample formalin, 1/8 sample ethanol
19/05/2018 07:57	76.28551	-9.05577	282.32	45	4	100	50	Preserved 1/2 sample formalin, 1/2 sample ethanol
19/05/2018 07:42	76.27671	-9.04701	281.49	45	3	150	100	Preserved 1/2 sample formalin, 1/2 sample ethanol

19/05/2018 07:27	76.26848	-9.03875	280.13	45	2	200	150	Preserved 1/2 sample formalin, 1/2 sample ethanol
19/05/2018 07:13	76.25965	-9.031	285.55	45	Net deployed		200	
19/05/2018 06:36	76.30057	-9.10491	280.91	44	Net recovered			
19/05/2018 06:21	76.29196	-9.09059	280.12	44	5	50	5	Picked, not retained
19/05/2018 06:07	76.28412	-9.07713	282.45	44	4	100	50	Picked, not retained
19/05/2018 05:52	76.27591	-9.06275	279.04	44	3	150	100	Picked, not retained
19/05/2018 05:37	76.26826	-9.0488	284.62	44	2	200	150	Picked, not retained
19/05/2018 05:23	76.25967	-9.03507	284.15	44	Net deployed		200	
18/05/2018 14:11	76.12955	-8.74867	904.64	34	Net recovered			
18/05/2018 14:01	76.12813	-8.72297	928.95	34	9	125	5	Preserved 1/2 or 1/4 in formalin, 1/2 or 1/4 in ethanol, check label
18/05/2018 13:51	76.12686	-8.69798	960.15	34	8	250	125	Preserved 1/2 sample formalin, 1/2 sample ethanol
18/05/2018 13:42	76.12561	-8.67619	983	34	7	375	250	Preserved 1/2 sample formalin, 1/2 sample ethanol
18/05/2018 13:32	76.12414	-8.65257	1005.41	34	6	500	375	Preserved 1/2 sample formalin, 1/2 sample ethanol
18/05/2018 13:18	76.12172	-8.62082	1040.8	34	5	625	500	Preserved 1/2 sample formalin, 1/2 sample ethanol
18/05/2018 13:08	76.11969	-8.59658	1067.09	34	4	750	625	Preserved 1/2 sample foramlin, 1/2 sample ethanol
18/05/2018 12:58	76.11728	-8.57326	1094.32	34	3	875	750	Preserved 1/2 sample formalin 1/2 sample ethanol

18/05/2018 12:50	76.11566	-8.55815	1113	34	2	974	875	Preserved 1/2 sample formalin, 1/2 sample ethanol
18/05/2018 11:51	76.10386	-8.43595	1239.54	34	Net deployed		974	
18/05/2018 09:27	76.1658	-8.7717	750.45	31	Net Recovery			09:27
18/05/2018 09:15	76.1608	-8.74602	791.47	31	9	125	5	Picked, not retained
18/05/2018 09:02	76.15545	-8.71632	836.64	31	8	250	125	Picked, not retained
18/05/2018 08:52	76.15152	-8.69367	872.05	31	7	325	250	Picked, not retained
18/05/2018 08:41	76.1475	-8.67023	903.53	31	6	500	375	Picked, not retained
18/05/2018 08:30	76.14314	-8.64598	938.15	31	5	625	500	Picked, not retained
18/05/2018 08:19	76.13942	-8.62285	970.06	31	4	750	625	Picked, not retained
18/05/2018 08:06	76.13506	-8.59487	1009.12	31	3	875	750	Picked, not retained
18/05/2018 07:56	76.13174	-8.57386	1040.22	31	2	1000	875	Picked, not retained
18/05/2018 06:49	76.10582	-8.43846	1229.6	31	Net Deployed		1000	
17/05/2018 06:47	75.84202	-7.59499	2377.94	26	Net recovered			
17/05/2018 06:10	75.83636	-7.49605	2453.27	26	9	150	5	Failed to trigger
17/05/2018 06:09	75.83611	-7.49384	2455.36	26	8	300	150	Failed to trigger
17/05/2018 06:08	75.83588	-7.4916	2457.32	26	7	450	300	Failed to trigger
17/05/2018 06:07	75.83573	-7.48937	2451.99	26	6	600	450	Failed to trigger
17/05/2018 05:57	75.8337	-7.46678	2479.07	26	5	750	600	Failed to trigger
17/05/2018 05:47	75.83099	-7.44416	2495.71	26	4	900	750	Failed to trigger
17/05/2018 05:37	75.82812	-7.42259	2513.03	26	3	1050	900	Failed to trigger
17/05/2018 05:25	75.82464	-7.39821	2534.1	26	2	1200	1050	Failed to trigger
17/05/2018 04:00	75.79937	-7.23843	2678.37	26	Net deployed		1200	
16/05/2018 11:49	75.22888	-5.51975	3547.49	18	Net recovered			
16/05/2018 11:33	75.23889	-5.51586	3550.13	18	9	150	5	Preserved 1/2 or 1/4 in formalin, 1/2 or 1/4 in ethanol, check label
16/05/2018 11:20	75.24796	-5.5123	3559.44	18	8	300	150	Preserved 1/2 sample formalin, 1/2 sample ethanol

16/05/2018 11:08	75.2562	-5.50947	3574.76	18	7	450	300	Preserved 1/2 sample formalin, 1/2 sample ethanol
16/05/2018 10:59	75.26229	-5.50752	3577.45	18	6	600	450	Preserved 1/2 sample formalin, 1/2 sample ethanol
16/05/2018 10:49	75.26829	-5.50498	3576.83	18	5	750	600	Preserved 1/2 sample formalin, 1/2 sample ethanol
16/05/2018 10:39	75.27412	-5.50239	3574.4	18	4	900	750	Preserved 1/2 sample foramlin, 1/2 sample ethanol
16/05/2018 10:28	75.28006	-5.49962	3573.26	18	3	1050	900	Preserved 1/2 sample formalin 1/2 sample ethanol
16/05/2018 10:18	75.28552	-5.49667	3571.26	18	2	1200	1050	Preserved 1/2 sample formalin, 1/2 sample ethanol
16/05/2018 08:59	75.33074	-5.46613	3570.28	18	Net deployed.			
16/05/2018 06:25	75.23702	-5.73019	3553.54	15	Net recovered.			
16/05/2018 06:10	75.24583	-5.70662	0	15	9	150	5	Respiration Picking
16/05/2018 05:58	75.25186	-5.68881	3562.37	15	8	300	150	Respiration Picking
16/05/2018 05:47	75.25687	-5.67356	3560.93	15	7	450	300	Respiration Picking
16/05/2018 05:34	75.26269	-5.6551	3564.13	15	6	600	450	Respiration Picking
16/05/2018 05:25	75.26742	-5.64148	3563.94	15	5	750	600	Picked
16/05/2018 05:17	75.27153	-5.62948	3561.49	15	4	900	750	No sample.
16/05/2018 05:05	75.27657	-5.61303	3557.18	15	3	1050	900	Picked
16/05/2018 04:47	75.28321	-5.59008	3557.86	15	2	1200	1050	Picked
16/05/2018 03:11	75.32898	-5.47984	3569.84	15	Net deployed.		1200	
13/05/2018 17:09	67.9573	-3.91755	3779.01	6	Net recovered.			
13/05/2018 16:45	67.96471	-3.96547	3770.28	6	Net deployed			

13/05/2018 12:29	67.96852	-3.97835	3769.84	3	Net recovered		
13/05/2018 11:58	67.99079	-3.98358	3736.22	3	Net deployed		

Table 5.1 List of deployments of MOCNESS nets during JR17005, with details on the fate of the catch

Bongo net deployments (JR17005)

Vertical hauls for zooplankton were made using a Motion Compensation Bongo net mechanism, comprising 2 x 57 cm diameter rings and 200 um net meshes. Hauls were made between 0 and 200 m in the open ocean or to within 20 m of the sea-bed in shelf environments. The net was paid out and hauled in at speeds of between 15 and 20 m per minute. The approximate time for a single deployment was around 25 minutes. The net was rinsed between deployments when clogging from phytoplankton was evident. Between 2 and 3 deployments were made at each station both day (around midday) and night (around midnight). An entire cod-end bucket from one of the deployments was preserved in 96% Ethanol and another in 4% formalin at least from the daytime set of deployments. This was frequently done for the nighttime deployment set also. The other deployments were made principally to obtain live specimens, mainly of *Calanus* spp. and *Metridia* spp and the remainder of the catches were not retained. A small collection of pteropods were also extracted from these catches (for genetic analysis).

The cod-end buckets on the Bongo nets were unclasped at the end of every haul so as to enable the catch to be taken off the net in its entirety and then processed in ways that were sympathetic to delicate organisms. The clasping buckets achieved this aim but at the expense of the spillage of a certain fraction of the sample during the unclasping process since there was sometimes a backlog of sample within the net (resulting from phytoplankton clogging). Therefore, none of the preserved samples represent a truly quantitative estimate of the total catch (between 5 and 20% of each catch was spilled).

The horizontal bar holding the mouths of the cod-ends was caught on the safety line box during the start of one deployment around half way through the cruise, bending the bar downwards on one side. This did not affect the integrity of the net and was left as it was for the remainder of the cruise.

Fig. 1 Cod-end buckets being clasped on prior to deployment

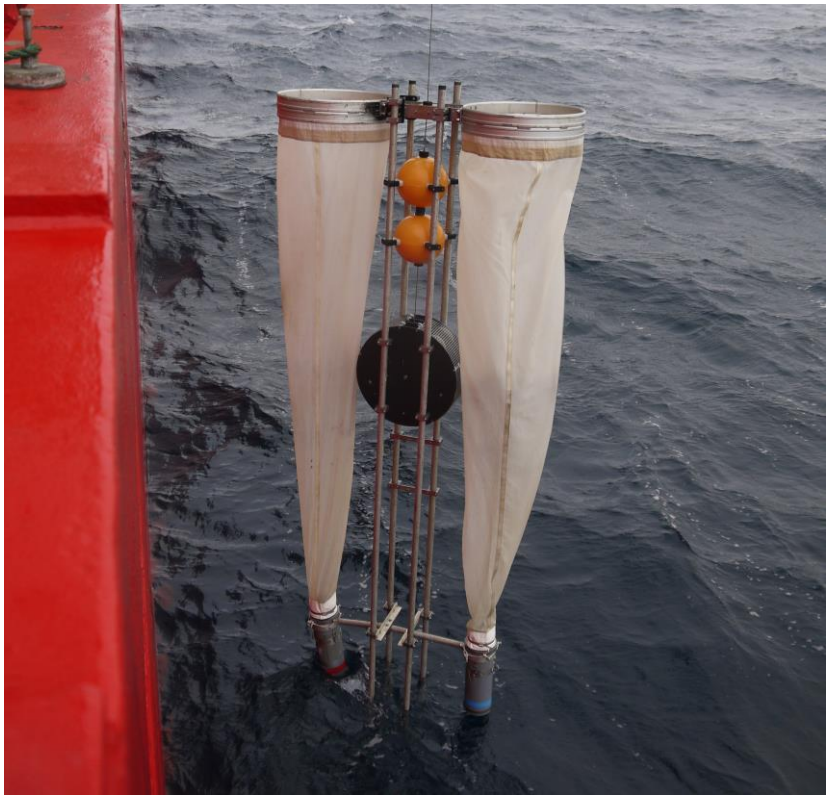


Fig 2: Deployment of Bongo net

Time	Latitude(seatex-gga - seatex-gga-lat)	Longitude(seatex-gga - seatex-gga-lon)	Water depth(ea600 - ea600-depth)	Event(Built In - Integer)	Net depth interval(Built In - String)	Catch fate(Built In - String)	Comment
05/06/2018 04:50	77.41669	19.49963	146.23	228	100		Bongo recovered. ST1 station.
05/06/2018 04:37	77.41668	19.49959	145.87	228	100		Bongo deployed. ST1 station.
05/06/2018 04:35	77.41669	19.49958	146.57	227	100		Bongo recovered. ST1 station.
05/06/2018 04:21	77.4167	19.49954	146.04	227	100	Preserved	Bongo deployed. ST1 station.
05/06/2018 01:20	77.41681	19.49983	145.85	225	100		Bongo recovered. ST1 station.
05/06/2018 01:05	77.41672	19.50016	146.06	225	100		Bongo deployed. ST1 station.
04/06/2018 22:57	77.41673	19.5001	145.45	222	100		Bongo recovered. ST1 station.
04/06/2018 22:38	77.41673	19.50009	145.72	222	100		Bongo deployed. ST1 station.
04/06/2018 22:35	77.41673	19.50011	145.43	221	100		Bongo recovered. ST1 station.
04/06/2018 22:23	77.41674	19.50012	145.36	221	100		Bongo deployed. ST1 station.
04/06/2018 22:19	77.41673	19.50014	145.88	220	100		Bongo recovered. ST1 station.
04/06/2018 22:08	77.41674	19.50013	145.12	220	100		Bongo deployed. ST1 station.
04/06/2018 22:04	77.41674	19.50012	145.29	219	100	Preserved	Bongo recovered. ST1 station.
04/06/2018 21:50	77.41674	19.50015	145.12	219	100		Bongo deployed. ST1 station.
03/06/2018 09:24	78.97966	9.48102	222.37	212	200		Bongo recovered. V12 station.
03/06/2018 09:03	78.97966	9.481	221.76	212	200		Bongo deployed. V12 station.

03/06/2018 08:58	78.97966	9.481	221.76	211	200		Bongo recovered. V12 station.
03/06/2018 08:33	78.97965	9.48108	221.78	211	200		Bongo deployed. V12 station.
03/06/2018 08:28	78.97965	9.48114	221.8	210	200		Bongo recovered. V12 station.
03/06/2018 08:03	78.97966	9.48109	221.92	210	200	Preserved	Bongo deployed. V12 station.
02/06/2018 23:59	79.03508	10.84313	315.59	204	200		Bongo recovered. KB0 station.
02/06/2018 23:36	79.03508	10.84304	315.01	204	200		Bongo deployed. KB0 station.
02/06/2018 23:33	79.03508	10.84304	314.75	203	200		Bongo recovered. KB0 station.
02/06/2018 23:10	79.03509	10.84308	315.16	203	200		Bongo deployed. KB0 station.
02/06/2018 23:06	79.03509	10.84303	315.24	202	200		Bongo recovered. KB0 station.
02/06/2018 22:42	79.03509	10.84309	314.75	202	200	Preserved	Bongo deployed. KB0 station.
01/06/2018 22:50	79.03328	8.3333	830.58	187	200		Bongo recovered. F2 station.
01/06/2018 22:27	79.03328	8.33331	830.61	187	200		Bongo deployed. F2 station.
01/06/2018 22:24	79.03329	8.33334	830.15	186	200		Bongo recovered. F2 station
01/06/2018 22:02	79.03329	8.33332	830.55	186	200		Bongo deployed. F2 station
01/06/2018 21:58	79.03328	8.33328	830.41	185	200		Bongo recovered. F2 station
01/06/2018 21:38	79.03327	8.3333	830.17	185	200	Preserved	Bongo deployed. F2 station
01/06/2018 06:49	79.03301	7.00025	1304.68	177	200		Bongo recovered. F4 station
01/06/2018 06:28	79.03301	7.0004	1304.01	177	200		Bongo deployed. F4 station
01/06/2018 06:25	79.033	7.00038	1304.43	176	200		Bongo recovered. F4 station
01/06/2018 06:01	79.03302	7.00042	1304.18	176	200	Preserved	Bongo deployed. F4 station
31/05/2018 22:52	79.03328	7.00008	1304.79	172	200		Bongo recovered. F4 station
31/05/2018 22:30	79.03329	7.00008	1304.99	172	200		Bongo deployed. F4 station
31/05/2018 22:27	79.03329	7.00007	1304.76	171	200		Bongo recovered. F4 station
31/05/2018 22:03	79.03328	7.00012	1305.55	171	200		Bongo deployed. F4 station
31/05/2018 21:59	79.03328	7.00004	1304.75	170	200		Bongo recovered. F4 station
31/05/2018 21:34	79.03327	6.99998	1304.55	170	200	Preserved	Bongo deployed. F4 station

31/05/2018 00:31	79.04835	4.33218	2458.33	162	200		Bongo recovered. HG-IV station
31/05/2018 00:08	79.04836	4.33213	2458.29	162	200		Bongo deployed. HG-IV station
31/05/2018 00:03	79.04836	4.33204	2458.3	161	200		Bongo recovered. HG-IV station
30/05/2018 23:40	79.04835	4.33201	2458.24	161	200		Bongo deployed. HG-IV station
30/05/2018 23:37	79.04835	4.33201	2458.24	160	200		Bongo recovered. HG-IV station
30/05/2018 23:12	79.04835	4.33204	2458.06	160	200	Preserved	Bongo deployed. HG-IV station.
30/05/2018 07:12	79.00001	1.99968	2507.97	153	200		Bongo recovered. F8 station.
30/05/2018 06:49	79.00001	1.99975	2508.13	153	200		Bongo deployed. F8 station.
30/05/2018 06:46	79.00002	1.99976	2507.98	152	200		Bongo recovered. F8 station.
30/05/2018 06:22	78.99998	1.9998	2510.42	152	200	Preserved	Bongo deployed. F8 station.
29/05/2018 23:29	79.00027	2.00253	2508.21	148	200		Bongo recovered. F8 station.
29/05/2018 23:04	78.99997	2.0003	2508.52	148	200		Bongo deployed. F8 station.
29/05/2018 23:00	79.00014	2.00151	2508.19	147	200		Bongo recovered. F8 station.
29/05/2018 22:34	78.99999	2.00041	2508.28	147	200		Bongo deployed. F8 station.
29/05/2018 22:31	79.00005	2.00079	2508.2	146	200		Bongo recovered. F8 station.
29/05/2018 22:05	78.99995	2.00011	2508.47	146	200	Preserved	Bongo deployed. F8 station.
29/05/2018 17:44	79.6423	1.99827	1502.74	144	200		Bongo recovered. FS2 station.
29/05/2018 17:15	79.64228	1.99825	1502.69	144	200		Bongo deployed. FS2 station.
29/05/2018 17:12	79.64229	1.99823	1502.81	143	200		Bongo recovered. FS2 station.
29/05/2018 16:46	79.6423	1.99828	1502.91	143	200	Preserved	Bongo deployed. FS2 station.
29/05/2018 10:53	80.28327	2.00003	1921.89	141	200		Bongo recovered. FS1 station.
29/05/2018 10:30	80.28335	2.00029	1922.07	141	200		Bongo deployed. FS1 station.

29/05/2018 10:27	80.28334	2.00032	1921.67	140	200		Bongo recovered. FS1 station.
29/05/2018 10:04	80.28338	2.00011	1922.2	140	200	Preserved	Bongo deployed. FS1 station.
28/05/2018 23:21	80.28332	2.0004	1922.21	135	200		Bongo recovered. FS1 station.
28/05/2018 22:59	80.28329	2.00016	1922.2	135	200		Bongo deployed. FS1 station.
28/05/2018 22:56	80.28332	2.00054	1924.39	134	200		Bongo recovered. FS1 station.
28/05/2018 22:30	80.28328	2.0002	1921.99	134	200		Bongo deployed. FS1 station.
28/05/2018 22:26	80.28329	2.00015	1921.69	133	200		Bongo recovered. FS1 station.
28/05/2018 22:02	80.2833	2.0002	1921.95	133	200	Preserved	Bongo deployed. FS1 station.
28/05/2018 06:56	78.99927	-0.00362	2590.39	129	200		Bongo recovered. F10 station.
28/05/2018 06:31	78.99935	-0.00251	2590.54	129	200		Bongo deployed. F10 station.
28/05/2018 06:28	78.99936	-0.00251	2590.43	128	200		Bongo recovered. F10 station.
28/05/2018 06:04	78.99936	-0.00255	2590.37	128	200	Preserved	Bongo deployed. F10 station.
27/05/2018 22:13	78.99994	-0.00002	2591.44	124	200		Bongo recovered. F10 station.
27/05/2018 21:49	78.99994	0	2591.2	124	200		Bongo deployed. F10 station.
27/05/2018 21:45	78.99994	0.00001	2591.19	123	200		Bongo recovered. F10 station.
27/05/2018 21:16	78.99995	0.00002	2591.11	123	200		Bongo deployed. F10 station.
27/05/2018 21:12	78.99996	0.00007	2591.17	122	200		Bongo recovered. F10 station.
27/05/2018 20:42	78.99994	-0.00002	2591.04	122	200	Preserved	Bongo deployed. F10 station.
26/05/2018 22:47	78.99651	-2.99944	2444.87	113	200		Bongo recovered. F13 station.
26/05/2018 22:24	78.99803	-2.99906	2444.27	113	200		Bongo deployed. F13 station.
26/05/2018 22:21	78.99805	-2.99899	2444.11	112	200		Bongo recovered. F13 station.

26/05/2018 21:58	78.9987	-2.99875	2443.88	112	200		Bongo deployed. F13 station.
26/05/2018 21:54	78.99888	-2.99877	2443.82	111	200		Bongo recovered. F13 station.
26/05/2018 21:19	79	-3.00008	2787.21	111	200	Preserved	Bongo deployed. F13 station.
26/05/2018 12:54	79.00002	-2.99983	2443.74	107	200		Bongo recovered. F13 station.
26/05/2018 12:28	78.99998	-2.99979	2443.44	107	200		Bongo deployed. F13 station.
26/05/2018 12:25	78.99999	-2.9998	2443.21	106	200		Bongo recovered. F13 station.
26/05/2018 12:00	79.00035	-3.00118	2442.47	106	200	Preserved	Bongo deployed. F13 station.
25/05/2018 23:56	78.98344	-5.00501	1296.76	102	200		Bongo recovered. F15 station.
25/05/2018 23:35	78.98399	-5.0039	1298	102	200		Bongo deployed. F15 station.
25/05/2018 23:31	78.9843	-5.00329	1298.86	101	200		Bongo recovered. F15 station.
25/05/2018 23:08	78.98492	-5.00208	1300.69	101	200		Bongo deployed. F15 station.
25/05/2018 23:06	78.98513	-5.00165	1301.01	100	200		Bongo recovered. F15 station.
25/05/2018 22:40	78.98609	-4.99978	1303.71	100	200	Preserved	Bongo deployed. F15 station.
25/05/2018 12:55	79.00147	-5.01646	1311.74	94	200		Bongo recovered. F15 station.
25/05/2018 12:31	79.00146	-5.0165	1311.74	94	200		Bongo deployed. F15 station.
25/05/2018 12:27	79.00146	-5.01696	1311.39	93	200		Bongo recovered. F15 station.
25/05/2018 12:00	79.00157	-5.02089	1309.22	93	200	Preserved	Bongo deployed. F15 station.
24/05/2018 23:17	78.9997	-5.992	568.88	88	200		Bongo recovered. F17 station.
24/05/2018 22:55	78.99964	-5.99097	569.74	88	200		Bongo deployed. F17 station.
24/05/2018 22:51	78.99963	-5.99096	569.9	87	200		Bongo recovered. F17 station.
24/05/2018 22:26	78.99933	-5.98651	575.03	87	200		Bongo deployed. F17 station.

24/05/2018 22:22	78.99931	-5.98652	574.94	86	200		Bongo recovered. F17 station.
24/05/2018 21:58	78.99931	-5.98658	574.96	86	200	Preserved	Bongo deployed. F17 station.
24/05/2018 13:21	78.99918	-5.95412	603.24	80	200		Bongo recovered. F17 station.
24/05/2018 12:55	79.00153	-5.96512	601.68	80	200		Bongo deployed. F17 station.
24/05/2018 12:51	79.0019	-5.96623	601.98	79	200		Bongo recovered. F17 station.
24/05/2018 12:25	79.00215	-5.96914	600.91	79	200	Preserved	Bongo Deployed. F17 station.
23/05/2018 04:29	78.95925	-9.30006	241.03	75	200		Bongo recovered. F21 station.
23/05/2018 03:51	78.96132	-9.29465	237.09	75	200	Preserved	Bongo deployed. F21 station.
23/05/2018 03:48	78.96154	-9.29408	237.26	74	200		Bongo recovered. F21 station.
23/05/2018 03:23	78.96347	-9.29022	227.83	74	200		Bongo deployed. F21 station.
22/05/2018 23:00	78.98235	-9.27496	258.1	71	200		Bongo recovered. F21 station.
22/05/2018 22:35	78.98355	-9.27856	260.55	71	200		Bongo deployed. F21 station.
22/05/2018 22:32	78.98369	-9.27897	260.43	70	200		Bongo recovered. F21 station.
22/05/2018 22:03	78.98462	-9.28125	259.53	70	200		Bongo deployed. F21 station.
20/05/2018 00:22	76.69977	-10.9213	332.65	56	200		Bongo recovered. NT2 station.
19/05/2018 23:45	76.70335	-10.9168	331.6	56	200	Preserved	Bongo deployed. NT2 station.
19/05/2018 23:42	76.70385	-10.9169	335.36	55	200		Bongo recovered. NT2 station.
19/05/2018 23:16	76.70608	-10.9132	335.52	55	200		Bongo deployed. NT2 station.
19/05/2018 23:12	76.70663	-10.9126	337.05	54	200		Bongo recovered. NT2 station.
19/05/2018 22:45	76.70913	-10.9096	338.89	54	200		Bongo deployed. NT2 station.
19/05/2018 10:08	76.25581	-9.02866	283.71	47	200		Bongo recovered. NT5 station.

19/05/2018 09:42	76.2558	-9.02865	283.24	47	200		Bongo deployed. NT5 station.
19/05/2018 09:39	76.2558	-9.02865	283.45	46	200		Bongo recovered. NT5 station.
19/05/2018 09:13	76.25581	-9.02866	285.12	46	200	Preserved	Bongo deployed. NT5 station.
19/05/2018 01:50	76.25576	-9.02851	286.22	41	200		Bongo recovered. NT5 station.
19/05/2018 01:24	76.25576	-9.02855	285.87	41	200	Preserved	Bongo deployed. NT5 station.
19/05/2018 01:20	76.25576	-9.02858	287.88	40	200		Bongo recovered. NT5 station.
19/05/2018 00:52	76.25577	-9.02861	285.92	40	200		Bongo deployed. NT5 station.
18/05/2018 11:23	76.10237	-8.41894	1255.8	33	200		Bongo recovered. NT6 station.
18/05/2018 10:56	76.10239	-8.41891	1255.67	33	200		Bongo deployed. NT6 station.
18/05/2018 10:52	76.10238	-8.41895	1255.49	32	200		Bongo recovered. NT6 station.
18/05/2018 10:27	76.1024	-8.41889	1255.93	32	200	Preserved	Bongo deployed. NT6 station.
17/05/2018 00:08	75.79557	-7.21793	2695.37	23	200		Bongo recovered. NT8 station.
16/05/2018 23:43	75.79556	-7.21792	2695.29	23	200	Preserved	Bongo deployed. NT8 station.
16/05/2018 23:38	75.79557	-7.21793	2695.39	22	200		Bongo recovered. NT8 station.
16/05/2018 23:11	75.79557	-7.21789	2695.27	22	200		Bongo deployed. NT8 station.
16/05/2018 08:39	75.3359	-5.45959	3571.36	17	200		Bongo recovered. NT11 station.
16/05/2018 08:13	75.33593	-5.45958	3571.07	17	200		Bongo deployed. NT11 station.
16/05/2018 08:10	75.33594	-5.45964	3571.2	16	200		Bongo recovered. NT11 station.
16/05/2018 07:43	75.33594	-5.45963	3571.18	16	200	Preserved	Bongo deployed. NT11 station.
15/05/2018 23:05	75.33555	-5.46438	3571.52	12	200		Bongo recovered. NT11 station.

15/05/2018 22:37	75.33554	-5.46434	3571.03	12	200		Bongo deployed. NT11 station.
15/05/2018 22:36	75.33555	-5.46432	3571.13	11	200		Bongo recovered. NT11 station.
15/05/2018 22:03	75.33556	-5.46435	3570.96	11	200		Bongo deployed. NT11 station.
13/05/2018 13:11	67.96659	-3.97779	3760.92	4	100		Bongo recovered. Test station.
13/05/2018 12:54	67.96659	-3.97779	3761.05	4	100		Bongo deployed. Test Station.

Table 5.1: Deployments of Bongo nets

6. Phytoplankton and Zooplankton Community

6.1 Zooplankton ecology and physiology

Daniel Mayor, Holly Jenkins and Florence Atherden

Rationale

Zooplankton are the vector through which energy and nutrition are transferred from phytoplankton to higher trophic levels, including fish, birds and mammals. Arctic zooplankton communities are dominated by copepods of the genus Calanus: *Calanus finmarchicus*, *Calanus glacialis* and *Calanus hyperboreus*. Understanding the physiological ecology of these animals is therefore central to understanding the wider ecology and biogeochemistry of the Arctic Ocean, and how it may change in the future.

All *Calanus* species can produce eggs from internal lipid reserves and this aspect of their physiology is central to how they are represented in large-scale population models. 'Capital breeding' in advance of, or during, pronounced periods of primary production increases the reproductive value of each egg but reduces an individual's maximum potential diapause duration. This strategy reduces the population-scale grazing impact during spring and the potential for carbon export via the large, fast sinking faecal pellets produced by adults. It also helps buffer the population's reproductive output from changes in the timing of autotrophic blooms. The largest of the sibling species of *Calanus*, *C. hyperboreus*, is renowned for its ability to undertake lipid-fuelled spawning well in advance of the spring bloom, and both *C. finmarchicus* and *C. glacialis* are also reported to undertake capital breeding at times. By contrast, 'income breeding' via the ingestion of microalgae reduces an individual's requirement for lipid reserves, but potentially reduces the reproductive value of each egg via increased grazing competition between parents and their developing offspring. This strategy necessitates a close coupling between the timing of female ascent from diapause and the onset of bloom conditions, and potentially stimulates regional biogeochemistry via the egestion and excretory activities of the adult population. *C. finmarchicus* and *C. glacialis* are frequently suggested to adopt this strategy, and *C. hyperboreus* may also be able to extend their reproductive period by feeding on the spring bloom. Nevertheless, the lack of empirical data on the rates of production and consumption of lipids in Arctic *Calanus* currently hampers our ability to understand the relative importance of capital and income breeding strategies and hence validate existing life history models and their biogeochemical implications.

The overarching aim of this work is to examine the relative importance of capital- and income breeding in *C. finmarchicus* and *C. glacialis.* Our objectives are to quantify:

- How the food environment influences the rates of egg production and the amounts of carbon, nitrogen and individual fatty acids that are ingested and derived from maternal reserves in female *C. finmarchicus* and *C. glacialis*;

- The reliance upon lipid-based metabolism in female *C. finmarchicus* and *C. glacialis* and how this changes in space and time;

- The basal rates at which carbon, nitrogen and individual fatty acids are catabolised by female *C. hyperboreus* and *C. glacialis*.

Methods

Experimental seawater was collected from the chlorophyll maximum using the CTD upcast (Table 6.1) and was gently transferred into HDPE carboys using wide-bore silicone tubing. Experimental animals were collected with a motion-compensated bongo net (200µm mesh) using a filtering cod end (Table 6.1) and were subsequently sorted into sterile filtered (0.2µm) seawater (FSW) under dim light using a dissection microscope. Sampling activities took place at or close to midnight. All experimental work was undertaken in the controlled temperature laboratory set at 2 °C. All of the experimental equipment was pre-soaked (>24 hrs) in seawater prior to its first use. All frozen material was stored at -80 °C.

Grazing experiments

Copepod grazing rates were examined using particle-removal experiments. In brief, 2.2l glass incubation bottles were gently filled with un-screened seawater from the chlorophyll maximum (Table 6.1) a little at a time to maximise homogeneity. Visibly discernible copepods were removed from the incubation water via a dip-tube prior to the addition of experimental animals. Ten female *C. finmarchicus*/*C. glacialis* (ID to be verified using molecular markers) were carefully introduced into each of 6 bottles and incubated alongside triplicate control bottles on a plankton wheel rotating at 1 rmp for 24 hr under continuous illumination. Experimental animals were subsequently transferred, via dip-tube, into fresh, un-screened seawater collected from the chlorophyll maximum each day for a total period of five days. At the start (t=0hrs) and end (t=24hrs) of each incubation period 200mls samples from each of the incubated bottles were collected and preserved with 1% acidified Lugols iodine to quantify changes in the microplankton community. The remaining post-incubation water was screened through a 63µm mesh to quantify the number of eggs produced. Additional 1000mls samples at the start (t=0hrs) and end (t=24hrs) of each incubation period were filtered onto pre-combusted (450° overnight) grade ‘F’ glass fibre filters (GF/F) and stored frozen in 2ml glass vials to quantify changes in the amounts of carbon, nitrogen and fatty acids in the seston. Replicate samples of experimental animals were collected at the beginning (t=0hrs) and very end (t = 120 hrs) of the experimental incubations and stored in tin cups or 2ml glass vials to quantify changes in the carbon, nitrogen and fatty acid content of the incubated animals.

Egg production experiments

Individual female *C. finmarchicus*/*C. glacialis* (ID to be verified using molecular markers) were incubated in 0.2µm FSW for 24 hrs in plexiglass egg production chambers fitted with a 300µm mesh bottom to avoid cannibalism. At the end of the experiment eggs from each chamber were collected on a 63µm mesh, counted, and gently transferred into 50ml centrifuge tubes containing 0.2µm FSW and incubated for a further 120 hrs to determine hatching success.

Basal turnover experiments

Experiments to determine the basal rates at which carbon, nitrogen and fatty acids turnover in female *Calanus hyperboreus* and *Calanus glacialis* were conducted using a previously established methodology (Mayor et al., 2011). In brief, replicate groups of animals were transferred into sterile-filtered (0.2 µm) seawater and incubated in 500ml HDPE bottles for up to 15 days. Six bottles were sacrificed at the start of the experiment and every 72 hrs thereafter. Incubated animals were retrieved by gently pouring each bottle onto a 63 µm mesh filter, checked for signs of life, and transferred into 2ml glass vials or tin cups for fatty acid or elemental analysis, respectively.

Metabolomics sample collection

Samples for metabolomic analysis, to determine the relative importance of lipid-based metabolism, were collected at all major stations (Table 6.1). Ten replicate samples of *C.finmarchicus/C. glacialis* were quickly picked into Precellys tubes and stored frozen. Five replicate 1 litre seston samples were collected from the chlorophyll maximum (Table 6.1) and filtered onto pre-combusted GF/F filters and stored frozen in 2ml glass vials.

Table 6.1. Stations and event numbers where zooplankton samples were collected. GRZ = grazing experiment, EPR = egg production rate experiment, MTB = metabolomics samples, ETH = ethanol (95%)-preserved net sample, FRM = saline formaldehyde (4%)-fixed samples.

Station	Date	Event	Gear	Depth (m)	GRZ	EPR	MTB	ETH	FRM
NT11	16/05/2018	10	CTD	20	X		X		
NT11	16/05/2018	11-12	Bongo	200-0	X	X	X		X
NT8	17/05/2018	21	CTD	20	X		X		
NT8	17/05/2018	22-23	Bongo	200-0	X	X	X	X	
NT5	19/05/2018	39	CTD	20	X		X		
NT5	19/05/2018	40-41	Bongo	200-0	X	X	X	X	
NT2	20/05/2018	53	CTD	10	X		X		
NT2	20/05/2018	54-56	Bongo	200-0	X	X	X	X	X
F21	23/05/2018	69	CTD	10	X		X		
F21	23/05/2018	70-75	Bongo	200-0	X	X	X	X	X
F17	25/05/2018	85	CTD	22	X		X		
F17	25/05/2018	86-88	Bongo	200-0	X	X	X	X	X
F15	26/05/2018	99	CTD	32	X		X		
F15	26/05/2018	100-102	Bongo	200-0	X	X	X	X	X
F13	26/05/2018	110	CTD	12	X		X		
F13	27/05/2018	111-113	Bongo	200-0	X	X	X	X	X
F10	27/05/2018	121	CTD	12	X		X		
F10	27/05/2018	122-124	Bongo	200-0	X	X	X	X	X
FS1	28/05/2018	132	CTD	10	X		X		
FS1	29/05/2018	133-135	Bongo	200-0	X	X	X	X	X
F8	29/05/2018	145	CTD	9	X		X		
F8	30/05/2018	146-148	Bongo	200-0	X	X	X	X	X
HG IV	31/05/2018	159	CTD	23	X		X		
HG IV	31/05/2018	160-162	Bongo	200-0	X	X	X	X	X
F4	01/06/2018	169	CTD	12	X		X		
F4	01/06/2018	170-172	Bongo	200-0	X	X	X	X	X
F2	01/06/2018	184	CTD	10	X		X		
F2	02/06/2018	185-187	Bongo	200-0	X	X	X	X	X
KB0	03/06/2018	201	CTD	10	X		X		
KB0	03/06/2018	202-204	Bongo	200-0	X	X	X	X	X
ST1	04/06/2018	218	CTD	23	X		X		
ST1	04/06/2018	219-222	Bongo	100-0	X	X	X	X	X

6.2 Bulk and compound-specific stable isotope ratios of Arctic *Calanus spp.*

Elliott Price (ARISE)

Rationale for sampling

The calanoid copepods *Calanus glacialis, Calanus finmarchicus and Calanus hyperboreus* are the dominant zooplankton taxa across the North Atlantic, Arctic shelf seas and the open Arctic Ocean, respectively. Given that they have high grazing rates on primary producers and are prey themselves for a range of marine organisms, *Calanus spp.* are of paramount importance in maintaining a stable and functional food web in the Arctic Ocean (AO). But the AO is one of the fastest changing environments across the globe. The changing climate is altering atmospheric and ocean temperatures, and influencing the dynamics of ocean circulation patterns, leading to a loss of sea ice, disruption of biogeochemical cycles and a potential long-term shift in the composition of aquatic communities (Harada, 2016). Changes to these oceanic characteristics are likely to have consequences for ecological processes of the marine food web.
Assessing how the diets and trophic positions of the keystone *Calanus spp.* species are changing in response to altered ocean characteristics can lead us to valuable insights into the health of the ecosystem. Analysing ^{15}N isotope ratios ($\delta^{15}N$), particularly those of specific amino acids (AA), allows the identification of trophic positions of zooplankton species and their potential dietary resource. By coupling AA $\delta^{15}N$ data with DNA analysis of zooplankton gut contents, it's possible to increase the resolution of our dietary estimates while simultaneously drawing conclusions about the wider food web.

The samples collected in the Fram Strait during the JR17005 cruise will go towards understanding the spatial differences between trophic ecologies of *Calanus spp.* in different hydrographic regions. In addition, the data obtained from here can be compared with datasets from previous years for a temporal comparison of how a warming climate may be affecting the diets and trophic relationships of *Calanus spp.* within the marine food web. Extra samples are to be stored in formaldehyde as well as in -80˚C for a preservation method test on stable isotope ratios

Sampling method

At each super station bongos were deployed and vertically hauled up to the surface from a depth of 200m or at 20m above the sea floor if the water depth was less or equal to 200m. From all bongo's, at least one cod end was reserved for picking Calanus for stable isotope analysis. The cod end was tipped into a bucket and placed in the 4˚C cold room. If the sample was too sparse, the entire buckets contents were passed through a 500 µm mesh attached to a smaller bucket to concentrate the sample. Conversely, if the sample was too concentrated the filtered underway water was added.

A small jug was then used to concentrate the sample further onto a small 200 µm mesh than sat within a petri dish ready to be looked at under a microscope. Individuals of *C. hyperboreus*, *C.*

glacialis/finmarchicus (uncertainty in identification using morphological methods) were picked from the sample and placed in separate petri dishes for different species filled with milli-q water. 3 x 20 individuals were picked for *C. hyperboreus* and 3 x 50 for *C. glacilais/finmarchicus*, or the maximum possible where abundance was low (Table 1). The individuals were rinsed a further three times in milli-q water before being transferred to cryovials and immediately placed in the -80˚C chest freezer. In addition to the -80˚C, where abundance was high, an extra triplicate sample was placed in formaldehyde to test for preservation effects of formaldehyde on stable isotope ratios. A further ~15 individuals were placed in individual cryovials and stored in an RNALater solution to preserve their RNA ready for molecular work. Samples in -80˚C for isotope analysis were prioritised over the other two preservations when abundance was low.

Sampling Issues

For a majority of the cruise, then abundance of *Calanus spp.* caught in the nets was low. This hindered the ability to collect an optimal amount of replicates at some stations for -80˚C stable isotopes, but most notably I was not able to collect an optimal (but not useless) amount of samples for the formaldehyde preservation test since it was not a top priority. In many cases, I used the contents of other cod ends that were left over from other zooplankton experiments to hit my quota where possible. The variable abundances at the different stations has resulted in an uneven sample list.

On two occasions (HGIV day net and the F4 day net), the abundance of *Calanus* in the cod ends was so low than I could not get an adequate amount of sample. In which case I used *Calanus* indivuals from the surface net of the mochness which were much more concentrated that the bongo net catches. The individuals here should be comparable in terms of stable isotopes to those caught in the bongo.

Table 1: Full sample list of Calanus spp. picked from the bongo nets on the JR17005 cruise to the Fram Strait.

Event	Station	LAT	LONG	Station Depth (m)	Sample Depth (m)	Time In	Time Out	Sample ID	No. picked	Stored	Species
11	NT11	75.3356	-5.4643	3554	200	22:03:00	22:36:00	NT11-N-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								NT11-N-H(1-3)	3 x 10	RNALater	*C.hyperboreus*
								NT11-N-H(1-3)	2 x 20		*C.hyperboreus*
								NT11-N-G1	1 x 30	-80˚C	*C.finmarchicus /glacialis*
17	NT11	75.3356	-5.4643	3554	200	08:13:00	08:39:00	NT11-D-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								NT11-D-G(1-3)	1 x 30	-80˚C	*C.finmarchicus /glacialis*
23	NT8	75.79556	-7.21792	2695	200	23:43:00	00:08:00	NT8-N-H(1-3)	3 x 20	-80˚C	*C. hyperboreus*
								MNT8-N-G1	1 x 30	-80˚C	*C.finmarchicus /glacialis*
33	NT6	76.06141	-8.25137	1256	200	10:56:00	11:23:00	NT6-D-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								NT6-D-D(1-15)	15 x 1	RNALater	*C.hyperboreus*
41	NT5	76.25576	-9.02853	286	200	01:22:00	01:51:00	NT5-N-H(1-3)	3 x 20	-80˚C	*C. hyperboreus*
47	NT5	76.2558	-9.02865		200	09:42:00	10:08:00	NT5-D-H(1-3)	3 x 20	-80˚C	*C. hyperboreus*
								NT5-D-D(1-20)	20 x 1	RNALater	*C.hyperboreus*
55	NT2	76.70608	-10.9132	335	200	23:16:00	23:42:00	NT2-N-G(1-3)	3 x 50	-80˚C	*C.finmarchicus /glacialis*
								NT2-N-H1	1 x 22	-80˚C	*C. hyperboreus*
71	F21	78.98355	-9.27856	258	200	22:35:00	23:00:00	F21-N-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								F21-N-G(1-3)	3 x 50	-80˚C	*C.finmarchicus /glacialis*
								F21-N-H(1-18)	18 x 1	RNALater	*C.hyperboreus*
								F21-N-H(1-2)	2 x 20	Formaldehyde	*C.hyperboreus*
								F21-N-G(1-2)	2 x 50	Formaldehyde	*C.hyperboreus*
80	F17	79.00153	-5.96511	600	200	12:55:00	13:21:00	F17-D-H1	1 x 20	-80˚C	*C. hyperboreus*
								F17-D-H(1-2)	2 x 20	-80˚C	*C.hyperboreus*
								F17-D-G1	1 x 50	-80˚C	*C.finmarchicus /glacialis*
								F17-D-D(1-13)	13 x 1	RNALater	*C. hyperboreus*
88	F17	78.99964	-5.99097	568	200	22:55:00	23:17:00	F17-N-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								F17-N-G(1-2)	2 x 50	-80˚C	*C.finmarchicus /glacialis*
								F17-N-H(1-3)	3 x 20	Formaldehyde	*C.hyperboreus*
								F17-N-D(1-20)	20 x 1	RNALater	*C.hyperboreus*
94	F15	79.00146	-5.0165	1312	200	12:31:00	12:55:00	F15-D-H(1-2)	2 x 20	-80˚C	*C.hyperboreus*
								F15-D-H3	1 x 13	-80˚C	*C.hyperboreus*
								F15-D-G(1-2)	2 x 50	-80˚C	*C.finmarchicus /glacialis*
102	F15	78.98399		1298	200	23:35:00	23:56:00	F15-N-H(1-2)	2 x 20	-80˚C	*C.hyperboreus*

			-5.0039					F15-N-H3	1 x 17	-80˚C	*C.hyperboreus*
								F15-N-G1	1 x 50	-80˚C	*C.finmarchicus /glacialis*
107	F13	78.99998	-2.99979	2443	200	12:28:00	12:54:00	F13-D-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								F13-D-G1	1 x 25	-80˚C	*C.finmarchicus /glacialis*
								F13-D-H1	1 x 20	Formaldehyde	*C.hyperboreus*
113	F13	78.99803	-2.99906	2444	200	22:24:00	22:47:00	F13-N-H(1-2)	2 x 20	-80˚C	*C.hyperboreus*
								F13-N-G1	1 x 41	-80˚C	*C.finmarchicus /glacialis*
								F13-N-G2	1 x 13	-80˚C	*C.finmarchicus /glacialis*
124	F10	78.99994	0	2591	200	21:49:00	22:13:00	F10-N-H1	1 x 20	-80˚C	*C. hyperboreus*
								F10-N-H2	1 x 12	-80˚C	*C.hyperboreus*
								F10-N-G1	1 x 32	-80˚C	*C.finmarchicus /glacialis*
129	F10	78.99935	-0.00251	2590	200	06:31:00	06:56:00	F10-D-H1	1 x 20	-80˚C	*C.hyperboreus*
								F10-D-H2	1 x 26	-80˚C	*C.hyperboreus*
								F10-D-G1	1 x 51	-80˚C	*C.finmarchicus /glacialis*
135	FS1	80.28329	2.00016	1922	200	22:59:00	23:21:00	FS1-N-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								F21-N-G1	1 x 20	-80˚C	*C.finmarchicus /glacialis*
								FS1-N-G2	1 x 22	-80˚C	*C.finmarchicus /glacialis*
								FS1-N-H(1-2)	2 x 20	Formaldehyde	*C.hyperboreus*
141	FS1	80.28333	2.00003	1922	200	10:30:00	10:53:00	FS1-D-H(1-2)	2 x 20	-80˚C	*C.hyperboreus*
								FS1-D-G1	1 x 15	-80˚C	*C.finmarchicus /glacialis*
								FS1-D-D(1-8)	8 x 1	RNALater	*C.hyperboreus*
144	FS2	79.64228	1.99822	1503	200	17:15:00	17:44:00	FS2-D-1	1 x 22	-80˚C	*C.hyperboreus*
148	F8	78.99997	2.0003	2508	200	23:04:00	23:29:00	F8-N-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								F8-N-G1	1 x 27	-80˚C	*C.finmarchicus /glacialis*
153	F8	79.00001	1.99975	2508	200	06:49:00	07:12:00	F8-N-H1	1 x 20	-80˚C	*C.hyperboreus*
								F8-N-H2	1 x 22	-80˚C	*C.hyperboreus*
								F8-N-G1	1 x 27	-80˚C	*C.hyperboreus*
162	HGIV	79.04836	4.33213	2548	200	00:08:00	00:31:00	HGVI-N-H(1-2)	2 x 20	-80˚C	*C.hyperboreus*
								HGVI-N-H3	1 x 13	-80˚C	*C.hyperboreus*
								HGVI-N-G1	1 x 27	-80˚C	*C.finmarchicus /glacialis*
165	HGIV	78.98372	4.36598	2619	200	04:34:00	07:05:00	HGIV-D-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
172	F4	79.03329	7.00008	1304	200	22:30:00	22:52:00	F4-N-H1	1 x 20	-80˚C	*C.hyperboreus*
								F4-N-H2	1 x 15	-80˚C	*C.hyperboreus*
								F4-N-G1	1 x 50	-80˚C	*C.finmarchicus /glacialis*
175	F4	79.03385	7.00585	1293	200	02:36:00	05:07:00	F4-D-H(1-3)	3 x 20	-80˚C	*C.hyperboreus*
								F4-D-H-4	1 x 50	-80˚C	*C.hyperboreus*
								F4-D-H(1-5)	5 x 20	Formaldehyde	*C.hyperboreus*
								F4-D-D(1-10)	10 x 1	RNALater	*C.hyperboreus*
187	F2	79.03328	8.33331	831	200	22:27:00	22:50:00	F2-N-H1	1 x 27	-80˚C	*C.hyperboreus*

204	KB0	79.03508	10.84304	316	200	23:36:00	23:59:00	KB0-N-G(1-3)	3 x 50	-80˚C	C.finmarchicus /glacialis
								KB0-N-D(1-2)	2 x 1	RNALater	*C.hyperboreus*
								KB0-N-G(1-2)	2 x 50	Formaldehyde	C.finmarchicus /glacialis
211	V12	78.97965	9.48108	222	200	08:33:00	08:58:00	V12-D-G1	1 x 50	-80˚C	C.finmarchicus /glacialis
								V12-D-G2	1 x 23	-80˚C	C.finmarchicus /glacialis
222	ST1	77.41673	19.50009	145	100	22:38:00	22:57:00	ST1-N-G1	1 x 50	-80˚C	C.finmarchicus /glacialis
								ST1-N-G2	1 x 47	-80˚C	C.finmarchicus /glacialis
228	ST1	77.41668	19.49959	146	100	04:37:00	04:50:00	ST1-D-G1	1 x 53	-80˚C	C.finmarchicus /glacialis

6.3 Loligo Microrespirometer Experiments

Sarah Reed and Vicky Dewar-Fowler

Respiration experiments were carried out at 16 stations during JR17005, using a presens loligo micro respirometer. Copepods used in these exposures were taken from both the MOCNESS and BONGO nets. In general, the BONGO net was used to collect animals from shallow waters whilst the MOCNESS (usually Net 6, 500-375 m) was used to collect animals from deeper waters. Three species were selected for these experiments; *Calanus hyperboreus, Calanus finmarchicus* and *Metridia longa.*

The aim of these experiments was to establish and compare oxygen consumption rates of copepods caught in both shallow waters and at depth. It is also hoped that this will enable us to compare respiration rates of copepods in diapause with those caught in shallow waters.

Sample Methodology

The micro respirometer uses a 24 well plate fitted with optode sensors at the base of each well. Three plates were used; a 1700 µl well plate (reader 695) for *C. hyperboreus,* a 500µl plate (reader 692) for *Calanus* sp. and a 500 µl plate (reader 655) for *M. longa*, and *Calanus* sp. on occasion. The plate sits on a specialised plate reader connected to a laptop and was set up to read the oxygen levels in each well every 3 minutes. Prior to use wells were hydrated with temperature equilibrated 0.2 µm filtered underway sea water, this was then replaced and filled to the top with bubbles being removed with a Pasteur pipette. Upon retrieval of the MOCNESS, the depth of greatest *Calanus* copepod abundance was selected for use in the respiration experiments. This catch was diluted and kept at 4°C until animals were selected for use. Two rows of each of the three well plates were filled with animals from this catch. A BONGO net was deployed shortly after retrieval of the MOCNESS, this catch was also diluted and kept at 4°C prior to picking. The final two rows of each plate were populated using copepods from this BONGO catch. In the case that either net was not able to be deployed all animals were collected from the other net. Once the well plates were populated they were topped up with 0.2 µm filtered sea water and sealed using parafilm underneath a silicon layer and weighted block in order to ensure no oxygen exchange could occur. Sealed well plates were placed in an incubator set to maintain a constant temperature of 2 °C. Exposures were carried out for up to 24 hours in the dark before being removed and photographed. Photos were taken using an integrated Leica microscope camera (Camera: IC90E, Microscope: Leica M80) and will be used to determine width, length and lipid sac area. Following this, all Metridia were placed in tin capsules and frozen at -80°C for CHN analysis. Half of the plate of *C. finmarchicus* and *C. hyperboreus* were also preserved in this way. The remaining copepods were preserved in ethanol for further analysis.

Limitations

All exposures were carried out at 2°C due to limitations of the calibrations carried out on the plates and the incubator used. The SST and temperature of deeper waters varied

throughout the cruise meaning that animals were often collected from water at a temperature other than 2°C.

Table 6.3.1: Details of Metridia collection for Respiration Exposures

Date	Station	Mocness Event Number	MOCNESS Depth	Bongo Event Number
16.5.18	NT11	15	Net 6, 500-375 m	17
18.5.18	NT6	31	Net 6, 500-375 m	33
19.5.18	NT5	44	Net 2, 200-150 m & Net 5, 50-5m	NA
20.5.18	NT2	NA	NA	56
23.5.18	F21	NA	NA	75
24.5.18	F17	81	125-5m (only net to fire)	NA
25.5.18	F15	92	Net 6, 500-375 m	94
26.5.18	F13	108	Net 6, 500-375 m	107
28.5.18	F10	127	Net 6, 500-375 m	129
29.5.18	FS1	138	Net 6, 500-375 m	141
30.5.18	F8	151	Net 6, 500-375 m	153
31.5.18	HGIV	165	Net 6, 500-375 m & Net 9, 125-5 m	NA
1.6.18	F4	175	Net 6, 500-375 m	177
2.6.18	F2	NA	NA	193 (ring net)
5.6.18	ST1	226	Net 2 100-75 m & Net 4, 50-25 m	NA

Table 6.3.2: Details of Sarah Reed's respiration experiment, with MOCNESS and bongo information the same as table 1 for results contact sarah.reed@sams.ac.uk

Date	Station	Mocness (Plate Row A&B)	Bongo (Plate Row C&D)	C. hyperboreus (Plate 695)	Calanus (Plate 642)
16.5.18	NT11	Y	Y	Y	Y
18.5.18	NT6	Y	Y	Y	Y
19.5.18	NT5	Y	Y	Y	Y
23.5.18	F21	N	Y	Y	Y
24.5.18	F17	N	Y	Y	Y
25.5.18	F15	Y	Y	Y	Y
26.5.18	F13	Y	Y	Y	Y
28.5.18	F10	Y	Y	Y	Y
29.5.18	FS1	Y	Y	Y	Y
30.5.18	F8	Y	Y	Y	Y
31.5.18	HGIV	Y	N	Y	Y
1.6.18	F4	Y	Y	Y	Y
2.6.18	F2	N	Y	Y	Y

3.6.18	V12	N	Y	Y	Y
5.6.18	ST1	Y	Y	N	Y

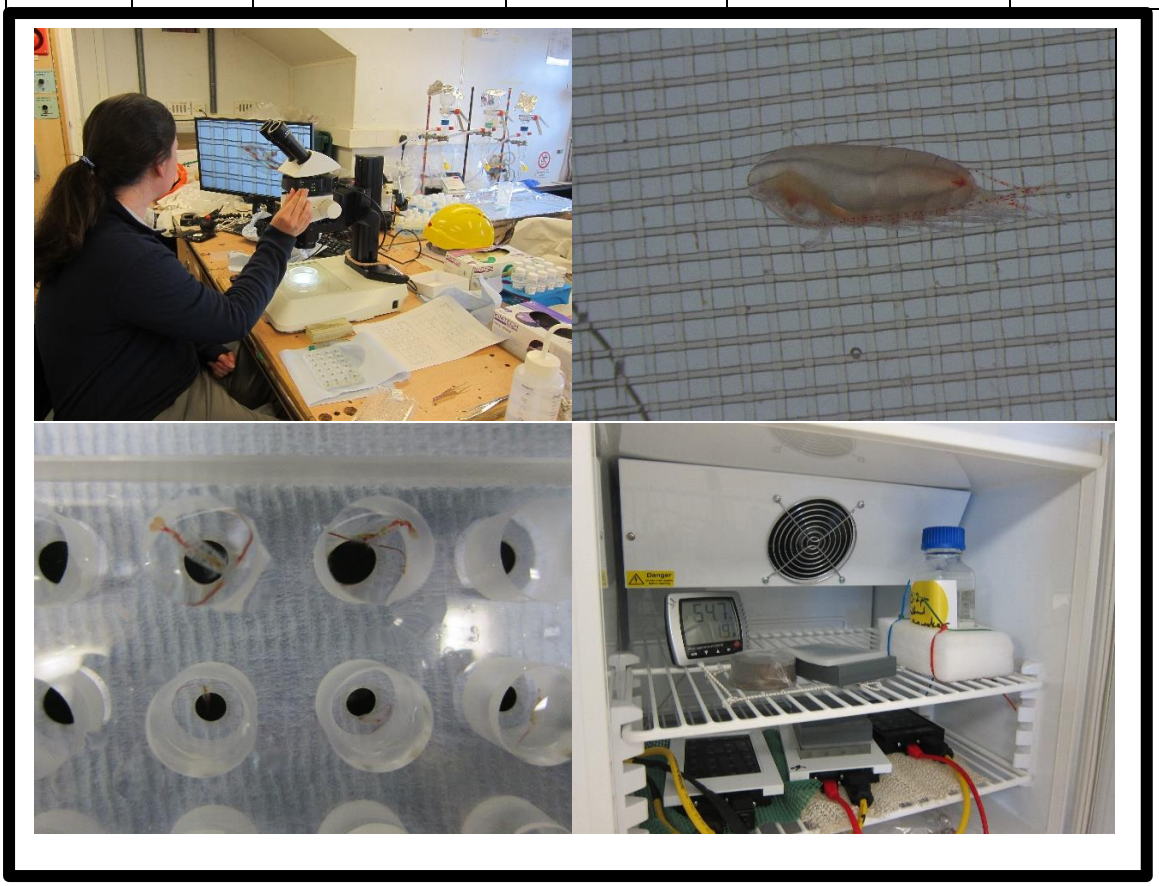


Figure 1: From top to bottom: Photos to present the microscope used to take the photographs; the types of photos that will be used to measure the individual for length, width and lipid sac area; the PreSens wells where individual zooplankton were analysed; the incubator set at 2 °C.

6.4 The effect of temperature on the energy requirement and lipid consumption of Arctic *Calanus* spp

Claudia Castellani, Plymouth Marine Laboratory

Rationale: The warming of the Arctic poses increasing physiological challenges to its inhabitants. Here many species have evolved specific physiological and life strategy to cope with an extreme environment. For instance, the life cycle of *Calanus* spp. is highly dependent on body lipid storage as an energy reserve. Increases in water temperature in the Arctic is expected to lead to an increase in the energy demand by these copepods. Higher metabolic rates are likely to result in lower body stored lipid (i.e. higher consumption and lower accumulation of lipids) particularly at times and locations where food resources are limited, and in turn to negatively impact the population dynamics, life cycle and persistence of these organisms.

Aim: This project aims to determine the changes in respiration rate and body lipid of *Calanus* spp with temperature to enable projections of energy demand and lipid consumption under a future global warming scenario.

Method: adult female *Calanus hyperboreus* were picked from surface sample collected with the Mocness net at station NT6 and F17 and incubated in 0.2 µm filtered sea-water overnight in a temperature controlled room kept at 2 °C. Groups of 200 copepods were then randomly allocated to between 3 (exp 1) and 5 (exp 2) different temperatures ranging between 2 °C and 10 °C into a temperature a gradient incubator. The respiration rate and lipid content of adult female *Calanus* sp were measured on freshly caught copepods and on copepods after 6 days from the start of the incubation. Fifty per cent of the water in the containers where the organisms were incubatedion was changed every other day and dead organisms removed. Mortality in the containers was overall very low < 1% over the temperature range

Respiration rate: Up to 10 adult females *Calanus* were incubated in filtered sea water (0.2 µm) into 4ml vials at each temperature and the decline in oxygen concentration in the vial measured at hourly or two hourly intervals over 10 hours using a portable oxygen Optode (FIBOX-4). At the end of the incubation the prosome length of each copepod was measured under a binocular microscope and the copepod stored into Eppendorf vials at - 80 °C for C/N analysis.

Lipid analysis: triplicates of 10 copepods were picked from the stock at each temperature at the end of the incubation (i.e. day 6) and stored into 4ml glass tubes at - 80 °C for subsequent lipid analysis in the home laboratory.

7. Sediment Geochemistry

Emma Burns, University of Manchester PhD Student

Dr Louisa Norman, University of Liverpool

Aims and Objectives

Sediment samples were taken for the ARISE project as part of a PhD studentship studying protein amino acids within the seafloor sediments primarily in the uppermost layers (up to 2cm), however, full cores up to 42cm in depth were taken. The samples will be analysed to look at the distribution of amino acids and further compound specific isotope analysis (CSIA) will be used on individual amino acids to better understand the contribution of land derived material to the seafloor sediments in the Fram Strait and consequently the Arctic food web.

Sample and Processing Methodology

Samples sites were selected prior to the cruise and transects were chosen that crossed over a deep water to slope to shelf morphology. Stations sampled were NT11, NT6, NT5, NT2, F21, F17, F15, F13, F10, FS1, F8, F4, F2, KBO and ST1 (see core log below). Ideally the samples would be of a mud to sand grain size as the equipment works best in soft sediments, although it was known that shelf sediments were likely to be of a coarser grain size. Sampling for sediment took place using two pieces of equipment; the Megacorer, fitted with four tubes, 110 mm diameter; Figure 7.1) to collect full cores and a Day Grab (Fig 7.2) that samples sediment layers to depths of ~20cm. Both pieces of equipment were supplied by the National Marine Facilities, Southampton.

Stations where the water depth was >1000m, the Megacorer was deployed (up to three deployments per station) and one core processed from each deployment to produce three replicate cores. At shallow stations (water depth <1000m) the Day Grab was deployed to check the suitability of the sediment prior to deploying the Megacorer. If the sediment was deemed unsuitable for the Megacorer then repeated day grab deployments were undertaken (up to three deployments per station).

Once the Megacorer was successfully deployed and recovered (Fig, 7.1), each core was plugged with a bung and taken away for slicing. A core extruder was used to remove the core from the tube and pre-measured rings were used to measure the depth down core. Each core was sliced into 5mm slices for the first 2cm, then 1cm slice for 4cm and finally the remaining part of the core was sliced into 2cm slices. The cores were sliced with two stainless steel plates which were washed with hot water and de-ionised water between each slice. In order to avoid contamination the samples were placed in combusted foil lined petri dishes (Fig 7.3) and nitrile gloves were worn at all times. These were then labelled together in a bag and placed into a -80 degrees Celsius freezer. The wet lab was cleaned before and after each sampling station as the space was also used as a biology lab. When it was only possible to use the Day Grab, a section of the top, middle (where possible) and underside of the grab sample was taken to compensate for not being able to accurately take a slice as you would a core. These samples were also stored at -80 degrees Celsius.

All samples will be analysed at the home laboratory, University of Manchester.

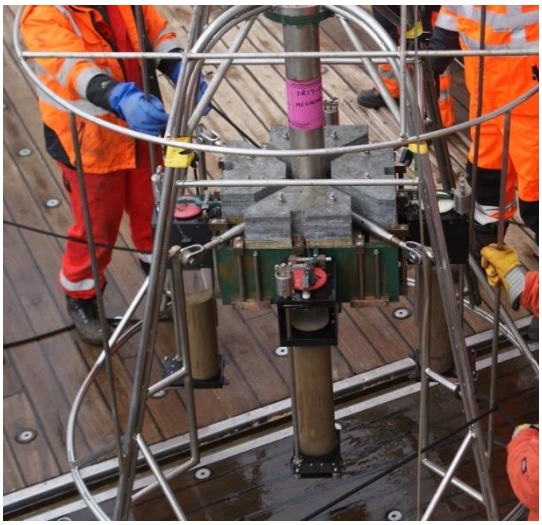


Figure 7.1, showing Megacorer on deck with 4 core collected from the seafloor. Photo Credit: John Hamilton, Purser JR17005.

Figure 7.2, showing Day Grab returning onto deck after collecting rocks from the seafloor. Photo Credit: Emma Burns, ARISE Scientist

Figure 7.3, showing Core slice being placed into combusted foil lined petri dishes. Photo Credit: Ross Saunders, AME JR17005.

Data quality notes/ problems

Unsuitability of sediment: At two stations, NT5 and F2, the sediment was gravel and rock or very patchy and so unsuitable for the deployment of the Megacorer. The day grab was used in these instances. Instrument and equipment problems: There were no significant operational problems with the either the Megacorer or day grab, although the glue which holds the 'collar' onto the tube failed on two occasions resulting in the loss of one tube. On the second occasion the collar was found to be loose and re-glued by the NMF technician.

Issues with the coring winch at five stations (NT8, NT2, F17, F15 and ST1) greatly impacted the time required for coring. No cores were taken at NT8 after an aborted deployment and replication was reduced at the other stations.

Time: At four stations (F10, F4, KB0 and ST1) scheduling did not allow enough time for replicate Megacorer/grab deployments. At these stations pseudo-replicates or a single sample were taken from one or two deployments.

Table 7.1 Samples collected

Station	**Latitude**	**Longitude**	**Water depth (m)**
NT11	75° 19. 623 N	5° 27. 703 W	3530
Event	**Samples taken**		
E007	Sediment core – 32 cm, 21 samples for amino acid analysis		
E008	Sediment core – 22 cm, 16 samples for amino acid analysis		
E009	Sediment core – 18 cm, 14 samples for amino acid analysis		

Station	**Latitude**	**Longitude**	**Water depth (m)**
NT6	76° 06. 134 N	8° 25. 148 W	1234
Event	**Samples taken**		
E036	Sediment core – 28 cm, 19 samples for amino acid analysis		
E037	Sediment core – 4 cm, 6 samples for amino acid analysis		
E038	Sediment core – 18 cm, 14 samples for amino acid analysis		

Station	**Latitude**	**Longitude**	**Water depth (m)**
NT5	76° 15. 348 N	19° 01. 716 W	285
Event	**Samples taken**		
E048	Sediment grab – surface sample, 3 samples for amino acid analysis		
E049	Sediment grab – Surface and underside samples, 6 samples for amino acid analysis		

Station	**Latitude**	**Longitude**	**Water depth (m)**
NT2	76° 42. 321 N	10° 53. 749 W	324
Event	**Samples taken**		
E059	Sediment grab – Surface, mid-depth and underside samples, 3 samples for amino acid analysis		
E060	Sediment grab – Surface, mid-depth and underside samples, 3 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
F21	78° 59. 995 N	9° 15.880 W	238
Event	**Samples taken**		
E061	Sediment grab – surface sample and underside samples, 2 samples for amino acid analysis		
E062	Sediment core – 38 cm, 24 samples for amino acid analysis		
E063	Sediment core – 42 cm, 26 samples for amino acid analysis		
E064	Sediment core – 40 cm, 25 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
F17	79° 00.996 N	5° 45. 933 W	780
Event	**Samples taken**		
E082	Two sediment cores – 38 cm and 36 cm, 47 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
F15	78° 59. 417 N	5° 01.788 W	1244
Event	**Samples taken**		
E097	Sediment core – 40 cm, 25 samples for amino acid analysis		
E098	Sediment core – 36 cm, 23 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
F13	78° 59. 786 N	2° 59. 970 W	2396
Event	**Samples taken**		
E116	Sediment core – 36 cm, 23 samples for amino acid analysis		
E117	Sediment core – 32 cm, 21 samples for amino acid analysis		
E118	Sediment core – 34 cm, 22 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
F10	79° 00.021 N	0° 00.021 W	2550
Event	**Samples taken**		
E131	Three sediment cores – 1 × 42 cm, 2 × 16 cm, 52 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
FS1	80° 16. 996 N	2° 00.006 E	1890
Event	**Samples taken**		
E142	Sediment core –38 cm, 24 samples for amino acid analysis		

Station	Latitude	Longitude	Water depth (m)
F8	79° 00. 585 N	1° 42. 936 E	2468
Event	**Samples taken**		
E155	Sediment core –30 cm, 20 samples for amino acid analysis		

E156	Sediment core –30 cm, 20 samples for amino acid analysis
E157	Sediment core –30 cm, 20 samples for amino acid analysis

Station	**Latitude**	**Longitude**	**Water depth (m)**
F4	79^{o} 01. 987 N	6^{o} 59. 792 E	1280
Event	**Samples taken**		
E179	Sediment core –30 cm, 20 samples for amino acid analysis		

Station	**Latitude**	**Longitude**	**Water depth (m)**
F2	79^{o} 02. 002 N	8^{o} 20. 022 E	818
Event	**Samples taken**		
E196	Sediment grab – Surface and underside samples, n = 2, for amino acid analysis		
E197	Sediment grab – Surface, n = 1, for amino acid analysis		

Station	**Latitude**	**Longitude**	**Water depth (m)**
KB0	79^{o} 02. 315 N	10^{o} 49. 438 E	337
Event	**Samples taken**		
E199	Sediment grab – Surface, mid-layer and underside samples, n = 3, for amino acid analysis		
E200	Sediment grab – Surface, mid-layer and underside samples, n = 3, for amino acid analysis		

Station	**Latitude**	**Longitude**	**Water depth (m)**
ST1	77^{o} 25. 043 N	19^{o} 28. 722 E	147
Event	**Samples taken**		
E214	Sediment grab – Surface and underside, 2 samples for amino acid analysis		
E215	Sediment core –30 cm, 20 samples for amino acid analysis		
E216	Sediment core –30 cm, 20 samples for amino acid analysis		
E217	Sediment core – 18 cm, 14 samples for amino acid analysis		

8. JR17005 IT Engineer's Report

Andrew England, BAS

Data Logging / SCS

The SCS server and data logging systems worked well throughout the cruise, with no additional logging events apart from the start & stop occurring.

Time & Date (GMT)	Event
2018/05/08 10:01	ACQ restarted, newleg run (**Leg: 20180508**)
2018/06/09	ACQ restarted, end of leg

Other systems

The other systems on board – the JRLB unix fileserver, SABRIS systems and ESX server all worked without any serious issues.

9. AME Electronics Report

Start date: 10th May 2018 Finish date: 8th June 2018

Name of AME engineers: Ross Sanders

LAB Instruments

Instrument	S/N Used	Comments
AutoSal 8400B	68959	Run by NMF. Drive belt replaced
Scintillation counter	NO	
XBT	NO	

ACOUSTIC

Instrument	S/N Used	Comments
ADCP	YES	
PES	YES	
EM122	YES	
TOPAS	NO	
Simrad EK60	YES	
K-Sync	YES	

Seapath 320+	YES	
USBL	NO	
10kHz IOS pinger	NO	
Benthos 12kHz pinger S/N 1316 + bracket	NO	
Benthos 12kHz pinger S/N 1317 + bracket	NO	
MORS 10kHz transponder	NO	

OCEANLOGGER

Instrument	S/N Used	Comments
Barometer1(UIC)	V145002	
Barometer2(UIC)	V145003	
Foremast Sensors		
Air humidity & temp1	60743897	
Air humidity & temp2	61698922	
TIR1 sensor (pyranometer)	172882	
TIR2 sensor (pyranometer)	172883	
PAR1 sensor	160959	
PAR2 sensor	160960	
prep lab		
Thermosalinograph SBE45	453893-0130	
Transmissometer	846DR	
Fluorometer	1498	
Flow meter	05/811950	
Seawater temp 1 SBE38	3862856-0599	
Seawater temp 2 SBE38	3862856-0601	

CTD (all kept in cage/ sci hold when not in use)

Instrument	S/N Used	Comments
Deck unit SBE11plus	11P15759-0458	
Underwater unit SBE9plus	09P30856-0707	
Temp1 sensor SBE3plus	032705	
Temp2 sensor SBE3plus	035042	

Cond1 sensor SBE 4C	042222	
Cond2 sensor SBE 4C	042255	
Pump1 SBE5T	054488	
Pump2 SBE5T	052371	
Standards Thermometer SBE35	3527735-0024	
Transmissometer C-Star	1399DR	
Oxygen sensor SBE43	432291	
PAR sensor	70688	
Fluorometer Chelsea Aqua	088-216	
Altimeter PA200	10127.244740	
CTD swivel linkage	1961018	
LADCP Master	14897	
LADCP Slave	15060	
SBE32 Pylon	0636	
Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc		NMF Frame + 20L bottles Additional wet labs CDOM flurometer connected to AUX2 for Norwegian Polar Institute. S/N FLCDRTD-1930
No of casts	21	
Max Depth	3068	
Min Depth		

AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	**Working ?**	**Comments**
EA600	YES	
Anemometer	YES	

Gyro	YES	
DopplerLog	YES	
EMLog	YES	

CHECK FANS ARE Running Daily

Instrument
Oceanlogger
EM122, TOPAS, NEPTUNE UPSs
Seatex Seapath
EM122 Tween Deck
TOPAS Tween Deck

End of Cruise Procedure

At the end of the cruise, please ensure that:

- The XBT is left in a suitable state (store in cage if not to be used for a while – do not leave on deck or in UIC as it will get kicked around). Remove all deck cables at end of cruise prior to refit.
- The salinity sample bottles have been washed out and left with deionised water in – please check this otherwise the bottles will build up crud and have to be replaced.
- the CTD is left in a suitable state (washed (including all peripherals), triton + deionised water washed through TC duct, empty syringes put on T duct inlets to keep dust out and stored appropriately). Be careful about freezing before next use – this will damage the C sensors (run through with used standard seawater to reduce the chance of freezing before the next use). Remove all the connector locking sleeves and wash with fresh water. Blank off all unconnected connectors. See the CTD wisdom file for more information. If the CTD is not going to be used for a few weeks, at the end of your cruise please clean all connectors and attach dummy plugs or fit the connectors back after cleaning if they are not corroded.
- The CTD winch slip rings are cleaned if the CTD has been used – this prevents failure through accumulated dirt.
- The SVP is left in a suitable state (washed and stowed). Do not leave this on deck without a cover for any length of time as it rusts. Stow inside at end of cruise.
- All manuals have been returned to the designated drawers and cupboards.
- Clean all the fans listed below every cruise or every month, whichever is the longer.

Clean the intake fans on the following machines:

NOTE: 2 key access to the fans

Instrument	Cleaned?
Oceanlogger	Y
EM122, TOPAS, NEPTUNE UPSs	Y
Seatex Seapath	Y
EM122 Tween Deck	Y
TOPAS Tween Deck	Y

Additional notes and recommendations for change / future work

CTD

NMF frame used along with NMF 20L bottles, LADCP brackets. All other CTD hardware, sensors and cables are BAS. SBE9+ bracket is from the BAS frame. BAS altimeter bracket used.

The 20L bottles are a snug fit on the frame and do not provide enough clearance to mount the PAR in the usual position inboard on the vertical bars. The PAR was mounted on the same bar but on the outside, with an ADCP bracket for protection.

A wet labs CDOM flurometer was used on all casts on behalf of the Norwegian Polar Institute. The instrument was connected to AUX2 with seasave configured to record the raw voltage output. The serial number was FLCDRTD-1930. The instrument worked without any issues.

While installing the fluormeter it was noticed that the power supply pin (6) of AUX 2 on the SBE9+ unit used on the last cruise (S/N 09P30856-0707). This port was also quite corroded. This is likely due to the port rarely being used and requiring the blanking plug to be removed.

The SBE9+ was swapped from (0707) to (S/N 09-125) which had all pins. Unfortunately this SBE9+ did not have a con file or recent cal data. This is the ‘spare spare.’

SBE9+ (0480) was eventually installed in place of (09-125) as this SBE9+ has all pins and files required to be fully operational.

During the shakedown cast a deck worker noticed that the LADCP bracket used for the slave LADCP did not have drain holes on the bottom of the tubes but did on top. Ross drilled a 4mm hole in the bottom of the tube which released a few litres of water.

On the 17th of May, while hauling the CTD and after firing 4 bottles the SBE32 could not be triggered to fire the 5th (or other) bottles. All other data was received as normal. The fault was eventually traced to the sea cable termination.

As the deck engineer was not happy with the condition of the CTD wire the opportunity was taken to cut 2.5KM off. The re-termination has operated well for the remainder of the cruise.

Occasionally, after approximately 25 casts, bottle number 4 has failed to fire. This has been resolved by removing the SBE32 rosette and cleaning it in warm fresh water to remove any contamination. The rosette has been rinsed with fresh water from the hose after every cast. The rosette was removed after cast 59, stripped to the individual releases and cleaned with warm water and a brush before reassembly.

On the 29th the Seasave 'failed to initialise NEMA'. A terminal could not be opened on COM4 either. One restart did not solve the issue but a second restart did. It is thought that this was a problem caused by a bind on the COM port but this has not been investigated further.

There have been various problems with the traction winch including the wire 'jumping a groove.' All problems were resolved by the deck engineer.

EM122

The EM122 was operated on the 5th of June to gather data to confirm if repairs made in Immingham were successful and to aid the bridge in navigating a fjord.

NavMet

The Python version of NAvMet and WinchMon have been very unstable. Both the server and local instances of NavMet have crashed approximately every hour and must be closed and restarted.

AutoSal

An NMF technician was operating the autosal during the cruise. While mobilising the Autosal the ‘stirrer’ drive belt was found to be broken and was replaced. The belt should be checked or even replaced at every mobilisation.

Some air is getting into the second lowest branch through the connection to the peristaltic pump. This hasn’t proved to cause any issues but should be checked at the next service.

Support Engineer: Ross Sanders Date: 05/06/2018

10. AME Cruise Report

Carwyn Davies, Bjørg Apeland

Bongo

The bongo has been deployed a total of **76** times.

It was noted that a valve for emptying the Bongo buckets would be an improvement as with the current system some of the sample is spilled when the bucket is removed from the net. Emptying parts of the sample before removing the bucket could eliminate this waste.

Cod end bracket has been bent, and should be replaced when back in Cambridge.

It is noted that the cable on the auxiliary winch used for deployment is at the end of its useful life. A new drum of cable has been left on board with the Bosun Sci Ops, however this is not to be fitted until the next use of the winch to prevent weather damage.

Mocness

The Mocness has been deployed a total of **29** times.

Failures:

13/05 – Shakedown Station – No depth

Depth sensor did not work. Depth sensor was changed and worked as expected. Old sensor has been marked and should be inspected in Cambridge.

16/05 – Cod end lost

The entire cod end fixture was lost. Almost certainly due to the jubilee clip not being fastened properly. Spare cod end fitted. New one to be ordered to replace spare.

17/05 – No comms. Traced to Biowire fault (see below).

24/05 – Fail to fire

Motor released only 2 of 5 releases. When tested on deck, all releases fired and there were apparently no problems. Mocness had not been used for 5 days before this deployment.

Unit deployed again and same problem persisted. The motor cable was believed to be the problem, and was changed. A test deployment with the new cable fired all nine nets as normal.

01/06 – Fail to fire

Some of the nets did not fire. Motor cable was believed to be problem again, with damage visible. This cable has a potted connection mid-way along its length, with a processing chip to pulse the motor through the three steps required to fire each net. Unfortunately this connection is incredibly vulnerable to damage and subsequent water ingress at pressure.

Due to a lack of spare parts, a straight cable with no processing assembly was fabricated. This required each of the three pulses required to be sent manually by the operator – a small increase in

complexity for what may be a large gain in reliability (evaluation of deployment data indicates that the two motor drive cables used this voyage lasted 16 and 13 successful deployments respectively).

After deck testing, a 300m test station was organised to prove functionality of this firing system. Unfortunately this test was also unsuccessful. Upon investigation, the pressure compensation diaphragm on the motor was seen to have collapsed, and so the motor/release assembly was removed for inspection. Before disassembly, the unit was tested on a bench power supply and found to require 5.2A to turn – approaching the overcurrent cutout of the control unit. Without pressure compensation, this current would undoubtedly exceed that available from the control unit when at depth.

The motor housing was split from the release shaft and opened. Particles in the oil bath were noted, suspected to be grease and thus inconsequential. The motor output shaft was found to be bent – 1mm out of alignment over a 50mm shaft. Additionally, the release shaft was bent by 1.5mm between bushings. Each shaft was measured using a dial gauge and straightened to within ± 0.1mm of neutral. Scoring to the bore of the shaft output hole in the housing was also noted – indicating potential previous poor alignment of the motor. The straightened motor shaft was realigned to the face plate of the housing, and tested using the bench supply. A maximum current draw of 2.6A was required.

New o-rings were fitted to the motor shaft and housing bleed screws, the housing was refilled with light turbine oil, sealed and bled. The motor was again turned over with a 2.6A draw. The release shaft bearings were lubricated with a silicone oil, and the motor was coupled to this shaft, with significant attention being paid to alignment. The spring-loaded releases were loaded under the shaft, and again the current draw was measured at maximum 2.6A.

The unit was tested on deck, attached to the net frame and loaded as per deployment, and a current peak of 3.1A was noted. A 50m test site was arranged for 03/06 and was successful.

Lessons learned:

It may not be advisable to cock the net in advance, this ensures that the motor will go through one rotation before being deployed.

Check before deployment that the pins on the release mechanism do not snag on the shaft – as this has the potential to bind the motor.

Bio-wire

The bio-wire has been re-terminated.

When deploying the Mocness on 17/05 an error message occurred indicating that packages of data where not received from the underwater unit. A Mega test was performed on the bio-wire, with a result of 0.1MΩ, indicating a faulty wire. It was therefore decided to re-terminate the bio-wire. When disassembling the existing termination, significant corrosion to electrical connections was noted – clear evidence of water ingress.

After re-termination the mega test result was 2.2GΩ, and full function was restored. A piece of foam packing was inserted into the termination where the electrical connection exits from the potting. It is hoped that this will reduce stress exerted on the potting/cable join, and thus increase the useful life of the termination.

Lessons learned:

It is suggested that the bio-wire is mega tested on a regular basis, and the result recorded as part of a maintenance record. This should ensure that the bio-wire can be re-terminated before failure.

11 NMF Mega Corer Cruise Report

Mechanical Tech- Ian Murdoch

1. Mega corer

Overview

The Mega Core has been deployed to a max depth: 3530M

The Coring on Jr17-005 has been very successful and the equipment has encountered no major issues. The corer has been deployed with four sampling units, one unit on each side of corer. The Mega Corer was deployed using the coring winch from the mid ships gantry. The corer is lowered to 100m from the seabed using the EA600 for depth at a rate of 60m/m then on to bottom operations at 10m/m. On ships winch-typical pull out loads seen on heave from the seabed.

Failures:

- Station F15 25/05/2018 - Lost a sample tube in the seabed, on each tube there is a plastic ring attached for fitment into sample units. If the sample tube hits a hard surface (Rock) this plastic ring can be disturbed and break free from the tube. The loss of this plastic tube was reported and logged on the JCR Bridge. The unit itself retuned undamaged.
- Shutter cutters failed to close on some deployments, this was either due to gravel in the sediment or failed trigger of sampling unit.

Lessons Learned:

- Investigate possible improvements to sampling tubes attachment collar ring.

The Day Grab was used for sampling the seabed when the water depth was below 1000m on the shelf stations to determine whether or not to deploy the Mega Corer. The Day Grab worked very well.

12. SAPs & Salinometry

Dougal Mountifield

National Oceanography Centre

National Marine Facilities – Sea Systems (NMF-SS) Sensors and Moorings Group

Summary

National Marine Facilities – Sea Systems (NMF-SS) Sensors & Moorings Group supplied the following equipment in support of JR17-005:

- NMF-SS 24-way Stainless Steel CTD Frame

- 24 off 20l OTE water samplers (internal spring) and associated spares
- 2 off TRDI Workhorse 300kHz LADCP instruments provided as spares for BAS supplied units
- 5 off Challenger Oceanic Stand Alone Pumps (SAPS) for in-situ water filtration complete with support equipment and associated spares
- 4 off Sea-Bird SBE39 Temperature & Pressure loggers
- 4 off Sea-Bird SBE39plus Temperature & Pressure Loggers
- Laptop, Software & Spares associated with SBE39/39plus instruments
- 2 off 100kg plastic coated lead ballast for SAPS use on deck-winch wire
- 1 off 500kg lead ballast for back-up use on ships fitted traction winch wire
- IAPSO Standard Seawater
- Salinity Sample Bottles & Inserts
- Laptop, Software, Consumables & Spares associated with salinity analysis with BAS supplied Autosal 8400B.

Salinometry

171 discrete salinity samples were taken from the CTD rosette by the science party using ~7.5 crates of sample bottles. 37 discrete salinity samples were taken from the underway TSG (Oceanlogger) flow using ~1.5 crates of sample bottles. All 9 salinity sample crates consisted of 24 bottles per crate. The science party took all samples from both the CTD water samplers and the underway TSG. A large number of samples were over-filled which prevented sufficient mixing of the sample to reduce stratification in the bottle prior to analysis.

All samples were analysed on BAS supplied Guildline Autosal 8400B S/N 68959. 7 crates were analysed by Dougal Mountifield (NMF-SS, NOC Southampton) and 2 crates by Jo Hopkins (NOC Liverpool). A standard was run as a sample before and after each crate of samples as a control for salinometer stability. The machine was not-restandardised following the first standardisation in order to characterise the drift. The machine displayed a linear drift of approximately +0.002 PSU/week (0.00010 in double conductivity ratio / week).

During the early part of the cruise the salinometer was commissioned by filling the bath with Milli-Q and switching on. The machine was checked after 24 hours but was not stable yet due to fluctuation in ambient temperature during servicing of A/C fan units by the vessel's Engineers. Two days later

the ambient temperature had stabilised at 22°C but the salinometer was still unstable. The bath was drained down and the machine was withdrawn from its casing. The fault was identified as a failed drive o-ring in the stirrer mechanism. A new stirrer drive o-ring was fitted from the BAS supplied spares. Both heater lamps were visually checked to be operating correctly whilst the machine was withdrawn from its casing. The salinometer bath was refilled and the bath temperature was set to 24°C for a nominal elevation of 2°C above ambient. The machine was checked for stability after 24 hours and again after 48 hours since power-up, and was suitably stable for standardisation.

The NMF salinity logging software was used. However, problems were encountered with the storing and parsing of the salinometer offset from standard at standardisation. After a protracted investigation, the issue was identified and solved. The software is a 32-bit executable and when the Windows installer is run on a 64-bit version of Windows (Windows 10 in this case), the software installation path defaults at *'C:\Program Files (x86)\Autosal_2009'*. When run, the executable cannot parse the *Autosal.ini* file which stores the details of last standardisation including offset. The software seems to have the path to this file hard-coded as *'C:\Program Files\Autosal_2009'*. In Windows 10 it is not possible to install 32-bit software in *'C:\Program Files'*.

The workaround is to create a folder named *'Autosal_2009'* in *'C:\Program Files'* and move the *Autosal.ini* file to here from *'C:\Program Files (x86)\Autosal_2009'*. The software will then be able to read the *Autosal.ini* file (observed by the standard deviation limit, COM port, cruise ID, salinometer serial number, operator and crate number etc being as per the *Autosal.ini* file) when the software is run. However in order to allow the software to write to the file, the program must be run as Administrator. Also to prevent latency issues causing read errors or timeouts with the serial port, the program should be run in Windows XP compatibility mode.

With a stable ambient temperature and bath temperature, and correctly functioning software, the machine was finally standardised on 21 May. The Autosal was standardised using IAPSO Standard Seawater batch P161 (K15=0.99987, 2xK15=1.99974, 34.995 PSU).

The software standard deviation limit was set at 0.00002 in double conductivity ratio. A measurement period of ~10 seconds is used for an averaged measurement. This is then repeated a further 2 times with the cell flushed and filled with new sample each time. Finally the three measurements are averaged for the analysed value. The three double conductivity ratio values, and the average are recorded in the data file. The machine offset in double conductivity ratio at standardisation is then corrected for before the salinity is calculated and recorded in the file.

The convention used was to name CTD samples as 'CTD' and underway TSG as 'TSG' with the bottle number of the salinity sample bottle for each sample. The standard that was run at the start and end of each crate were named 'STD' with bottle number 999 for clarity. The offset between this value and the P161 label value must be applied to all the salinity values in the data file in post-processing.

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. These log-sheets were also supplied along with scans in pdf format. A data file and paper log-sheet was also provided for the standardisation on 21 May.

In-Situ Pumps (SAPs)

Four Challenger Oceanic Stand Alone Pumps units were deployed on the cruise:

S/N 03-03 (Daisy)

S/N 02-002 (Kitty)

S/N 03-05 (Sophie)

S/N 04-11 (Bambi)

New pump end-caps, magnetic windows, motors and all 8 cells in both battery packs were fitted to S/N 03-03 (Daisy) and S/N 02-002 (Kitty) prior to the cruise. This upgrades S/N 02-002 (Kitty) from MkII to MkIII build. All four units have PJB systems electronics. S/N 04-11 (Bambi) is the only unit used that has the MkIV battery isolating bulkhead connector fitted.

New pump housings were fitted to all units prior to the cruise.

New battery cells were available as spares to replace both packs in all four units but were not required.

The test cast (SAP_01) with filters fitted identified issues with S/N 03-05 (Sophie)'s pump binding. All pumps were subsequently tested by circulating from a bucket of water for 10 minutes. All pumps were found to be very noisy and intermittent. All pumps were dismantled for inspection of condition and measurement of impeller clearances and end-float. All impeller assemblies of spindle, bush, and thrust washers were then selected individually for best fit from best available old-stock and lapped to improve fit. A repeat of the water circulation test indicated that all pumps now operated very quietly and pumped approximately 1200 litres per hour (~200l in ~10 mins) without the pancake housing and filters fitted.

Configuration

293mm double chamber pancake filter housings were used with a 90 deg elbow on the inlet and the outlet plumbed directly into the flow-meter.

For all deployments a ~50um nylon mesh was used in the first filter location as a pre-filter for zooplankton. A single ~0.7um GFF was used as the main filter directly on the spiral filter support plate in the second filter location. No additional support filter was used. Material that was accreted on the nylon mesh were rinsed off the mesh and filtered through a separate GFF post-deployment.

Sea-Bird SBE 39plus Temperature & Pressure Loggers

Each SAP was fitted with a Sea-Bird SBE 39plus Temperature and Pressure Logger:

- 39p-8514 fitted to S/N 03-03 (Daisy)
- 39p-8512 fitted to S/N 02-002 (Kitty)
- 39p-8511 fitted to S/N 03-05 (Sophie)
- 39p-8513 fitted to S/N 04-11 (Bambi)

All four SBE 39plus instruments are new units and have original manufacture's calibrations for temperature and pressure dated November 2017.

The internal battery condition of the main and backup batteries was checked on all four units during mobilisation and the real-time clocks were set to UTC.

The sample interval was set to 1 second.

The serial sync mode was disabled as this was not used.

The real-time output was enabled to confirm logging pre and post deployment.

The instruments were configured to record temperature and pressure in converted engineering output with temperature in Celsius and pressure in Decibar. The instruments were configured to output the sample number as well as the date/time stamp for each sample.

After configuration, terminal captures were obtained of each instruments response to the DS (Display Settings) and DC (Display Calibrations) and saved as for future reference.

Data was downloaded using Sea-term V2 to obtain the .xml and .asc data files.

Deployment Summary

The SAP units were deployed near the forecastle using the MacArtney deck winch, deck mounted diverted snatch-block, and a second snatch-block hung from the 1.1T 8m crane. A stainless steel wire was used with a ~100kg plastic-coated lead ballast weight. For one deployment in heavy pack-ice, the SAPs were deployed midships using the trawl traction winch and the coring block.

Normally the SAPs were deployed concurrently with the CTD, except in heavier ice conditions when the wires were worked seperately. The ballast weight was always deployed and veered to 10m before starting the SBE39plus loggers and starting the SAP timer sequence. The period from starting the SAP timer sequence to having all SAPs at their target depths was approximately 30 minutes. Recovery from start of haul to all inboard was approximately 15-20 minutes.

The SAPs were operated from the Rough Workshop on the JCR. A trolley was used to move 2 SAPs at a time between the Rough Workshop and the deployment location.

A three stage battery charging regime was used:

- BOOST: CC @ 2.8A (1.4A per pack) to 21.2V at the packs (23V CV limit at the charger)
  Nominal duration 2 hours
- TRICKLE: CV @ 20.6V at the charger until 19.6V at the packs and < 0.7A (0.35A per pack)
  Nominal duration 1 hour
- FLOAT: CV @ 18.8V at the charger (18.3V at the packs) until <20mA (10mA per pack) and keep on
  Nominal duration of at least one hour

A total of 17 deployments were completed including the first test deployment. The filters from the test deployment were discarded. Four SAP units were used for each cast. First on the wire at the bottom was always targeted at 200m apart from the last cast in 145m of water when this was raised to 100m targeted depth. The second on the wire was nominally targeted at 75m, third on the wire at 25m and fourth on the wire at 5m (near surface). The near surface unit was lowered to 10-15m in pack-ice to reduce the risk of potential ice damage.

For clarity photographs were taken of each SAP flow-meter pre deployment. Post-deployment flow-meter readings were double checked after fresh water rinsing. Approximately 5 litres (2-10 litres) of fresh water was flushed through the flow-meter post-deployment.

The same unit was used in each position on the wire to keep a similar pressure operating environment and to monitor expected volumes for each unit in situ. This also reduces potential confusion when processing filter samples.

	03-03 Daisy		**02-002 Kitty**		**03-05 Sophie**		**04-11 Bambi**	
Deployment	Depth / m	Volume / litres	Depth / m	Volume / litres	Depth / m	Volume / litres	Depth / m	Volume / litres
1 (TEST)	*5*	*~500*	*20*	*~600*	*75*	*0*	*200*	*~1200*
2	5	595	25	568	75	776	200	1206
3	5	564	25	602	75	722	200	1153
4	5	543	15	474	75	986	200	1148

5	15	757	50	1116	75	1229	200	1288
6	5	630	15	764	75	1135	200	1210
7	10	515	50	932	100	1184	200	1335
8	5	617	22	463	50	956	200	1370
9	5	323	25	680	75	667	200	1143
10	5	369	25	798	75	1236	200	1353
11	10	311	50	699	100	1016	200	1247
12	5	398	35	954	50	1208	200	1254
13	5	93	25	102	75	661	200	1214
14	5	98	25	513	75	785	200	1297
15	5	339	25	294	75	332	200	1003
16	5	107	25	379	75	434	200	742
17	5	471	25	478	75	724	100	780
Total Volume per Unit / litres	6730		9816		14051		18743	
Total Volume Pumped / litres	49340							

All SAP units were configured to pump for 1.5 hours (90 minutes). The delay was set at 45 minutes to give approximately 15 minutes of contingency during deployment. Start of recovery was begun 5-10 minutes after estimated completion of pumping. The pancake filter housings were not primed prior to deployment. The inlet elbows and exhaust adapters were protected by aluminium foil until fitting the filter housings approximately 1-2 hours prior to deployment.

In some of the coldest surface water the near surface unit (Daisy) terminated pumping early a few times due to low battery (caused by a reduction in terminal voltage in the low operating temperature). However even in these cases, over 1hr and 20minutes of pumping was achieved.

Technical Issues

Considerable preparation pre-cruise, during mobilisation and between the test deployment and the first scientific deployment has paid dividends with excellent consistent and fault-free performance from all four units. A fifth, spare unit was available but its use was not required.

One of the two units with new battery packs was selected for the near surface location due to the anticipated cold temperatures. With the exception of a few deployments where it terminated pumping early (~80 minutes achieved of the 90 minutes programmed) due to low-battery voltage, it performed well in the cold environment.

The near-surface unit also suffered temporary freezing early during deployment of residual fresh water in the pressure port of the SBE39plus temperature and pressure logger. This only lasted a few minutes before seawater intruded and thawed the port.

There was one deployment where the water froze instantly during post-deployment fresh-water wash on a windy -5°C night, however this thawed promptly when the units were subsequently removed from deck to the rough workshop.

13. Laboratory Report

Aisling Smith

Lab handover was conducted by the Chief Officer, Georgina L and the PSO, David Pond on the 9th of May 2018. Cargo was unpacked and laboratory workstations were set up over the new few days.

Risk assessment and COSHH information were made available to all users. A master copy of all paperwork for planned lab work was stored in the main Lab near the door and SDS information of chemicals in each room was stored electronically on the L Drive. Emergency information hazard sheets were prepared for each Lab door, which included the location and hazards of chemicals in the room and the emergency contact information.

The Rad Lab was in use during the cruise for oxygen titration, the room does not have a fixed general chemical spill kit, the spill kit from the Bio Lab was moved into this Lab for the duration of the cruise so that a spill kit was at hand if required.

A lab induction was given to scientific lab users at the start of the cruise which covered general housekeeping, Lab code of conduct, use of fixed equipment, sample storage, AIME reporting, use and disposal of chemicals.

The Laboratory manager met with the Doctor on board and discussed emergency plans for spills and provided the link to the central copy of all SDS sheets for the cruise and discussed possible injuries pertaining to the work planned.

Use of PPE was consistent throughout the cruise by all in the science team and good practice was observed. Wet weather gear was acceptable for use in the wet lab and on deck. Lab coats were used for working with hazardous chemicals in the lab.

Several days before entering the ice, lab users were advised that the Milli-Q tank could not be refilled. It was advised that some Milli-Q water be stored should time in the ice be extended. The tank was filled before entering the ice. Lab users were also informed that the uncontaminated seawater supply would be switched off in ice.

During the cruise the temperature of the Cool Specimen Room was reduced to 2 degrees as the room was in use for live physiology experiments. The CT room during this cruise was not sufficient for the number of people working or the space required by the various projects. Issues with humidity in the room were reported and it is recommended that alternative arrangements be made for next years cruise. Strong vibration of one of the benches within the room was reported and due to this was not usable for microscope work.

Laboratory users noticed a number of minor issues of wear and tear in the Labs over the duration of the cruise; this list has been passed to the Deck Engineer, Thomas Biggs, for further investigation during the upcoming refit period. There is a lack of sufficient storage space for Lab coats within the Labs, a solution to this is being explored.

14. Data Management Report

Sarah Chapman, BODC

Data Storage

All data recorded by instrumentation linked to the ships network in the legdata K: Drive and additional folders created by cruise participants in legwork L: Drive will be backed up and transferred to the Storage Area Network (SAN) at BAS. All cruise participants will have access to this area and can contact the polardatacentre@bas.ac.uk or bodcenquiries@bodc.ac.uk for copies of data or files.

Event Logging

JR17005 bridge log was maintained by the officers on watch and assigned unique event numbers to all equipment deployments.

Digital Event Logs were created for the: Day Grab, Zooplankton Net, CTD, Mega corer, SAPS, Bongo, MOCNESS, CTD bottles (auto-generated), Underway Salinity Samples. These logs contain un-calibrated raw data from the underway streams to assist with sampling. Exports of these logs have been saved on the JCR L: Drive.

Paper logsheets were created to record all deployments using BODC/PDC templates. All logsheets have been scanned and stored on the legdata drive.

Cruise Datasets

See TABLE for a list of cruise datasets and their uses.

Data Submissions

Data should be submitted to the relevant Data Centre as per the agreed Changing Arctic Ocean Data Management Plan (DMP) see Appendix 1.1.

Data Discovery – How to access your cruise data?

Data held at British Oceanographic Data Centre can be accessed via BODC archives or the National Oceanographic Database (NODB) online or by contacting Joana Beja bodcenquiries@bodc.ac.uk .

Data held at the Polar Data Centre Archives can be accessed by contacting Katy Buckland, Scientific Data Co-ordinator polardatacentre@enquiries.ac.uk.

15. Cruise Event log

				START (Deployed)			AT BOTTOM/AT DEPTH			END (on deck)						
EVENT	STATION	ID	TYPE	DATE (DD/MM/YYYY 24HH:MM:SS)	LATITUDE	LONGITUDE	DATE (DD/MM/YYYY 24HH:MM:SS)	LATITUDE	LONGITUDE	DATE (DD/MM/YYYY 24HH:MM:SS)	LATITUDE	LONGITUDE	WDEPTH (m)	EVENTDEPTH (m)	PERSON	COMMENTS (e.g. failed deployments, issues)
1	NB	CTD001	CTD	13/05/2018 08:03:00	67.99834	-3.98539	13/05/2018 08:25:00	67.99835	-3.98544	13/05/2018 08:46:00	67.99834	-3.98543	3738	1000	Jo	Shakedown station. Event Depth 1000m.
2	NB	CTD002	CTD	13/05/2018 09:03:00	67.99833	-3.98545	13/05/2018 10:11:54	67.99834	-3.98543	13/05/2018 11:35:30	67.99833	-3.98544	3735	2600	Jo	Shakedown station. Event depth 2600m.
3	NB	MOC001	MOCNESS	13/05/2018 11:58:00	67.99097	-3.98375	13/05/2018 12:09:00	67.98341	-3.98195	13/05/2018 12:29:00	67.96852	-3.97835	3736	300	Bjorg/Carwyn	Shakedown station. Depth Sensor failed. Failed deployment. Event depth 300m.
4	NB	BON001	BONGO	13/05/2018 12:54:00	67.96658	-3.97779				13/05/2018 13:11:00	67.96658	-3.97781	3761	100	Geraint	Shakedown station.
5	NB	SAPS001	SAPS	13/05/2018 14:05:00	67.96658	-3.97776				13/05/2018 16:26:00	67.96661	-3.97772	3760		Dougal	Shakedown station.Daisy (5m), Kitty (20m), Sophie (75m), Bamby (200m)
6	NB	MOC002	MOCNESS	13/05/2018 16:45:00	67.96471	-3.96547	13/05/2018 16:59:00	67.96072	-3.93915	13/05/2018 17:09:00	67.9573	-3.91755	3770	300	Bjorg/Carwyn	
7	NT11	CORE001	MEGACORER	15/05/2018 10:40:00	75.32667	-5.46221	15/05/2018 11:52:00	75.32667	-5.46217	15/05/2018 13:05:00	75.32665	-5.46214	3571	3571	Ian/Louisa/Emma	Pullout tension 2.46 t. Core sliced into 5mm, 10mm and 20mm slices
8	NT11	CORE002	MEGACORER	15/05/2018 14:44:00	75.32666	-5.46214	15/05/2018 15:52:00	75.32666	-5.46217	15/05/2018 17:09:00	75.32664	-5.46219	3571	3571	Ian/Louisa/Emma	Pullout tension 2.62 t. Core sliced into 5mm, 10mm and 20mm slices
9	NT11	CORE003	MEGACORER	15/05/2018 17:42:00	75.32665	-5.46214	15/05/2018 18:58:00	75.32668	-5.46219	15/05/2018 20:15:00	75.32666	-5.46221	3570	3580	Ian/Louisa/Emma	Pullout tension 2.43 t. Core sliced into 5mm, 10mm and 20mm slices
10	NT11	CTD003	CTD	15/05/2018 21:34:00	75.3356	-5.46428	15/05/2018 21:38:00	75.33555	-5.46429	15/05/2018 21:43:00	75.33554	-5.46428	3571	50	Jo	

11	NT11	BON002	BONGO	15/05/2018 22:03:00	75.33556	-5.46435				15/05/2018 22:36:00	75.33555	-5.46432	3571	200	Dan	
12	NT11	BON003	BONGO	15/05/2018 22:37:00	75.33554	-5.46434				15/05/2018 23:05:00	75.33556	-5.46438	3571	200	Dan	
13	NT11	CTD004	CTD	15/05/2018 23:24:00	75.33556	-5.46434	15/05/2018 00:25:00	75.33555	-5.46437	16/05/2018 02:12:00	75.33553	-5.46431	3518	3570	Ross	
14	NT11	SAPS002	SAPS	15/05/2018 23:07:00	75.33556	-5.46434				16/05/2018 02:38:00	75.33555	-5.46435	3571		Dougal	Bambi 200m, Sophie 75m, Kitty 25m, Daisy 5m.
15	NT11	MOC003	MOCNESS	16/05/2018 03:11:00	75.32898	-5.47983				16/05/2018 06:27:00	75.23702	-5.73019	3569	1200	Bjorg/Carwyn	
16	NT11	BON004	BONGO	16/05/2018 07:43:00	75.33594	-5.45963				16/05/2018 08:10:00	75.33594	-5.45964	3571	200	Geraint	
17	NT11	BON005	BONGO	16/05/2018 08:13:00	75.33593	-5.45958				16/05/2018 08:39:00	75.3359	-5.45959	3572	200	Geraint	
18	NT11	MOC004	MOCNESS	16/05/2018 08:59:50	75.33074	-5.46613				16/05/2018 11:49:09	75.22888	-5.51975	3570	1200	Bjorg/Carwyn	
19	NT10	CTD005	CTD	16/05/2018 13:48:00	75.48844	-6.04536	16/05/2018 14:50:00	75.489	-6.0435	16/05/2018 16:47:00	75.48902	-6.04343	3495	3300	Jo	
20	NT9	CTD006	CTD	16/05/2018 18:41:00	75.64234	-6.62752	16/05/2018 19:39:00	75.64235	-6.62757	16/05/2018 21:08:00	75.64234	-6.62749	3282	3200	Jo	
21	NT8	CTD007	CTD	16/05/2018 22:50:00	75.79556	-7.21797	16/05/2018 22:55:00	75.79557	-7.21792	16/05/2018 23:01:00	75.79557	-7.21793	2695	50	Ross	Shallow CTD
22	NT8	BON006	BONGO	16/05/2018 23:11:00	75.79557	-7.21789				16/05/2018 23:38:00	75.79557	-7.21793	2695	200	Dan	
23	NT8	BON007	BONGO	16/05/2018 23:43:00	75.79556	-7.21792				17/05/2018 00:08:00	75.79557	-7.21793	2695	200	Dan	
24	NT8	CTD008	CTD	17/05/2018 00:31:00	75.79556	-7.21794	17/05/2018 01:21:00	75.79555	-7.21792	17/05/2018 02:34:00	75.79555	-7.21792	2695	2643	Ross	Full depth CTD
25	NT8	SAPS003	SAPS	17/05/2018 00:37:00	75.79556	-7.21787				17/05/2018 03:30:00	75.79557	-7.21802	2695		Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 200m.
26	NT8	MOC005	MOCNESS	17/05/2018 04:00:00	75.79937	-7.23843				17/05/2018 06:47:00	75.84202	-7.59499	2678	1200	Bjorg/Carwyn	
27	NT8	CTD009	CTD	17/05/2018 10:07:00	75.79418	-7.2195	17/05/2018 10:58:00	75.79417	-7.21967	17/05/2018 12:16:00	75.79415	-7.21969	2702	2638	Jo	First cast after cable repair.
28	NT8	CORE004	MEGACORER	17/05/2018 12:54:00	75.79415	-7.21973				17/05/2018 13:55:00	75.79415	-7.21962	2700	2700	Ian/Louisa/Emma	Failed deployment. Issues with winch. Deployed to 400 m then recovered. No cores.
29	NT7	CTD010	CTD	17/05/2018 17:29:00	75.94852	-7.81841				17/05/2018 18:02:00	75.94852	-7.81846	2037	550	Jo	Comms timeout at 550 m. Returned to surface with no bottles fired.

30	NT7	CTD011	CTD	18/05/2018 01:58:00	75.94908	-7.81496	18/05/2018 02:36:00	75.94907	-7.81503	18/05/2018 04:47:00	75.94908	-7.81486	2040	2000	Ross	Winch issue. Resolved and CTD working fine.
31	NT6	MOC006	MOCNESS	18/05/2018 06:49:41	76.10582	-8.43846				18/05/2018 09:27:00	76.1658	-8.7717	1229	1200	Bjorg/Carwyn	Picked for lipids, respiration and CHN analysis. Not preserved.
32	NT6	BON008	BONGO	18/05/2018 10:27:00	75.79556	-7.21792				18/05/2018 10:52:00	76.10238	-8.41895	1256	200	Geraint	
33	NT6	BON009	BONGO	18/05/2018 10:56:00	76.10239	-8.41891				18/05/2018 11:23:00	76.10237	-8.41894	1256	200	Geraint	
34	NT6	MOC007	MOCNESS	18/05/2018 11:51:00	76.10386	-8.43595				18/05/2018 14:11:00	76.12955	-8.74867	1239	1200	Bjorg/Carwyn	Net 1 not preserved. Other nets preserved
35	NT6	CTD012	CTD	18/05/2018 15:33:00	76.10225	-8.41915	18/05/2018 16:00:00	76.10224	-8.41917	18/05/2018 16:44:00	76.10225	-8.41913	1256	1212	Jo	
36	NT6	CORE005	MEGACORER	18/05/2018 17:37:00	76.10225	-8.41914				18/05/2018 18:45:00	76.10226	-8.41913	1256	1256	Ian/Louisa/Emma	
37	NT6	CORE006	MEGACORER	18/05/2018 19:16:00	76.10226	-8.41909				18/05/2018 20:22:00	76.10226	-8.41903	1256	1256	Ian/Louisa/Emma	
38	NT6	CORE007	MEGACORER	18/05/2018 20:52:00	76.10225	-8.41912				18/05/2018 21:58:00	76.10226	-8.41908	1256	1256	Ian/Louisa/Emma	
39	NT5	CTD013	CTD	19/05/2018 00:03:00	76.25775	-9.028673	19/05/2018 00:07:00	76.25774	-9.02873	19/05/2018 00:13:00	76.25774	-9.02863	287	200	Ross	
40	NT5	BON010	BONGO	19/05/2018 00:52:00	76.25577	-9.02861				19/05/2018 01:20:00	76.25576	-9.02858	286	200	Dan	
41	NT5	BON011	BONGO	19/05/2018 01:24:00	76.25576	-9.02855				19/05/2018 01:50:00	76.25576	-9.02851	286	200	Dan	
42	NT5	CTD014	CTD	19/05/2018 02:08:00	76.25576	-9.0285	19/05/2018 02:21:00	76.25576	-9.02851	19/05/2018 02:47:00	76.25576	-9.02853	287	270	Ross	
43	NT5	SAPS004	SAPS	19/05/2018 02:15:00	76.25576	-9.0285				19/05/2018 05:00:00	76.25577	-9.02852	287		Dougal	Daisy 5m, Kitty 15m, Sophie 75m, Bambi 200m.
44	NT5	MOC008	MOCNESS	19/05/2018 05:23:00	76.25967	-9.03507				19/05/2018 06:36:00	76.30057	-9.10491	284	200	Bjorg/Carwyn	
45	NT5	MOC009	MOCNESS	19/05/2018 07:13:00	76.25965	-9.031				19/05/2018 08:30:00	76.30672	-9.07577	285	200	Bjorg/Carwyn	Net 1 not preserved. Other nets preserved in ethanol and formalin in ratios given in logsheet.
46	NT5	BON012	BONGO	19/05/2018 09:13:00	76.25581	-9.02866				19/05/2018 09:39:00	76.2558	-9.02865	282	200	Geraint	
47	NT5	BON013	BONGO	19/05/2018 09:42:00	76.2558	-9.02865				19/05/2018 10:08:00	76.25581	-9.02866	284	200	Geraint	
48	NT5	GRAB001	DAYGRAB	19/05/2018 10:37:00	76.2558	-9.0286				19/05/2018 10:58:00	76.2558	-9.02861	283	283	Ian/Louisa/Emma	Probably not suitable for megacorer

49	NT5	GRAB002	DAYGRAB	19/05/2018 11:12:00	76.25579	-9.02856				19/05/2018 11:29:00	76.2558	76.2558	283	283	Ian/Louisa/Emma	
50	NT6B	CTD015	CTD	19/05/2018 12:55:00	76.17927	-8.72192	19/05/2018 13:13:00	76.17929	-8.72188	19/05/2018 13:28:00	76.17929	-8.72191	753	730	Jo	No bottles
51	NT4	CTD016	CTD	19/05/2018 16:03:00	76.40921	-9.65243	19/05/2018 16:12:00	76.40884	-9.65388	19/05/2018 16:30:00	76.40798	-9.65979	247	230	Jo	First station in the ice. Only 10 data points stored in SBE35 memory
52	NT3	CTD017	CTD	19/05/2018 18:47:00	76.5683	-10.26487	19/05/2018 18:55:00	76.56829	-10.26485	19/05/2018 19:16:00	76.56829	-10.26491	271	250	Jo	
53	NT2	CTD018	CTD	19/05/2018 22:03:00	76.71327	-10.90499	19/05/2018 22:16:00	76.71209	-10.90637	19/05/2018 22:34:00	76.71004	-10.90837	338	50	Ross	
54	NT2	BON014	BONGO	19/05/2018 22:45:00	76.70913	-10.90959				19/05/2018 23:12:00	76.70663	-10.91264	341	200	Dan	
55	NT2	BON015	BONGO	19/05/2018 23:16:00	76.70608	-10.91317				19/05/2018 23:42:00	76.70385	-10.91685	335	200	Dan	
56	NT2	BON016	BONGO	19/05/2018 23:45:00	76.70335	-10.9168				20/05/2018 00:22:00	76.69977	-10.92129	331	200	Dan	
57	NT2	CTD019	CTD	20/05/2018 17:57:00	76.71498	-10.88129	20/05/2018 18:06:00	76.71411	-10.88189	20/05/2018 18:30:00	76.71147	-10.88708	343	320	Jo	
58	NT2	GRAB003	DAYGRAB	20/05/2018 19:23:00	76.7052	-10.89597				20/05/2018 20:07:00	76.69948	-10.90936	339	25	Ian/Louisa/Emma	Failed deployment due to winch problem.
59	NT2	GRAB004	DAYGRAB	20/05/2018 20:29:00	76.69644	-10.91839				20/05/2018 20:52:00	76.69423	-10.9261	342	342	Ian/Louisa/Emma	Deployed from mcartney winch. Samples taken from top of bottom grab.
60	NT2	GRAB005	DAYGRAB	20/05/2018 21:34:00	76.68808	-10.94839				20/05/2018 21:49:00	76.68625	-10.95335	335	335	Ian/Louisa/Emma	Deployed from mcartney winch. Samples taken from top of bottom grab.
61	NT2	SAPS005	SAPS	20/05/2018 23:51:00	76.72014	-10.99097				21/05/2018 02:33:00	76.70753	-11.07813	342		Dougal	Daisy 15m, Kitty 50m, Sophie 75m, Bambi 200m.
62	F21	GRAB006	DAYGRAB	22/05/2018 15:49:00	78.99927	-9.2647				22/05/2018 16:20:00	78.99741	-9.26864	238	238	Ian/Louisa/Emma	
63	F21	CORE008	MEGACORER	22/05/2018 16:47:00	78.99522	-9.27314				22/05/2018 17:12:00	78.99414	-9.27696	242	242	Ian/Louisa/Emma	

64	F21	CORE009	MEGACORER	22/05/2018 17:38:00	78.99173	-9.28045				22/05/2018 18:06:00	78.99129	-9.283	252	252	Ian/Louisa/Emma	
65	F21	CORE010	MEGACORER	22/05/2018 18:34:00	78.98896	-9.28953				22/05/2018 18:59:00	78.98843	-9.29006	256	256	Ian/Louisa/Emma	
66	F21	ZP001	ZooNet	22/05/2018 19:35:00	78.98762	-9.28687				22/05/2018 19:39:00	78.98752	-9.28711	256	200	Dave	Failed kit.
67	F21	ZP002	ZooNet	22/05/2018 19:44:00	78.98741	-9.28738				22/05/2018 20:11:00	78.98697	-9.2885	256	200	Dave	
68	F21	ZP003	ZooNet	22/05/2018 20:17:00	78.98708	-9.28594				22/05/2018 20:46:00	78.98688	-9.28557	256	200	Dave	
69	F21	CTD020	CTD	22/05/2018 21:38:00	78.98491	-9.2813	22/05/2018 21:45:00	78.98473	-9.28123	22/05/2018 21:53:00	78.98461	-9.28118	257	50	Ross	
70	F21	BON017	BONGO	22/05/2018 22:03:00	78.98462	-9.28125				22/05/2018 22:32:00	78.98369	-9.27897	200	260	Dan	
71	F21	BON018	BONGO	22/05/2018 22:35:00	78.98355	-9.27856				22/05/2018 23:00:00	78.98235	-9.27496	200	258	Dan	
72	F21	CTD021	CTD	22/05/2018 23:28:00	78.98142	-9.27539	22/05/2018 23:42:00	78.98142	-9.27539	23/05/2018 00:10:00	78.97949	-9.27095	257	242	Ross	
73	F21	SAPS006	SAPS	23/05/2018 00:15:00	78.97925	-9.27034				23/05/2018 03:03:00	78.96457	-9.28685	257		Dougal	Daisy 5m, Kitty 15m, Sophie 75m, Bambi 200m.
74	F21	BON019	BONGO	23/05/2018 03:23:00	78.96347	-9.29022				23/05/2018 03:48:00	78.96154	-9.29408	228	200	Dan	
75	F21	BON020	BONGO	23/05/2018 03:51:00	78.96132	-9.29488				23/05/2018 04:29:00	78.95925	-9.30006	237	200	Vicky	
76	F19	CTD022	CTD	23/05/2018 14:17:00	79.00227	-7.9943	23/05/2018 14:26:00	79.00155	-7.99951	23/05/2018 14:52:00	78.99949	-8.01	203	180	Jo	
77	F17B	CTD023	CTD	24/05/2018 07:07:00	78.66576	-6.70865	24/05/2018 07:19:00	78.66577	-6.70869	24/05/2018 07:54:00	78.66497	-6.71033	246	230	Ross	
78	F17	MOC010	MOCNESS	24/05/2018 10:41:00	78.97593	-5.87558				24/05/2018 11:58:00	79.01727	-5.82858	651	500	Bjorg/Carwyn	Firing of nets failed.
79	F17	BON021	BONGO	24/05/2018 12:25:00	79.00215	-5.96914				24/05/2018 12:51:00	79.0019	-5.96623	600	200	Geraint	
80	F17	BON022	BONGO	24/05/2018 12:55:00	79.00153	-5.96511				24/05/2018 13:21:00	78.99917	-5.95411	602	200	Geraint	
81	F17	MOC011	MOCNESS	24/05/2018 13:50:00	78.9847	-5.85477				24/05/2018 15:12:00	79.01744	-5.74137	662	500	Bjorg/Carwyn	End of transect water depth 798m.
82	F17	CORE011	MEGACORER	24/05/2018 15:40:00	79.0166	-5.76558				24/05/2018 17:38:00	79.01552	-5.77008	786	786	Ian/Louisa/Emma	
83	F17	MOC012	MOCNESS	24/05/2018 18:23:00	79.00442	-5.72341				24/05/2018 19:00:00	78.9941	-5.65343	833	833	Ian/Louisa/Emma	
84	F17	CORE012	MEGACORER	24/05/2018 19:33:00	79.00442	-5.72341				24/05/2018 20:27:00	79.00395	-5.73623	780	780	Ian/Louisa/Emma	
85	F17	CTD024	CTD	24/05/2018 21:35:00	78.99929	-5.98215	24/05/2018 21:40:00	78.99928	-5.98347	24/05/2018 21:45:00	78.99929	-5.98492	582	22	Ross	

86	F17	BON023	BONGO	24/05/2018 21:58:00	78.99931	-5.98658				24/05/2018 22:22:00	79.00144	-5.95828	607	200	Dan	
87	F17	BON024	BONGO	24/05/2018 22:26:00	78.99933	-5.98651				24/05/2018 22:51:00	78.99963	-5.99096	575	200	Dan	
88	F17	BON025	BONGO	24/05/2018 22:55:00	78.99964	-5.99097				24/05/2018 23:17:00	78.9997	-5.992	568	200	Dan	
89	F17	CTD025	CTD	24/05/2018 23:35:00	78.99976	-5.99101	24/05/2018 23:46:00	78.99979	-5.98946	25/05/2018 00:18:00	78.99987	-5.98366	570	554	Ross	
90	F17	SAPS007	SAPS	25/04/2018 00:48:00	78.99897	-5.96812				25/05/2018 03:45:00	78.98159	-5.87677	610		Dougal	Daisy 10m, Kitty 50m, Sophie 100m, Bambi 200m
91	F16	CTD026	CTD	25/04/2018 05:43:00	79.00018	-5.49989	25/04/2018 06:07:00	79.00021	-5.49987	25/04/2018 06:59:00	79.0067	-5.52424	972	950	Ross	
92	F15	MOC013	MOCNESS	25/04/2018 08:43:00	78.99929	-5.06454				25/04/2018 11:14:00	78.97194	-4.63544	1271	1000	Bjorg/Carwyn	End of transect water depth 1572m.
93	F15	BON026	BONGO	25/05/2018 12:00:00	79.00157	-5.02089				25/05/2018 12:27:00	79.00146	-5.01696	1309	200	Geraint	
94	F15	BON027	BONGO	25/05/2018 12:31:00	79.00146	-5.0165				25/05/2018 12:55:00	79.00147	-5.01646	1312	200	Geraint	
95	F15	MOC014	MOCNESS	25/05/2018 13:19:00	79.0013	-5.00949				25/05/2018 15:36:00	78.98449	-4.63639	1314	1000	Bjorg/Carwyn	End of transect water depth 1563m.
96	F15	CORE013	MEGACORER	25/05/2018 16:57:00	78.99176	-5.02473				25/05/2018 17:33:00	78.99175	-5.02472	1290	1290	Ian/Louisa/Emma	
97	F15	CORE014	MEGACORER	25/05/2018 18:35:00	78.99032	-5.02924	25/05/2018 19:11:00	78.98915	78.98915	25/05/2018 19:42:00	78.98875	-5.07678	1288	1288	Ian/Louisa/Emma	
98	F15	CORE015	MEGACORER	25/05/2018 20:04:00	78.98794	-5.06276				25/05/2018 21:07:00	78.98767	-5.0589	1245	1245	Ian/Louisa/Emma	
99	F15	CTD027	CTD	25/05/2018 22:16:00	78.98609	-4.99978	25/05/2018 22:22:00	78.98608	-4.99978	25/05/2018 22:30:00	78.98609	-4.99978	1303	32	Ross	
100	F15	BON029	BONGO	25/05/2018 22:40:00	78.98609	-4.99978				25/05/2018 23:06:00	78.98513	-5.00165	1304	200	Dan	
101	F15	BON030	BONGO	25/05/2018 23:08:00	78.98492	-5.00208				25/05/2018 23:31:00	78.9843	-5.00329	1300	200	Dan	
102	F15	BON031	BONGO	25/05/2018 23:35:00	78.98399	-5.0039				25/05/2018 23:56:00	78.98344	-5.00501	1298	200	Dan	
103	F15	CTD028	CTD	26/05/2018 00:10:00	78.98248	-5.00698	26/05/2018 00:37:00	78.98161	-5.01406	26/05/2018 01:23:00	78.97956	-5.03315	1271	1287	Ross	
104	F15	SAPS008	SAPS	26/05/2018 00:24:00	78.98183	-5.00876				26/05/2018 03:12:00	78.97278	-5.11855	1271		Dougal	Daisy 5m, Kitty 22m, Sophie 50m, 200m.
105	F14	CTD029	CTD	26/05/2018 07:38:00	78.91409	-3.99921	26/05/2018 08:37:00	78.91441	-3.99119	26/05/2018 09:47:00	78.91285	-3.98705	2010	2000	Ross	
106	F13	BON032	BONGO	26/05/2018 12:00:00	79.00035	-3.00118				26/05/2018 12:25:00	78.99999	-2.9998	2442	200	Geraint	
107	F13	BON033	BONGO	26/05/2018 12:28:00	78.99998	-2.99979				26/05/2018 12:54:00	79.00002	-2.99983	2443	200	Geraint	

108	F13	MOC014	MOCNESS	26/05/2018 13:11:00	79.00205	-2.22116				26/05/2018 16:02:00	78.86851	-3.04673	2443	1000	Bjorg/Carwyn	End of transect water depth 2510m.
109	F13	MOC015	MOCNESS	26/05/2018 17:33:00	79.00205	-2.22116				26/05/2018 21:03:00	78.99175	-2.7258	2597	1000	Bjorg/Carwyn	End of transect water depth 2520m.
110	F13	CTD030	CTD	26/05/2018 20:43:00	78.99685	-2.99575	26/05/2018 20:47:00	78.99692	-2.99589	26/05/2018 20:52:00	78.99677	-2.99625	2446	50	Jo	
111	F13	BON034	BONGO	26/05/2018 21:19:00	79	-3.00008				26/05/2018 21:54:00	78.99888	-2.99877	2787	200	Dan	
112	F13	BON035	BONGO	26/05/2018 21:58:00	78.9987	-2.99875				26/05/2018 22:21:00	78.99805	-2.99899	2444	200	Dan	
113	F13	BON036	BONGO	26/05/2018 22:24:00	78.99803	-2.99906				26/05/2018 22:47:00	78.99651	-2.99944	2444	200	Dan	
114	F13	CTD031	CTD	26/05/2018 23:15:00	78.99649	-2.99958	27/05/2018 00:00:00	78.9965	-2.9996	27/05/2018 01:07:00	78.99642	-2.99947	2444	2400	Ross	
115	F13	SAPS009	SAPS	26/05/2018 23:18:00	78.9965	-2.99954				27/05/2018 02:15:00	78.99643	-2.99958	2445		Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 200m.
116	F13	CORE016	MEGACORER	27/05/2018 02:32:00	78.99644	-2.99951				27/05/2018 04:40:00	78.99642	-2.99953	2444	2444	Ian/Louisa/Emma	
117	F13	CORE017	MEGACORER	27/05/2018 04:54:00	78.99641	-2.99953	27/05/2018 05:56:00	78.9964	-2.99935	27/05/2018 06:52:00	78.99511	-2.98048	2453	2453	Ian/Louisa/Emma	
118	F13	CORE018	MEGACORER	27/05/2018 07:19:00	78.99448	-2.96858	27/05/2018 08:18:00	78.99419	-2.94664	27/05/2018 09:17:00	78.99419	-2.94672	2457	2457	Ian/Louisa/Emma	
119	F12	CTD032	CTD	27/05/2018 10:53:00	78.99979	-1.9966	27/05/2018 11:41:00	79.00001	-1.99953	27/05/2018 12:48:00	79.00001	-1.99948	2632	2600	Jo	
120	F11	CTD033	CTD	27/05/2018 14:31:00	79.0002	-0.99976	27/05/2018 15:19:00	79.00018	-0.99963	27/05/2018 16:26:00	79.00017	-0.99965	2645	2630	Jo	
121	F10	CTD034	CTD	27/05/2018 20:08:00	78.99993	-0.00006	27/05/2018 20:12:00	78.99993	-0.00006	27/05/2018 20:16:00	78.99994	0.00005	2591	50	Jo	
122	F10	BON037	BONGO	27/05/2018 20:42:00	78.99994	-0.00002				27/05/2018 21:12:00	78.99996	0.00007	2591	200	Dan	
123	F10	BON038	BONGO	27/05/2018 21:16:00	78.99995	0.00002				27/05/2018 21:45:00	78.99994	0.00001	2591	200	Dan	
124	F10	BON039	BONGO	27/05/2018 21:49:00	78.99994	0				27/05/2018 22:13:00	78.99994	-0.00002	2591	200	Dan	
125	F10	CTD035	CTD	27/05/2018 22:37:00	78.99995	0.00002	27/05/2018 23:25:00	78.99994	-0.00005	28/05/2018 00:35:00	78.99992	0	2591	2550	Ross	
126	F10	SAPS010	SAPS	27/05/2018 22:39:00	78.99995	0.00001				28/05/2018 01:32:00	78.99994	0.00009			Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 200m.
127	F10	MOC016	MOCNESS	28/05/2018 02:09:00	79.00182	-0.03903				28/05/2018 04:48:00	79.02486	-0.57063	2591	1000	Bjorg/Carwyn	End of transect water depth 2467m.
128	F10	BON040	BONGO	28/05/2018 06:04:00	78.99936	-0.00255				28/05/2018 06:28:00	78.99936	-0.00251	2590	200	Geraint	

129	F10	BON041	BONGO	28/05/2018 06:31:00	78.99935	-0.00251				28/05/2018 06:56:00	78.99927	-0.00362	2590	200	Geraint	
130	F10	MOC017	MOCNESS	28/05/2018 07:12:00	79.00295	-0.02541				28/05/2018 09:47:00	79.06363	-0.36537	2592	1000	Bjorg/Carwyn	End of transect water depth 2611m.
131	F10	CORE019	MEGACORER	28/05/2018 10:54:00	79.00036	-0.00036	28/05/2018 11:51:00	79.00003	0.00036	28/05/2018 12:50:00	79.00003	0.00036	2591	2591	Ian/Louisa/Emma	
132	FS1	CTD036	CTD	28/05/2018 21:30:00	80.28328	2.00005	28/05/2018 21:40:00	80.28327	2.00009	28/05/2018 21:53:00	80.28327	2.00011	1921	50	Ross	
133	FS1	BON042	BONGO	28/05/2018 22:02:00	80.2833	2.0002				28/05/2018 22:26:00	80.28329	2.00015	1921	200	Dan	
134	FS1	BON043	BONGO	28/05/2018 22:30:00	80.28328	2.0002				28/05/2018 22:56:00	80.28332	2.00054	1921	200	Dan	
135	FS1	BON044	BONGO	28/05/2018 22:59:00	80.28329	2.00016				28/05/2018 23:21:00	80.28332	2.0004	1922	200	Dan	
136	FS1	CTD037	CTD	28/05/2018 23:45:00	80.28329	2.00024	29/05/2018 00:22:00	80.28329	2.00022	29/05/2018 01:20:00	80.28328	2.00015	1922	1900	Ross	
137	FS1	SAPS011	SAPS	28/05/2018 22:31:00	80.2833	2.0002				29/05/2018 02:40:00	80.28329	2.00012	1922		Dougal	
138	FS1	MOC018	MOCNESS	29/05/2018 03:06:00	80.28528	2.01913				29/05/2018 06:34:00	80.34094	2.50404	1919	100	Bjorg/Carwyn	
139	FS1	MOC019	MOCNESS	29/05/2018 06:34:00	80.28333	2				29/05/18 09:00	80.33333	2.45	1802	1000	Geraint	
140	FS1	BON045	BONGO	29/05/2018 10:04:00	80.28337	2.00017				29/05/2018 10:27:00	80.28337	2.00017	1922	200	Geraint	
141	FS1	BON046	BONGO	29/05/2018 10:30:00	80.28333	2.00003				29/05/2018 10:53:00	80.28333	2.00003	1922	200	Bjorg/Carwyn	
142	FS1	CORE020	MEGACORER	29/05/2018 11:18:00	80.28327	2.0001	29/05/2018 12:02:00	80.28327	2.0001	29/05/2018 12:50:00	80.28327	2.0001	1890	1890	Ian	
143	FS2	BON047	BONGO	29/05/2018 16:46:00	79.64228	1.99823				29/05/2018 17:12:00	79.64228	1.99823	1503	200	Geraint	
144	FS2	BON048	BONGO	29/05/2018 17:15:00	79.64228	1.99822				29/05/2018 17:44:00	79.64228	1.99822	1503	200	Geraint	
145	F8	CTD038	CTD	29/05/2018 21:42:00	79.00002	2.00024	29/05/2018 21:47:00	78.99998	2.00024	29/05/2018 21:53:00	78.99993	2.00015		50	Ross	
146	F8	BON049	BONGO	29/05/2018 22:05:00	78.99995	2.00011				29/05/2018 22:31:00	79.00005	2.00079	2508	200	Dan	
147	F8	BON050	BONGO	29/05/2018 22:34:00	78.99999	2.00041				29/05/2018 23:00:00	79.00014	2.00151	2508	200	Dan	
148	F8	BON051	BONGO	29/05/2018 23:04:00	78.99997	2.0003				29/05/2018 23:29:00	79.00027	2.00253	2508	200	Dan	
149	F8	CTD039	CTD	29/05/2018 23:42:00	79.00008	2.00223	30/05/2018 00:30:00	79.00006	2.00004	30/05/2018 01:40:00	79.00011	1.99975	2508	2500	Ross	
150	F8	SAPS012	SAPS	29/05/2018 23:44:00	79.00008	2.00193				30/05/2018 02:42:00	79.00012	1.99969	2509		Dougal	Daisy 5m, Kitty 35m, Sophie 50m, Bambi 200m

151	F8	MOC020	MOCNESS	30/05/2018 03:07:00	79.00013	1.98081				30/05/2018 05:29:00	79.00729	1.59365		1000	Bjorg/Carwyn	
152	F8	BON052	BONGO	30/05/2018 06:22:00	78.99998	1.9998				30/05/2018 06:46:00	79.00002	1.99976	2510	200	Geraint	
153	F8	BON053	BONGO	30/05/2018 06:49:00	79.00001	1.99975				30/05/2018 07:12:00	79.00001	1.99968	2508	200	Geraint	
154	F8	MOC021	MOCNESS	30/05/2018 07:29:00	79	1.99333				30/05/2018 09:52:00	79.00967	1.715	2508	1000	Bjorg/Carwyn	
155	F8	CORE021	MEGACORER	30/05/2018 10:47:00	79.00975	1.7156	30/05/2018 11:36:00	79.00004	1.99982	30/05/2018 12:31:00	79.00975	1.7156	2537	2537	Ian	
156	F8	CORE022	MEGACORER	30/05/2018 12:53:00	79.00003	1.99988	30/05/2018 13:46:00	79.00004	1.99985	30/05/2018 14:42:00	79.00003	1.99988	2509	2509	Ian	
157	F8	CORE023	MEGACORER	30/05/2018 15:04:00	79	1.9998	30/05/2018 15:58:00	79.00004	1.99981	30/05/2018 16:50:00	79	1.9998	2509	2509	Ian	
158	F9	CTD040	CTD	30/05/2018 18:37:00	78.99997	0.99981	30/05/2018 18:52:00	78.99997	0.99976	30/05/2018 19:19:00	78.99996	0.99978	2563	700	Jo	
159	HGIV	CTD041	CTD	30/05/2018 22:50:00	79.04837	4.33207	30/05/2018 22:54:00	79.04836	4.33205	30/05/2018 23:05:00	79.04837	4.33199	2458	60	Ross	
160	HGIV	BON054	BONGO	30/05/2018 23:12:00	79.04835	4.33204				30/05/2018 23:37:00	79.04835	4.33201	2548	200	Dan	
161	HGIV	BON055	BONGO	30/05/2018 23:40:00	79.04835	4.33201				31/05/2018 00:03:00	79.04836	4.33204	2548	200	Dan	
162	HGIV	BON056	BONGO	31/05/2018 00:08:00	79.04836	4.33213				31/05/2018 00:31:00	79.04835	4.33218	2548	200	Dan	
163	HGIV	CTD042	CTD	31/05/2018 00:50:00	79.04835	4.33214	31/05/2018 01:37:00	79.04835	4.33212	31/05/2018 02:44:00	79.04836	4.33207	2458	2400	Ross	
164	HGIV	SAPS013	SAPS	31/05/2018 00:53:00	79.04835	4.33205				31/05/2018 03:45:00	79.04834	4.33215	2458		Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 200m.
165	HGIV	MOC022	MOCNESS	31/05/2018 04:34:00	78.98372	4.36598				31/05/2018 07:05:00	78.9362	4.82361	2619	1000	Bjorg/Carwyn	
166	F7	CTD043	CTD	31/05/2018 09:20:00	78.99997	3.33397	31/05/2018 10:19:00	78.99998	3.33351	31/05/2018 11:43:00	78.99999	3.33348	3044	3016	Jo	
167	F6	CTD044	CTD	31/05/2018 14:01:00	79.00003	5.00006	31/05/2018 14:47:00	79.00005	5.00007	31/05/2018 15:55:00	79.00006	5.00018	2436	2437	Jo	
168	F5	CTD045	CTD	31/05/2018 17:30:00	79.00013	5.99927	31/05/2018 18:05:00	79.00015	5.99922	31/05/2018 18:55:00	79.00012	5.99925	1874	1860	Jo	
169	F4	CTD046	CTD	31/05/2018 21:02:00	79.03329	6.99998	31/05/2018 21:07:00	79.03329	7.00006	31/05/2018 21:11:00	79.03328	7.00003	1305	50	Ross	
170	F4	BON057	BONGO	31/05/2018 21:34:00	79.03327	6.99998				31/05/2018 21:59:00	79.03328	7.00004	1304	200	Dan	
171	F4	BON058	BONGO	31/05/2018 22:03:00	79.03328	7.00012				31/05/2018 22:27:00	79.03329	7.00007	1305	200	Dan	
172	F4	BON059	BONGO	31/05/2018 22:30:00	79.03329	7.00008				31/05/2018 22:52:00	79.03328	7.00008	1304	200	Dan	

173	F4	CTD047	CTD	31/05/2018 23:15:00	79.03328	7.00004	31/05/2018 23:41:00	79.03328	7.00004	01/06/2018 00:25:00	79.03327	7.00005	1305	1305	Ross	
174	F4	SAPS014	SAPS	31/05/2018 23:16:00	79.03329	7.00009				01/06/2018 02:41:00	79.03329	7.00009	1305		Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 200m.
175	F4	MOC023	MOCNESS	01/06/2018 02:36:00	79.03385	7.00585				01/06/2018 05:07:00	79.05574	7.4346	1293	1000	Bjorg/Carwyn	
176	F4	BON060	BONGO	01/06/2018 06:01:00	79.033	7.00042				01/06/2018 06:25:00	79.033	7.00042	1304	200	Geraint	
177	F4	BON061	BONGO	01/06/2018 06:28:00	79.033	7				01/06/2018 06:49:00	79.033	7	1304	200	Geraint	
178	F4	MOC024	MOCNESS	01/06/2018 07:07:00	79.0351	7.03443				01/06/2018 09:39:00	79.06651	7.44748	1310	1000	Bjorg/Carwyn	Failed deployment. Nets not opened. End of transect depth 1283m.
179	F4	CORE024	MEGACORER	01/06/2018 10:43:00	79.03312	6.99653	01/06/2018 11:12:00	79.03332	7.00025	01/06/2018 11:46:00	79.03312	6.99653	1305	1305	Ian	
180	F3	CTD048	CTD	01/06/2018 13:41:00	79.03335	8.00019	01/06/2018 14:07:00	79.03334	8.0001	01/06/2018 14:52:00	79.0334	7.99994	1114	1100	Jo	
181	F1	CTD049	CTD	01/06/2018 16:17:00	79.00026	8.66793	01/06/2018 16:26:00	79.00026	8.66786	01/06/2018 16:32:00	79.00025	8.6679	251	230	Jo	
182	F0	CTD050	CTD	01/06/2018 17:32:00	79.0002	9.07443	01/06/2018 17:38:00	79.00021	9.07444	01/06/2018 17:43:00	79.00021	9.07445	197		Jo	No event depth listed.
183	V12	CTD051	CTD	01/06/2018 18:43:00	78.97927	9.48171	01/06/2018 18:50:00	78.97927	9.48169	01/06/2018 18:55:00	78.97927	9.48169	222		Jo	No event depth listed.
184	F2	CTD052	CTD	01/06/2018 21:09:00	79.0333	8.33323	01/06/2018 21:13:00	79.03329	8.33318	01/06/2018 21:17:00	79.03328	8.33325	831	50	Jo	
185	F2	BON062	BONGO	01/06/2018 21:38:00	79.03327	8.3333				01/06/2018 21:58:00	79.03328	8.33328	830	200	Dan	
186	F2	BON063	BONGO	01/06/2018 22:02:00	79.03329	8.33332				01/06/2018 22:24:00	79.03329	8.33334	831	200	Dan	
187	F2	BON064	BONGO	01/06/2018 22:27:00	79.03328	8.33331				01/06/2018 22:50:00	79.03328	8.3333	831	200	Dan	
188	F2	CTD053	CTD	01/06/2018 23:08:00	79.03328	8.33332	01/06/2018 23:27:00	79.03329	8.33341	02/06/2018 00:40:00	79.03327	8.33338	831	820	Ross	
189	F2	SAPS015	SAPS	01/06/2018 23:09:00	79.03329	8.33334				02/06/2018 02:06:00	79.03328	8.33338	831		Dougal	
190	F2	MOC025	MOCNESS	02/06/2018 02:51:00	78.99769	8.25119				02/06/2018 03:15:00	78.98849	8.27157	890	250	Bjorg/Carwyn	Test Deployment. No buckets, no samples. Failed.
191	F3B	CTD054	CTD	02/06/2018 05:02:00	79.03432	7.49755	02/06/2018 05:33:00	79.03429	7.49749	02/06/2018 05:58:00	79.03435	7.49742	1270	1200	Ross	
192	F4B	CTD055	CTD	02/06/2018 07:33:00	79.01661	6.49995	02/06/2018 08:01:00	79.01661	6.49991	02/06/2018 08:34:00	79.01663	6.50212	1366	1300	Ross/Ash	

193	F2	ZP004	ZooNet	02/06/2018 10:37:00	79.03338	8.33338				02/06/2018 11:05:00	79.03338	8.33338	829	200	Elliot/Dave	
194	F2	ZP005	ZooNet	02/06/2018 11:13:00	79.03337	8.33368				02/06/2018 11:41:00	79.03337	8.33368	830	200	Elliot/Dave	
195	F2	GRAB007	DAYGRAB	02/06/2018 11:59:00	79.03333	8.3337	02/06/2018 12:43:00	79.03333	8.3337	02/06/2018 13:16:00	79.03333	8.3337	818	818	Ian	
196	F2	GRAB008	DAYGRAB	02/06/2018 13:55:00	79.02888	8.3338	02/06/2018 14:30:00	79.02888	8.3338	02/06/2018 14:56:00	79.02888	8.3338	828	828	Ian	
197	F2	GRAB009	DAYGRAB	02/06/2018 15:07:00	79.02939	8.3337	02/06/2018 15:49:00	79.02939	8.3337	02/06/2018 16:14:00	79.02939	8.3337	820	820	Ian	
198	F2	GRAB010	DAYGRAB	02/06/2018 16:24:00	79.02888	8.33368	02/06/2018 16:56:00	79.02888	8.33368	02/06/2018 17:24:00	79.02888	8.33368	823	823	Ian	
199	KB0	GRAB011	DAYGRAB	02/06/2018 20:47:00	79.03859	10.82384	02/06/2018 21:03:00	79.0386	10.82398	02/06/2018 21:16:00	79.03856	10.82397	337	337	Ian	
200	KB0	GRAB012	DAYGRAB	02/06/2018 21:28:00	79.03844	10.82464	02/06/2018 21:42:00	79.03843	10.82464	02/06/2018 21:56:00	79.03791	10.82746	335	335	Ian	
201	KB0	CTD056	CTD	02/06/2018 22:22:00	79.03509	10.84316	02/06/2018 22:27:00	79.03509	10.84315	02/06/2018 22:33:00	79.03509	10.84314	315	50	Ross	
202	KB0	BON065	BONGO	02/06/2018 22:42:00	79.03509	10.84309				02/06/2018 23:06:00	79.03509	10.84303	315	200	Dan	
203	KB0	BON066	BONGO	02/06/2018 23:10:00	79.03509	10.84308				02/06/2018 23:33:00	79.03508	10.84304	315	200	Dan	
204	KB0	BON067	BONGO	02/06/2018 23:36:00	79.03508	10.84304				02/06/2018 23:59:00	79.03508	10.84313	316	200	Dan	
205	KB0	CTD057	CTD	03/06/2018 00:14:00	79.03509	10.84303	03/06/2018 00:23:00	79.03509	10.843	03/06/2018 00:25:00	79.03508	10.84316	316	303	Ross	
206	KB0	SAPS016	SAPS	03/06/2018 00:22:00	79.03509	10.84301				03/06/2018 03:06:00	79.03508	10.84319	315		Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 200m.
207	KB1	CTD058	CTD	03/06/2018 04:00:00	79.02435	10.58379	03/06/2018 04:11:00	79.02434	10.58366	03/06/2018 04:23:00	79.02435	10.58369	296	290	Ross	
208	KB2	CTD059	CTD	03/06/2018 05:37:00	79.00151	10.02739	03/06/2018 05:49:00	79.00153	10.02776	03/06/2018 05:56:00	79.00152	10.02776	262	250	Ross	
209	V12	CTD060	CTD	03/06/2018 07:06:00	78.97966	9.48106	03/06/2018 07:15:00	78.97965	9.48094	03/06/2018 07:45:00	78.97965	9.48104	222	211	Ross	
210	V12	BON068	BONGO	03/06/2018 08:03:00	78.97966	9.48109				03/06/2018 08:28:00	78.97965	9.48114	222	200	Geraint	
211	V12	BON069	BONGO	03/06/2018 08:33:00	78.97965	9.48108				03/06/2018 08:58:00	78.97966	9.481	222	200	Geraint	
212	V12	BONO70	BONGO	03/06/2018 09:03:00	78.97966	9.481				03/06/2018 09:24:00	78.97966	9.48102	222	200	Geraint	
213	V12	MOC026	MOCNESS	03/06/2018 09:39:00	78.97695	9.49569				03/06/2018 10:06:00	78.9659	9.55385	223	70	Bjorg/Carwyn	Successful test deployment. No samples taken.

214	ST1	GRAB013	DAYGRAB	04/06/2018 14:03:00	77.41738	19.47865	04/06/2018 14:18:00	77.41738	19.47865	04/06/2018 14:30:00	77.47865	19.47865	149	149	Ian	
215	ST1	CORE025	MEGACORER	04/06/2018 14:49:00	77.41738	19.4787	04/06/2018 15:02:00	77.41738	19.4787	04/06/2018 16:00:00	77.41738	19.4787	149	149	Ian	
216	ST1	CORE026	MEGACORER	04/06/2018 15:38:00	77.41737	19.4787	04/06/2018 15:49:00	77.41737	19.4787	04/06/2018 15:59:00	77.41737	19.4787	149	149	Ian	
217	ST1	CORE027	MEGACORER	04/06/2018 16:34:00	77.41747	19.47872	04/06/2018 16:42:00	77.41747	19.47872	04/06/2018 19:04:00	77.41747	19.478725	148	148	Ian	Issues with winch when starting to recover from bottom. Recovery started at 18:53.
218	ST1	CTD061	CTD	04/06/2018 21:23:00	77.41672	19.50015	04/06/2018 21:29:00	77.41672	19.50014	04/06/2018 21:35:00	77.41672	19.50014	145	50	Ross	
219	ST1	BON071	BONGO	04/06/2018 21:50:00	77.41674	19.50015				04/06/2018 22:04:00	77.41674	19.50012	145	100	Dan/Flo	
220	ST1	BON072	BONGO	04/06/2018 22:08:00	77.41674	19.50013				04/06/2018 22:19:00	77.41673	19.50014	145	100	Dan/Flo	
221	ST1	BON073	BONGO	04/06/2018 22:23:00	77.41674	19.50012				04/06/2018 22:35:00	77.41673	19.50011	145	100	Dan/Flo	
222	ST1	BON074	BONGO	04/06/2018 22:38:00	77.41673	19.50009				04/06/2018 22:57:00	77.41673	19.5001	145	100	Dan/Flo	
223	ST1	CTD062	CTD	04/06/2018 23:03:00	77.41674	19.50012	04/06/2018 23:09:00	77.41675	19.50014	04/06/2018 23:31:00	77.41673	19.50012	146	140	Ross	
224	ST1	SAPS017	SAPS	04/06/2018 23:08:00	77.41674	19.50014				05/06/2018 01:54:00	77.41673	19.50017			Dougal	Daisy 5m, Kitty 25m, Sophie 75m, Bambi 100m
225	ST1	BON075	BONGO	05/06/2018 01:05:00	77.41672	19.50016				05/06/2018 01:20:00	77.41681	19.49983	145	100	Dan	
226	ST1	MOC027	MOCNESS	05/06/2018 02:54:00	77.365	19.34878				05/06/2018 03:50:00	77.39472	19.42389	149	100	Bjorg/Carwyn	
227	ST1	BON076	BONGO	05/06/2018 04:21:00	77.4167	19.49954				05/06/2018 04:35:00	77.41669	19.49958	146	100	Geraint	
228	ST1	BON077	BONGO	05/06/2018 04:37:00	77.41668	19.49959				05/06/2018 04:50:00	77.41669	19.49963	146	100	Geraint	
229	ST1	MOC028	MOCNESS	05/06/2018 05:43:00	77.365	19.355				05/06/2018 06:41:00	77.39513	19.42424	150	100	Bjorg/Carwyn	
230	ST2	CTD063	CTD	05/06/2018 09:42:00	77.12503	19.50003	05/06/2018 09:50:00	77.12503	19.50003	05/06/2018 10:01:00	77.12503	19.50003	155	130	Jo	
231	ST2a	CTD064	CTD	05/06/2018 13:03:00	77.125	17.63302	05/06/2018 13:12:00	77.125	17.63302	05/06/2018 13:22:00	77.125	17.63302	88	75	Jo	
232	ST2b	CTD065	CTD	05/06/2018 14:25:00	77.12603	18.09495	05/06/2018 14:33:00	77.12603	18.09495	05/06/2018 14:44:00	77.12603	18.09495	116	96	Jo	
233	ST2c	CTD066	CTD	05/06/2018 15:51:00	77.12468	18.54978	05/06/2018 15:58:00	77.12468	18.54978	05/06/2018 16:05:00	77.12468	18.54978	64	43	Jo	

234	ST2d	CTD067	CTD	05/06/2018 17:08:00	77.12487	19.02615	05/06/2018 17:16:00	77.12487	19.02615	05/06/2018 17:24:00	77.12487	19.02615	139	121	Jo	
235	ST2	CTD068	CTD	05/06/2018 18:25:00	77.12502	19.50002	05/06/2018 18:41:00	77.12502	19.50002	05/06/2018 18:47:00	77.12502	19.5002	156	133	Jo	
236	ST2e	CTD069	CTD	05/06/2018 19:48:00	77.125	19.96671	05/06/2018 19:52:00	77.125	19.96671	05/06/2018 19:58:00	77.125	19.396671	112	95	Jo	
237	ST2f	CTD070	CTD	05/06/2018 20:55:00	77.12517	20.37023	05/06/2018 21:00:00	77.12517	20.37023	05/06/2018 21:07:00	77.12517	20.37023	116	97	Jo	
238	ST2g	CTD071	CTD	05/06/2018 22:01:00	77.12498	20.74961	05/06/2018 22:05:00	77.12498	20.7496	05/06/2018 22:13:00	77.12499	20.74962	88	67	Jo	
239	B10	CTD072	CTD	06/06/2018 21:20:00	76.00001	10.66649	06/06/2018 22:04:00	76.00005	10.66662	06/06/2018 23:08:00	76.00004	10.66656	2260	2200	Ross	

16. Datasets

Datasets	Logging	Digital Data	Long Term Data Management (DMP) British Oceanographic Data Centre (BODC) Polar Data Centre (PDC)	Person Responsible	Team	Comments
Underway (Nav, Met, Surf)	n/a	Raw/Processed data files	Raw Data (PDC), Processed Data (BODC)	Jo (Uni. Liv)		
Underway salinity calibration	Paper Logshseet/Digital Event Log (Aiden, Sarah)		BODC	Dougal (NMF), Sarah (BODC), Aiden (Uni. Strath)		Underway TSG sensor salinity data calibrated against samples collected and analysed with the bench salinometer (Autosal). Samples collected by Aiden and Sarah. Files produced from the autosal
EK60	n/a	Digital Event Log. Raw data no plans for processing	Raw Data (PDC)	Geraint (BAS)		
ADCP	n/a	Raw - no plans for processing?	Raw Data (PDC),	Jo (Uni. Liv)		

			Processed Data (BODC)			
CTD	Paper Logsheets (Ross/CTD Technician), CTD Bottle samples (Louisa)	Raw .btl and .cnv files - Processed .mat	Raw Data (PDC), Processed Data (BODC)	Jo (Uni. Liv)		
CTD salinity calibration	CTD bottle sample paper logsheet	Data held on I:drive	BODC	Dougal NMF Technician		Samples collected by Louisa/Jo for CTD salinity calibration. Analysed in the Autosal - files will be generated from the autosal for each crate.
d15N, DIC, 13cDIC, silicate isotopes, opal from CTD water samples			BODC	Celeste/Robyn (Uni. Edin)	ARISE	
POM bulk isotopes analysis from CTD water samples			BODC	Camile (Uni. Liv)	ARISE	
CDOM, d180, salinity, alkalinity (?) from CTD water samples			BODC	Torgeir (NPI)	ARISE (Project Partner)	Due to limited equipment, alkalinity may or may not be tested.
Nutrient analyses from CTD water samples (silicate, nitrate, nitrite, ammonium, phospate)			BODC	Rich (SAMS)	DIAPOD	All samples measured on-board using a Lachet Auto analyser
CTD water sample dissolved oxygen winkler titrations			BODC	Debbie (SAMS), Sarah R (SAMS)	DIAPOD	All analysis will be done on-board Metrohm 848 autotitrator.
Chla, POCs, phytoplankton, cocalithopores and flow			BODC	Elaine (SAMS)	DIAPOD	Samples will be processed back at the lab. Water samples taken from full depth/shallow depth

cytometry CTD water samples						
Fatty acids and pigments CTD water samples			BODC	David (SAMS), Sarah R (SAMS)	DIAPOD	Samples will be taken at the surface and the chl max.
LADCP	n/a - same as CTD	Raw .000 and processed .lad files	Raw Data (PDC), Processed Data (BODC)	Jo (Uni. Liv)	ARISE	
SAPS	Paper Logsheets (Dougal)	Raw file. Data held on L:drive	Raw Data (BODC)	Dougal (NMF), Camille (Uni. Liv)	ARISE	Raw files with sensor data, Camille will analyse filters. SAPS logsheet will be scanned by Dougal and hard copies will come to BODC.
POM for compound specific isotopes from SAPS water samples			BODC	Camile (Uni. Liv)	ARISE	
Megacorer	Paper Logsheets (Louisa)			Ian (NMF), Emma (Uni. Liv), Louisa (Uni. Liv)	ARISE	
Stable isotope analysis from sediment cores			BODC	Emma (Uni. Liv)	ARISE	Approximate 4 sediment cores to be taken from each megacore, sliced and frozen for stable isotope analysis.
Bongo	Paper logsheets (UIC), Digital Event Logs (Geraint)		PDC	AME/Geraint	DIAPOD/ARISE	
MOCNESS	Paper logsheets (Geraint), Digital Event Logs (Geraint)		PDC	AME/Geraint	DIAPOD/ARISE	

Zooplankton samples from bongo nets picking and size fractioning for calanus and stable isotopes, compound specific analysis			BODC/PDC	Elliot (Uni. Liv)	ARISE	Samples will be frozen and at 1 station a preservation test will be completed.
Calanus samples from bongo and mocness for respiration experiments at depth			PDC	Vicky (BAS)	DIAPOD	
Collection of individual calanus for carbon and nitrogen analyses frozen at -80 degrees.			PDC	Geraint (BAS)	DIAPOD	
Species composition analysis preserved in formalin from bongo and mocness samples			PDC	Geraint (BAS)	DIAPOD	
Zooplankton physiology respiration rate experiment measuring carbon, nitrogren and lipids using specimens from bongo net samples.			PDC	Claudia (SAMS)	DIAPOD	Time series experiment over 5 days to see the impact of temperature gradients and food deprivation against zooplankton
Zooplankton Calanus grazing (Cell count samples)			PDC	Holly (NOC)	DIAPOD	Preserved calanus samples to be taken back to NOC.
Zooplankton Calanus egg production (Ethanol for genetic identification)			PDC	Flo (NOC)	DIAPOD	Preserved calanus samples to be taken back to NOC.
Calanus metabonics picking and freezing (metabolom)			PDC		DIAPOD	Preserved calanus samples to be taken back to NOC.

17.Cruise Summary Report

CRUISE SUMMARY REPORT	FOR COLLATING CENTRE USE **Centre: BODC Ref. No.:** Is data exchange restricted ☐ Yes ☐ In part ☐ No

SHIP enter the full name and international radio call sign of the ship from which the data were collected, and indicate the type of ship, for example, research ship; ship of opportunity, naval survey vessel; etc.

Name: RRS James Clark Ross **Call Sign:** ZDLP

enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate).

Type of ship: Research Ship

CRUISE NO. / NAME JR17005

CRUISE PERIOD start 08/05/2018 to 08/06/2018 end

(set sail) **day/ month/ year** **day/ month/ year** **(return to port)**

PORT OF DEPARTURE (enter name and country) Immingham, UK

PORT OF RETURN (enter name and country) Longyearbyen, Svalbard

RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coordinating the scientific planning of the cruise

Name: Dr. David Pond

Address: University of Stirling

Country: United Kingdom

CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise.

Prof. Dr. David Pond, University of Stirling

OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so

as to provide the context in which the report data were collected.

The activities associated with research cruise JR17005 cover two NERC Changing Arctic Ocean projects: DIAPOD and ARISE Research summary for DIAPOD: Copepod species of the genus Calanus (Calanus hereafter) are rice grain size crustaceans that occur throughout the Arctic Ocean consuming enormous quantities of phytoplankton. These tiny animals represent the primary food source for many Arctic fish,seabirds and whales. During early spring, they gorge on extensive seasonal blooms of diatoms, fatrich phytoplankton that proliferates both beneath the sea ice and in the open ocean. This allows Calanus to rapidly obtain sufficient fate to survive during the many months of food scarcity during the Arctic winter. Diatoms also produce on the the main marine omega3 polyunsaturated fatty acids that Calanus require to successfully survive and reproduce in the frozen Arctic waters. Calanus seasonally migrate into deep waters to save energy and reduce their losses to predation in an overwintering process called diapause that is fuelled entirely by carbon rich fat (lipids). This vertical lipid pump transfers vast quantities of carbon in the oceans interior and ultimate presents the drawdown of atmospheric carbon dioxide. Continued global warming throughout the 21st century is expected to exert a strong influence on the timing, magnitude and spatial distribution of diatom productivity in the Arctic Ocean. Little is known about how Calanus will respond to these changes, making it difficult to understand how the wider Arctic ecosystem and its biogeochemistry will be affected by climate change. The overarching goal of this project is to develop a predictive understanding of how Calanus in the Arctic will be affected by future climate change. Research summary for ARISE: Due to unprecedented rates of environmental change, the Arctic is now a crucible of multiple concurrent stressors. A reduction in sea ice concentrations is increasing the persistence and distribution of open water. Along with enhanced warming and riverine inputs, the Arctic is becoming more stratified, causing an alteration in vertical nutrient fluxes. Overall, Arctic primary productivity has increased by 30% over the past decade and there have been regional changes to phytoplankton community size structure and diversity at the base of the food web. We currently don't know how sensitive food webs are to alterations at the base of the food web and thus their spatial and temporal response to these multiple environmental stressors. The overarching goal of this project is to develop a new framework using observations, novel biomarkers and modelling to allow us to detect change in Arctic ecosystems. Rather than characterize the entire ecosystem, we will focus on the base of the food web and two pelagic feeding predators, the harp seal and the ringed seal, both considered as excellent indicator species. During NERC cruises, we will characterize the variability observed at the base of the food web in consideration of gradients in the environment due to sea ice, shelf versus open water and different water masses.

At each station, a series of activities were undertaken to provide samples to address the objectives of both DIAPOD and ARISE. Specifically, for DIAPOD, a series of nets (including Bongo opening closing, Mocness and ring nets) will be deployed to different depth horizons to study the depth distribution of Calanus and collect specimens for identification, lipids and determination of key metabolic rates (e.g. respiration and grazing). Subsamples of Calanus were collected for ARISE for biomarker analysis. CTD deployments collected complimentary data on phytoplankton biomass and community structure. A second full depth CTD was used to determine the vertical profile in stable isotopes of dissolved and particulate material, focusing on water mass end members and key oceanographic features. Standalone pumps collected large quantities of particulate material for biomarker analysis. Finally, a megacorer will be deployed to collect a sediment core to quantify the influence of terrestrial material on the Arctic marine ecosystem.

PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition), then enter the name of the project, and of organisation responsible for co-ordinating the project.

Project name: Changing Arctic Ocean

Coordinating body: Natural Environment Research Council (NERC), UK

PRINCIPAL INVESTIGATORS: Enter the **name**, **organisational affiliation** and **email address** of the Principal Investigators responsible for the data collected on the cruise and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pages 2 and 3, under the column heading 'PI', to identify the data sets for which they are responsible)

David Pond

Geraint Tarling

Dan Mayor

Claudia Castellani

Debra Brennan

Elaine Mitchell

Victoria Fowler

Richard Able

Joanne Hopkins

Emma Burns

Louisa Norman

Celeste Kellock

Camille de la Vega

Robyn Tuerena

Elliot Price

Torgeir Blaesterdalen

Dougal Mountfield

Ross Sanders

Holly Jenkins

Florence Atherden

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section

may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI	APPROXIMATE POSITION						DATA TYPE	DESCRIPTION
	LATITUDE			LONGITUDE				Identify, as appropriate, the nature of the instrumentation the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any identifiers given to the site.
See top of page.	deg	min	N/S	deg	min	E/W	enter code(s) from list on last page.	
								Please continue on separate sheet if necessary

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the cruise, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) BT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO, UNITS : for each data set, enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

PI	NO	UNITS	DATA TYPE	DESCRIPTION

see page 2	see above	see above	Enter code(s) from list on last page	Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e. g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
I	29	Days	D90	Underway Navigation
I	29	Days	M06	Underway Meteorology (Wind speed/direction, air pressure, humidity, air temperature, PAR, TIR sensors)
I	26	Days	H71	Underway Surface Hydrography (temperature, salinity, chlorophyll-a fluorescence, transmission)
I/Q	37	Samples	H71	Underway Salinity Calibration
I	29	Days	D71	Vessel Mounted ADCP
B	29	Days	B28	EK60
I	72	Casts	H10	CTD profiles (temperature, salinity, PAR, Oxygen, Chlorophyll-a, transmission)
I	71	Casts	D71	Lowered ADCP casts
I/Q	171	Samples	H09	CTD salinity calibration
N/L	18	Stations	H32, H26	CTD water samples: d15N, DIC, silicate isotopes and opal
P	18	Stations	H27, H32	CTD water samples: CDOM, d180, salinity and alkalinity
F	28	Stations	B71, B02, B08	CTD water samples: Chlorophyl-a, POCs, Phytoplankton, Cocalithopores and flow cytometry
A		Stations	B02, B72	CTD water samples: Fatty acids and pigments
H	34	Stations	H22, H24, H25, H26, H90	CTD water samples: Nutrient Analyses (silicate, nitrate, nitrite, ammonium, phosphate)
E	34	Stations	H21	CTD water samples: Dissolved Oxygen Titrations
M	18	Stations	B71, H32	CTD water samples: POM bulk isotope analysis
Q	17	Stations	D90	Stand Alone Pumps (SAPS) deployed at four depths at each station between surface and 300m.

M	17	Samples	B71	POM for compound specific isotopes from SAPS water samples
J	40	Station	G02, G03, G04	Megacorer and grab deployments for sediment sampling
J	44	Cores	H32	Sediment cores for stable isotope analysis
B/C	77	Stations	B09	Bongo net deployments for collection of zooplankton
B	28	Stations	B09	Mocness net deployments for collection of zooplankton
A	5	Stations	B09	Zooplankton ring net deployments for collection of zooplankton
O		Stations	B09	Zooplankton nets (Bongo) for picking and size fractioning of Calanus and stable isotopes, compound and specific analysis.
G		Stations	B09	Zooplankton nets (Bongo/Mocness) to collect Calanus specimens for respiration experiments at depth
B		Stations	B09	Zooplankton nets to (Bongo/Mocness) collect individual Calanus for Carbon and Nitrogen analyses frozen at -80 degrees.
B		Stations	B09	Zooplankton nets to collect specimens for species composition analysis
D		Stations	B09	Zooplankton nets (Bongo) to collect specimens for physiology respiration rate experiment measuring carbon, nitrogen and lipids
C/S	5	Stations	B09	Zooplankton nets (Bongo) to collect specimens for Calanus grazing experiments
C/T	16	Stations	B09, B13	Zooplankton nets (Bongo) to collect specimens for Calanus egg production rates
C	16	Stations	B09	Zooplankton nets (Bongo) to collect Calanus specimens for metabolonics
R	1	Days	G74	Opportunistic Swath Baythymetry data from EM122 multibeam echsounder
				Please continue on separate sheet if necessary

TRACK CHART: You are strongly encouraged to submit, with the completed report, an annotated track chart illustrating the route followed and the points where measurements were taken.	Insert a tick(✔) in **this box if a track chart is supplied**	☐

GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

Fram Strait, Arctic

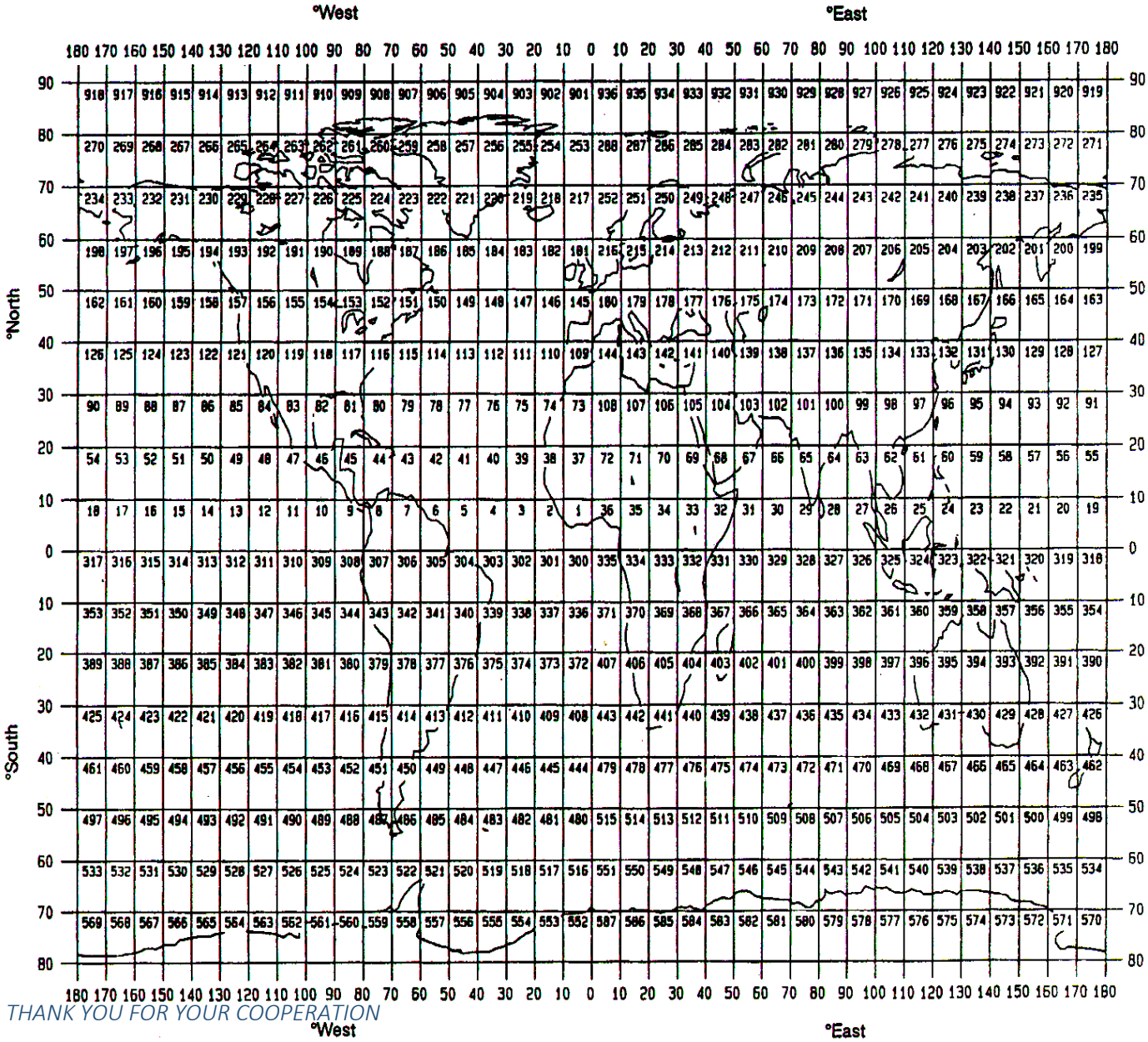
SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea, then enter a description of the area(s). Such descriptions may include references to local geographic areas, to sea floor features, or to geographic coordinates.

Please insert here the number of each square in which data were collected from the below given chart

901, 936, 253, 288

see above

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



THANK YOU FOR YOUR COOPERATION

PARAMETER CODES

METEOROLOGY

M01	Upper air observations
M02	Incident radiation
M05	Occasional standard measurements
M06	Routine standard measurements
M71	Atmospheric chemistry
M90	Other meteorological measurements

PHYSICAL OCEANOGRAPHY

H71	Surface measurements underway (T,S)
H13	Bathythermograph
H09	Water bottle stations
H10	CTD stations
H11	Subsurface measurements underway (T,S)
H72	Thermistor chain
H16	Transparency (eg transmissometer)
H17	Optics (eg underwater light levels)
H73	Geochemical tracers (eg freons)
D01	Current meters
D71	Current profiler (eg ADCP)
D03	Currents measured from ship drift
D04	GEK
D05	Surface drifters/drifting buoys
D06	Neutrally buoyant floats
D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY

H21	Oxygen
H74	Carbon dioxide
H33	Other dissolved gases
H22	Phosphate
H23	Total - P
H24	Nitrate
H25	Nitrite
H75	Total - N
H76	Ammonia
H26	Silicate
H27	Alkalinity
H28	PH
H30	Trace elements
H31	Radioactivity
H32	Isotopes
H90	Other chemical oceanographic measurements

MARINE CONTAMINANTS/POLLUTION

P01	Suspended matter
P02	Trace metals
P03	Petroleum residues
P04	Chlorinated hydrocarbons
P05	Other dissolved substances
P12	Bottom deposits
P13	Contaminants in organisms
P90	Other contaminant measurements

MARINE BIOLOGY/FISHERIES

B01	Primary productivity
B02	Phytoplankton pigments (eg chlorophyll, fluorescence)
B71	Particulate organic matter (inc POC, PON)
B06	Dissolved organic matter (inc DOC)
B72	Biochemical measurements (eg lipids, amino acids)
B73	Sediment traps
B08	Phytoplankton
B09	Zooplankton
B03	Seston
B10	Neuston
B11	Nekton
B13	Eggs & larvae
B07	Pelagic bacteria/micro-organisms
B16	Benthic bacteria/micro-organisms
B17	Phytobenthos
B18	Zoobenthos
B25	Birds
B26	Mammals & reptiles
B14	Pelagic fish
B19	Demersal fish
B20	Molluscs
B21	Crustaceans
B28	Acoustic reflection on marine organisms
B37	Taggings
B64	Gear research
B65	Exploratory fishing
B90	Other biological/fisheries measurements

MARINE GEOLOGY/GEOPHYSICS

G01	Dredge
G02	Grab
G03	Core - rock
G04	Core - soft bottom
G08	Bottom photography
G71	In-situ seafloor measurement/sampling
G72	Geophysical measurements made at depth
G73	Single-beam echosounding
G74	Multi-beam echosounding
G24	Long/short range side scan sonar
G75	Single channel seismic reflection
G76	Multichannel seismic reflection
G26	Seismic refraction
G27	Gravity measurements
G28	Magnetic measurements
G90	Other geological/geophysical measurements

18. Relevant Datasets Collected from Data Management Plan (DMP)

DIAPOD								
Dataset Description	**Contact**	**Data Volume**	**Data Format**	**Issues**	**Delivery Date**	**Embargo Date**	**Reuse Scenario**	**Preservation Plan**
CTD profiles from 2018 and 2019 cruises (3 cruises)	Geraint Tarling (BAS)	600MB	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Underway navigation from 2018, 2019 cruises (2 cruises)	David Pond (SAMS)	700MB/cruise	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Underway meteorology from 2018, 2019 cruises (2 cruises)	David Pond (SAMS)	700MB/cruise	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Underway surface hydrography from 2018, 2019 cruises (2 cruises)	David Pond (SAMS)	700MB/cruise	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Microplankton samples from water samples	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely, datasets to be held at BAS-PDC
Chlorophyll a, POC/PON, fatty acids and pigments from water samples	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Net deployments from 2018 and 2019 cruises (3 cruises)	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely, datasets to be held at BAS-PDC
Genetics for Calanus samples	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC, copy to be sent to GENBANK?
Respiration rates for	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or	Within six months	2 years after	Incorporation into existing databases for	Keep indefinitely, datasets to

Calanus species				retention issues	of end of cruise	end of cruise	oceanographic measurements	be held at BAS-PDC
Copepod lipids and biomarker composition	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely, datasets to be held at BAS-PDC
Lipid studies in zooplankton from samples collected in the 2018 and 2019 cruises (3 cruises)	Daniel Mayor (NOCS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely, datasets to be held at BAS-PDC
Molecular identification of zooplankton	Geraint Tarling (BAS)	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely, datasets to be held at BAS-PDC
ARISE								
Dataset Description	**Contact**	**Data Volume**	**Data Format**	**Issues**	**Delivery Date**	**Embargo Date**	**Reuse Scenario**	**Preservation Plan**
CTD profiles from 2017, 2018 cruises (2 cruises)	Jo Hopkins (NOCL)	600MB	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Underway navigation from 2017, 2018 cruises (2 cruises)	Jo Hopkins (NOCL)	700MB/cruise	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Underway surface hydrography from 2017, 2018 cruises (2 cruises)	Jo Hopkins (NOCL)	700MB/cruise	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Underway meteorology from 2017, 2018 cruises (2 cruises)	Jo Hopkins (NOCL)	700MB/cruise	Netcdf/matlab	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Stable nitrogen and carbon isotopes waters samples from 2017, 2018 and 2019 cruises (5 cruises)	Claire Francois and Grange	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC

Stable nitrogen and carbon isotopes and biomarkers particle samples from 2017, 2018 and 2019 cruises (5 cruises)	Francois and Grange	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely at BODC
Stable nitrogen and carbon isotopes, biomarker content and molecular data from zooplankton from 2017 and 2018 cruises	Francois and Grange	<5MB	Excel	No legal, access, ethical or retention issues	Within six months of end of cruise	2 years after end of cruise	Incorporation into existing databases for oceanographic measurements	Keep indefinitely, datasets to be held at BAS-PDC