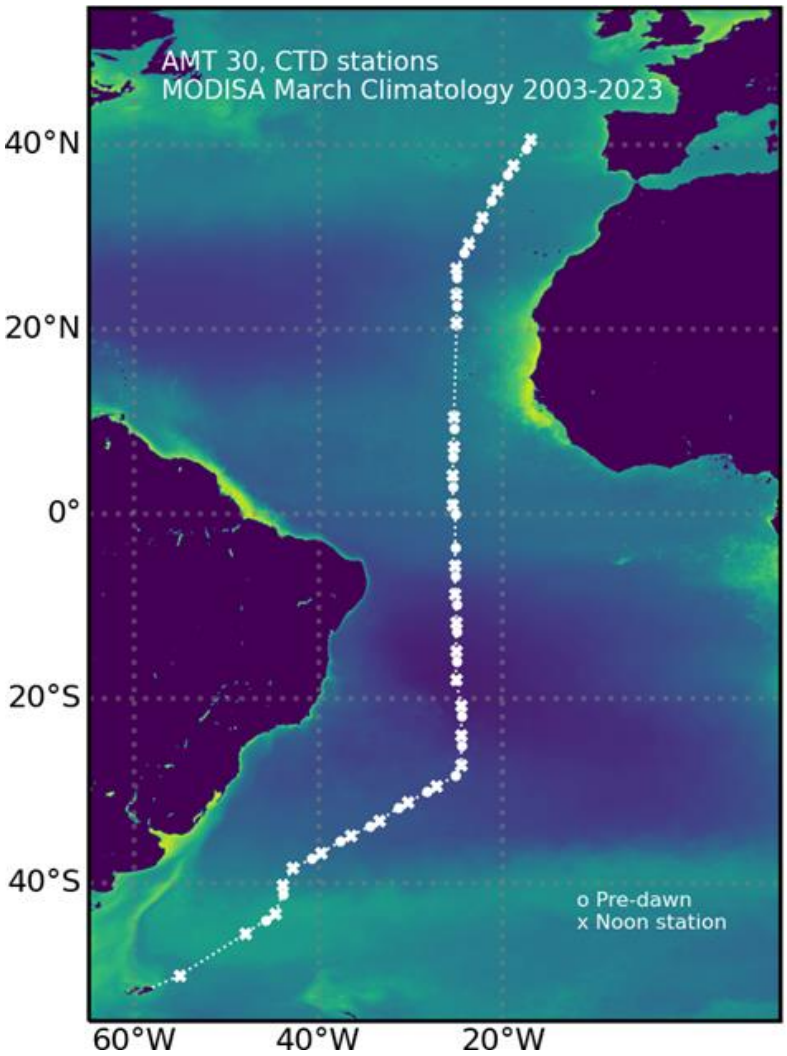
AMT 30 Cruise Report



RRS Discovery (DY157)

(20th February – 30th March 2023)

Chief Scientist: Andy Rees
Plymouth Marine Laboratory

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(Front cover image courtesy of Joaquin Chaves, NASA)

Overview

In a break with tradition the 30th AMT cruise, the first since the COVID pandemic hit in 2020, departed Port Stanley on the 20th February 2023 and headed north, arriving in Southampton on 30th March. Onboard were teams from Plymouth Marine Laboratory, the National Oceanography Centre, UK Universities of Exeter, Heriot-Watt, East Anglia, Liverpool and Oxford, the Scottish Association for Marine Science, National Aeronautics and Space Administration, Michigan State University, University of Lisbon, Centre for Scientific Research and Higher Education of Ensenada and the University of Pretoria. Operations onboard included the measurement of core AMT variables in the maintenance of the now 28 year time series; Optical and atmospheric observations in support of NASA and the European Space Agency satellites; Deployment of 14 ARGO floats for the UK MetOffice and the NOC; and the recovery of the NOC - SOG sediment trap mooring in the South Atlantic gyre. AMT's oceanography training program continued with places occupied by six PhD students from UK, US and South African universities alongside opportunities provided by POGO in the sponsorship of a research fellow from Mexico.

The whole of the scientific complement would like to extend their gratitude to Captain Stewart Mackay and his officers and crew who supported our activities throughout with dedication and extreme professionalism. Our thanks are also extended to the team from NMF (Tom Ballinger, Andy Cotmore and Nick Harker) who ensured the delivery of all scientific activities My particular thanks as always to Glen Tarran and Christina Devereux who assisted in ways too numerous to mention here.

Now in its 28th year the AMT is a multidisciplinary program which undertakes biological, chemical and physical oceanographic research during an annual voyage throughout the Atlantic Ocean.

AMT objectives have evolved to enable the maintenance of a continuous set of observations, whilst addressing global issues that are raised throughout the most recent IPCC assessment and UK environmental strategy. AMT objectives are to:

(1) quantify the nature and causes of ecological and biogeochemical variability in planktonic ecosystems;

(2) quantify the effects of this variability on nutrient cycling, on biogenic export and on air-sea exchange of climate active gases;

(3) construct a multi-decadal, multidisciplinary ocean time-series which is integrated within a wider "Pole-to-pole" observatory concept;

(4) provide essential sea-truth validation for current and next generation satellite missions;

(5) provide essential data for global ecosystem model development and validation and;

(6) provide a valuable, highly sought after training arena for the next generation of UK and International oceanographers.

(Photo credit Gavin Tilstone)

Dr A.P. Rees

Plymouth Marine Laboratory
September 2023

Cruise Participants

Andy Rees (Chief Scientist)

Plymouth Marine Laboratory

Andreia Tracana (Phytoplankton)

University of Lisbon

Adam Francis (Organic nutrients)

Scottish Association for Marine Science

Dan Mayor (Zooplankton)

University of Exeter

Tzu Hao Wang (Th isotopes)

University of Oxford

Eloise Savineau (Zooplankton)

University of Southampton

Federico Ienna (Optics)

University of Lisbon

Gavin Tilstone (Optics/Primary production)

Plymouth Marine Laboratory

Glen Tarran (Microbial plankton)

Plymouth Marine Laboratory

Harrison Smith (Bio-optics)

NASA

Ian Brown (Carbon chemistry)

Plymouth Marine Laboratory

Jack Williams (Particle export)

University of Southampton

Joaquin Chaves (Bio-optics)

NASA

John Gittings (Optics)

University of Athens

Kathryn Cook (Zooplankton)

University of Exeter

Kirsten Fentzke (Iodine uptake)

Michigan State University

Marika Takeuchi (Particle export)

National Oceanography Centre

Mayibongwe Buthelezi (DMS cycling)

University of Pretoria

Mojtaba Masoudi (Particle export)

National Oceanography Centre

Philippa Rickard (Surface micro-layer)

Herriot Watt University

Prima Anugerahanti (Zooplankton)

University of Liverpool

Rachel Shelley (Atmospheric deposition)

University of East Anglia

Roseanna Wright (Data Manager)

British Oceanographic Data Centre

Sarah Breimann (Nutrients)

Plymouth Marine Laboratory

Will Major
(Particle export)

National Oceanography Centre

Yessica Contreras Pacheco
(POGO Fellow)

CICESE, Mexico

National Marine Facilities Technicians

Tom Ballinger
(Lead Tech – Instrumentation)

Andy Cotmore
(Ocean Engineering)

Nick Harker
(Computing)

Ship's Officers

Captain - Stewart

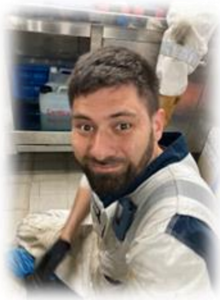
C/O - Andy

2/O - Graham

3/O - Rachel

C/E - Gary

2/E - Del



3/E - Jon

3/E - Dan

ETO - Charles

Purser - Graham

Ship's Crew

CPO(S) - Steve

CPO(D) - Stuart

PO(S) - Grant

PO(D) - Ryan

A/B - Neil

A/B - Harry

A/B - Terry

ERPO - Paul

Head Chef - Peter

Chef - Peter

Steward - Tina

A/Steward - Kevin

CTD and underway sensor calibrations

Roseanna Wright
British Oceanographic Data Centre

Cruise Objectives
In total, 56 CTD casts along the cruise transect were deployed to obtain profiles of the water column from a range of sensors. All casts were conventional profiling casts with 24 x 20L Ocean Test Equipment (OTE) Niskin bottles for sampling water. CTD's were deployed pre-dawn at ~05:00 and noon ~15:00 UTC (~03:30 and ~12:00 ship time) each day, from 23rd February 2023 until 26th March 2023. The CTDs profiled down to 500 metres depth twice a day. Sensors on the CTD included pressure, temperature, conductivity, oxygen, fluorescence, PAR (Photosynthetically Active Radiation), turbidity, transmittance and attenuation.

Methods
The Sea-Bird data collection software Seasave-Win32 recorded the raw data output from the CTD casts. Processing the raw data occurred daily, following the BODC recommended guidelines using SBE Data Processing-Win32 v7.26.7.1. Outlined below are the processing routines used to convert the raw CTD data into CNV files, each routine is named after each stage in brackets < >.
Conversion of the raw binary Sea-Bird files to ASCII files (CNV) containing the 24 Hz data for up and down casts <DatCnv>. Generation of bottle files for each cast containing the mean values of all the variables at the time of bottle firing events <Bottle Summary>. Using the CNV files processing routines were applied to remove pressure spikes <WildEdit>. Following this the oxygen sensor was then shifted relative to the pressure by 2 seconds, to compensate for the lag in the sensor response time <AlignCTD> and the effect of thermal 'inertia' on the conductivity cells was removed <CellTM>. The surface soak for each cast was identified using <SeaPlot> and removed manually using a text editor. <LoopEdit> was run to mark scans with a bad flag wherever there was a pressure slowdown or reversal. Salinity and oxygen concentration were re-derived and density (sigma-theta) values were derived <Derive> after the corrections for sensor lag and thermal 'inertia' had been applied. The CTD files produced from Sea-Bird processing were converted from 24 Hz ascii files into 1 dbar downcast files for calibration and visualisation on-board <BinAverage>. Removal of the initial salinity and oxygen channels produced at the DatCnv stage, along with the conductivity, voltage and altimeter channels from the 1-dbar downcast files <Strip>.

Collation of the sensor values at bottle firing generated by the <Bottle Summary> routine formed the dataset for calibrating the two CTD salinity sensors and oxygen sensor against discrete bench salinometer measurements and oxygen Winkler measurements, respectively. The fluorometer sensor will be calibrated post-cruise using AC-9 data calibrated against HPLC data.

To generate a calibration, an offset between the discrete water sample measurement (salinity) and the nominal value from the sensor at bottle firing was calculated. Outliers were identified using plots of offset against the discrete sample values and a linear regression was applied.

Where the regression was strong and significant the calibration equation was derived by rearranging the regression equation:

Offset = a * Discrete sample + b

Where offset = Discrete sample – Sensor value

To give Calibrated value = 1/(1-a) * Sensor value + b/(1-a)

Where the regression was not significant or did not improve the dataset, the mean value of the offset was applied.

All provisional calibration datasets will be checked and confirmed once back at BODC. Calibration datasets are available upon request from BODC post cruise.

Provisional Results

- Temperature

There were no independent measurements of temperature made during the cruise and the two CTD temperature sensors on the rig returned consistent data. There was no further calibration of these sensors. Fig 1. below shows the section plot of the primary temperature sensor along the cruise track.

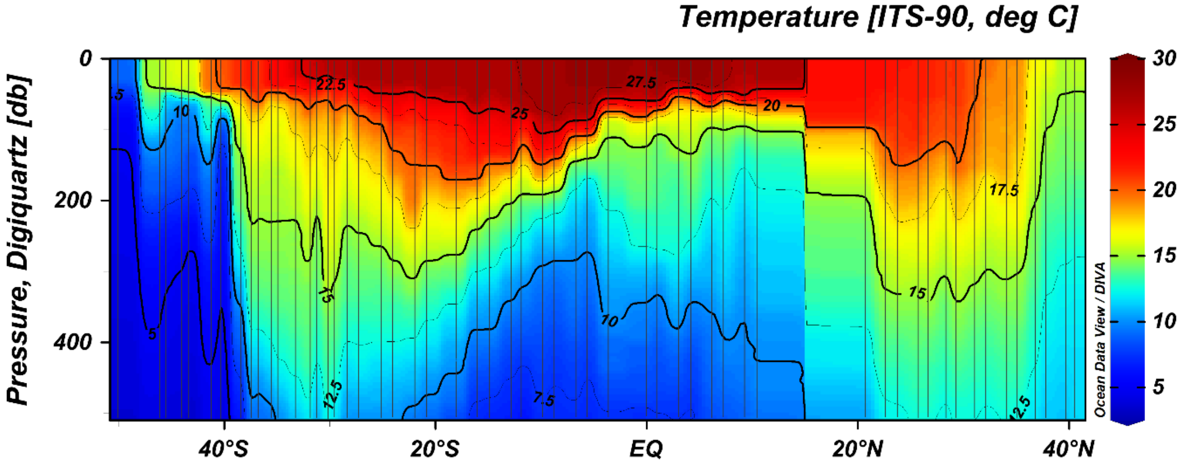


Fig. 1: Temperature section plot along the AMT30 transect by latitude (approximately 50 deg S – 40 deg N) from the primary temperature sensor, located on the CTD vane.

- Salinity

The salinity channels were calibrated against bench salinometer measurements from four samples collected from each CTD cast. Further details of these measurements can be found in the salinity sampling cruise report section.

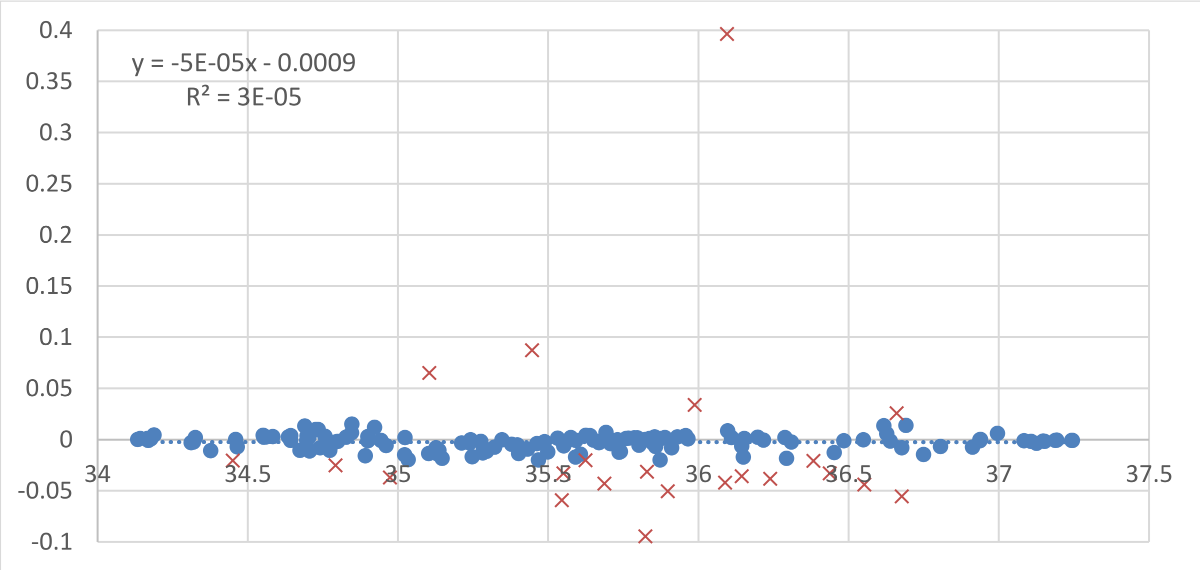


Fig. 2: Salinity offsets for the primary salinity sensor against discrete sample salinity measured with a bench salinometer.

For salinity sensor 1, there was no significant relationship between bench salinity and offset (n = 185; $r^2 = 0.0007$; p = > 0.05). Therefore, the mean offset was applied.

Calibrated primary salinity = uncalibrated salinity - 0.002645946

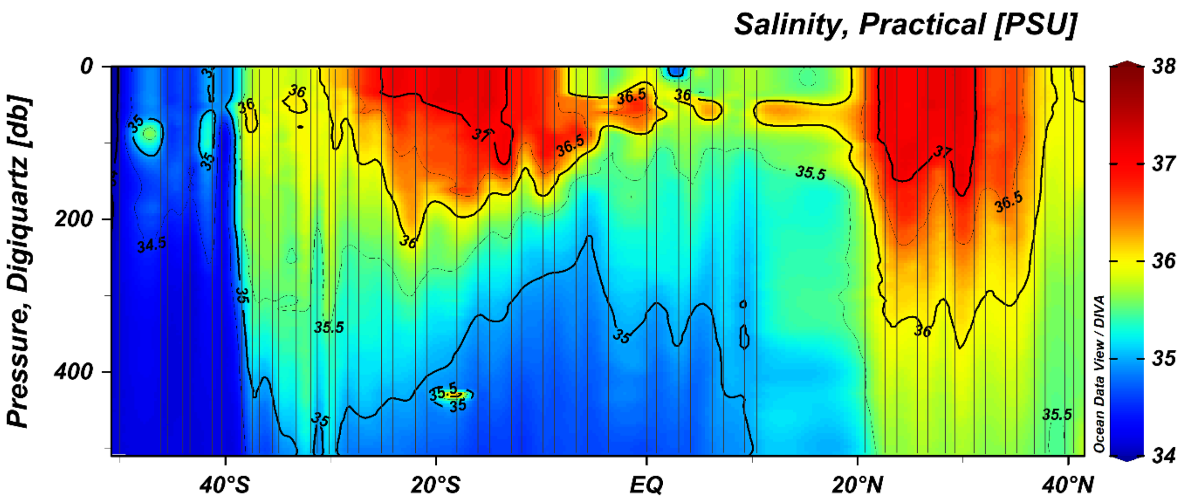


Fig. 3: Salinity section plot along the AMT30 transect by latitude (approximately 50 deg S – 40 deg N) from the primary salinity sensor.

The secondary CTD salinity sensor was calibrated against discrete salinity measurements. Again, there was no significant relationship between bench salinity and offset (n = 186; r^2 = 0.0036; p = > 0.05). Therefore, the mean offset was applied.

Calibrated secondary salinity = uncalibrated salinity - 0.000783871

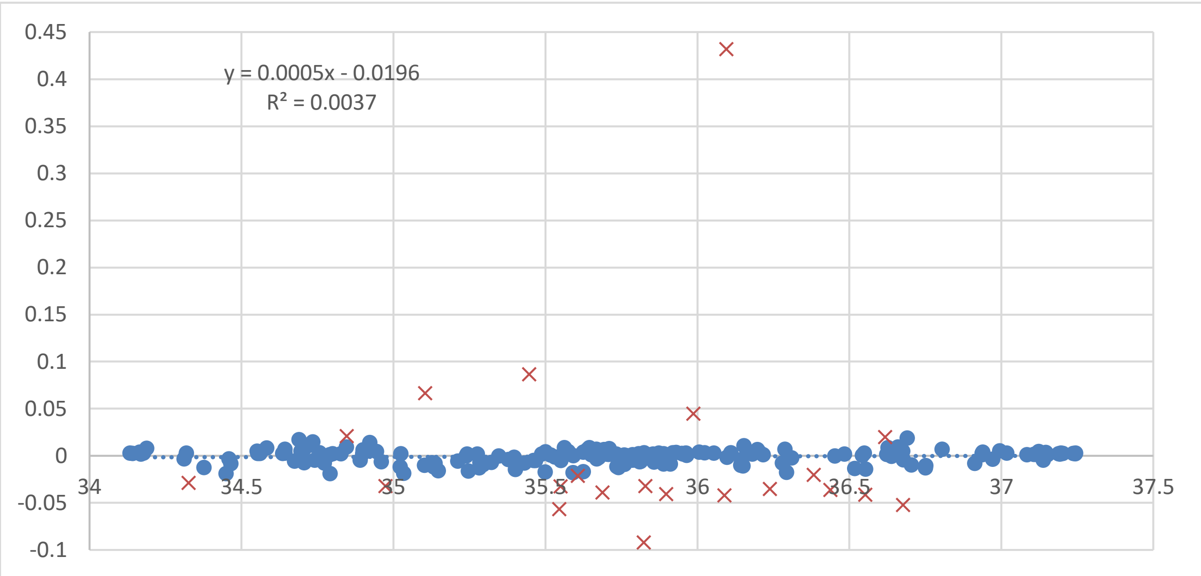


Fig. 4: Salinity offsets for the secondary salinity sensor against discrete sample salinity measured with a bench salinometer.

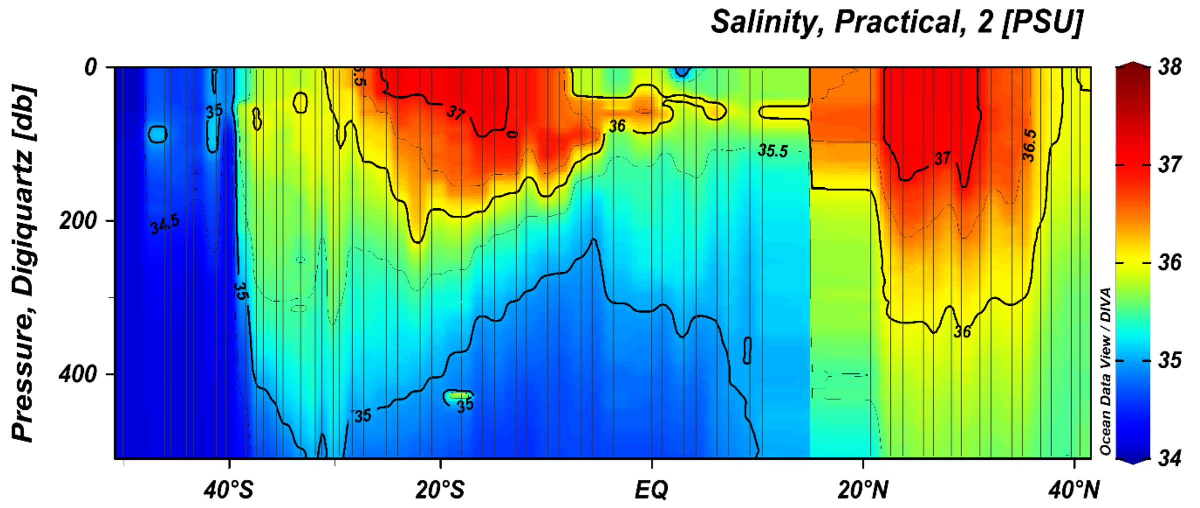


Fig. 5: Salinity section plot along the AMT30 transect by latitude (approximately 50 deg S – 40 deg N) from the secondary salinity sensor calibrated against bench salinity samples.

- Oxygen

Although discrete samples for Oxygen Winkler titration analysis were collected at 5 depths during the pre-dawn and noon casts. Unfortunately, the oxygen Winkler analyses performed during the cruise did not produce any useable data, so calibration of the SBE 43 oxygen sensors against these discrete measurements was not possible. However, the two SBE 43 oxygen sensors both displayed the same data patterns with very similar values. More details are available in Ian Brown's cruise report. The oxygen sensor operated without problem throughout the remainder of the cruise.

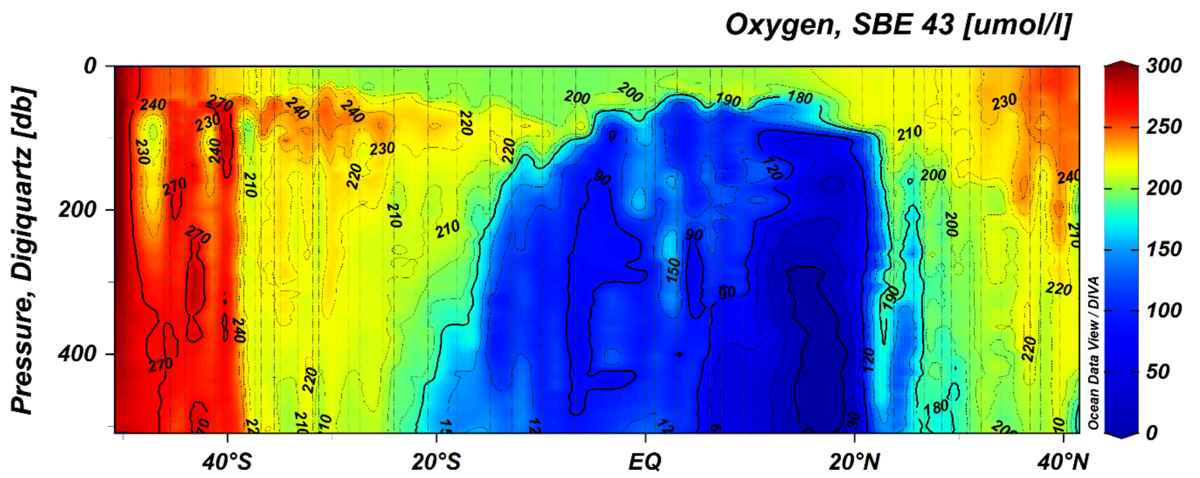


Fig. 6: Oxygen concentration section plot along the AMT30 transect by latitude (approximately 50 deg S – 40 deg N) from the uncalibrated SBE43 oxygen sensor.

- Fluorometer

The CTD fluorometer operated without problem during the cruise. Calibration of the CTD fluorometer sensor against sample data will be carried out after the cruise against AC-9 and HPLC data. A section plot of the fluorescence data along the AMT30 cruise track is shown below.

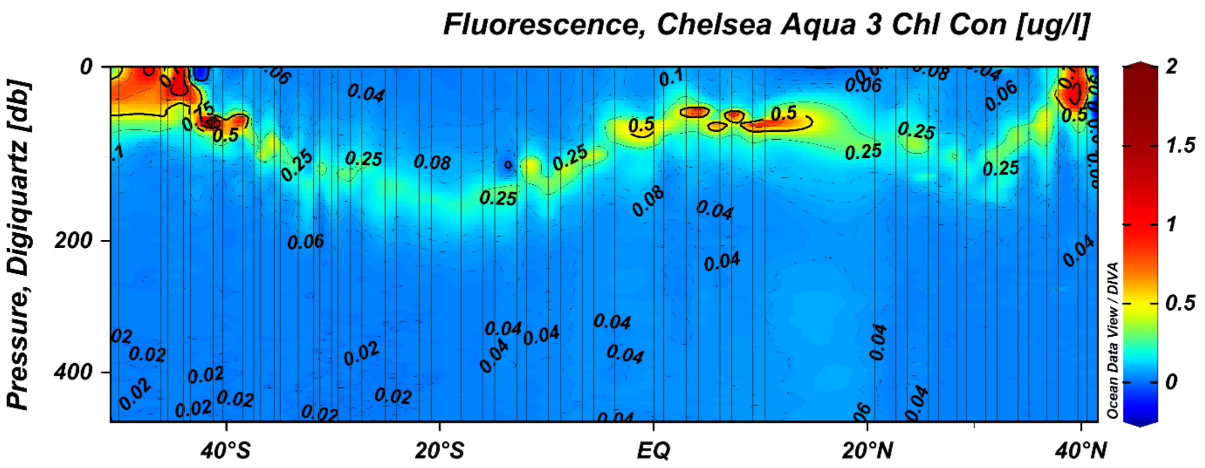


Fig. 7: Fluorometer section plot along the AMT30 transect by latitude (approximately 50 deg S – 40 deg N).

Underway sensors

The ship's underway meteorological and surface systems were run continuously throughout the cruise. The sea surface hydrography system started logging from 20/02/2023 14:39 (UTC) and was switched off prior to arrival at Southampton on 27/03/2023. Samples were collected to calibrate the TSG connected to the ship's non-toxic flow-through system, which draws water from approximately 5.5 m below the water line on the RRS Discovery.

- Sea Surface Temperature Hull sensor (temp_r, remote temperature)

The remote sea surface underway temperature sensor was calibrated against the mean of the primary and secondary CTD temperature sensor values from each CTD at around 5.5 dbar. Several values were excluded from the regression where the surface value was anomalous.

A regression analysis was performed on the offset (CTD temperature – underway temperature) against cruise day and offset against CTD temperature. There was no relationship between the offset and the surface CTD sensor values ($n = 48$; $r^2 = 0.01056$; $p > 0.05$). There was also no relationship between the offset and cruise day ($n=48$; $r^2 = 0.05509$; $p > 0.05$). Therefore, the mean offset was applied.

$$\text{Underway temperature}_{\text{[Calibrated]}} = \text{Underway temperature}_{\text{[uncalibrated]}} + 0.000357149$$

The correction will be applied during BODC processing after the cruise before the data is made available online.

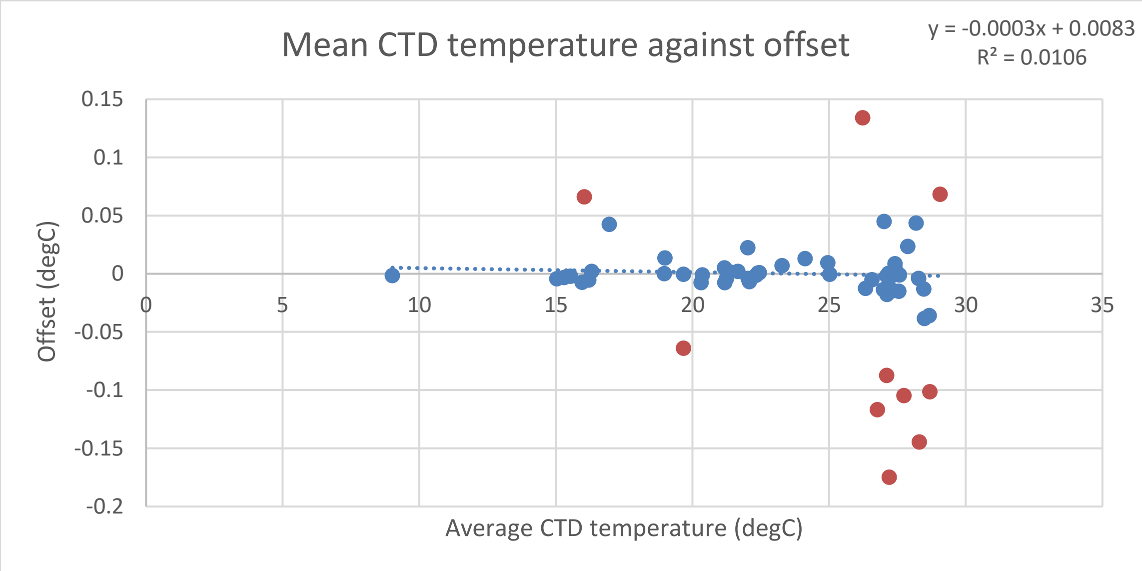


Fig. 8: Hull sensor temperature offsets against surface CTD temperature measurements.

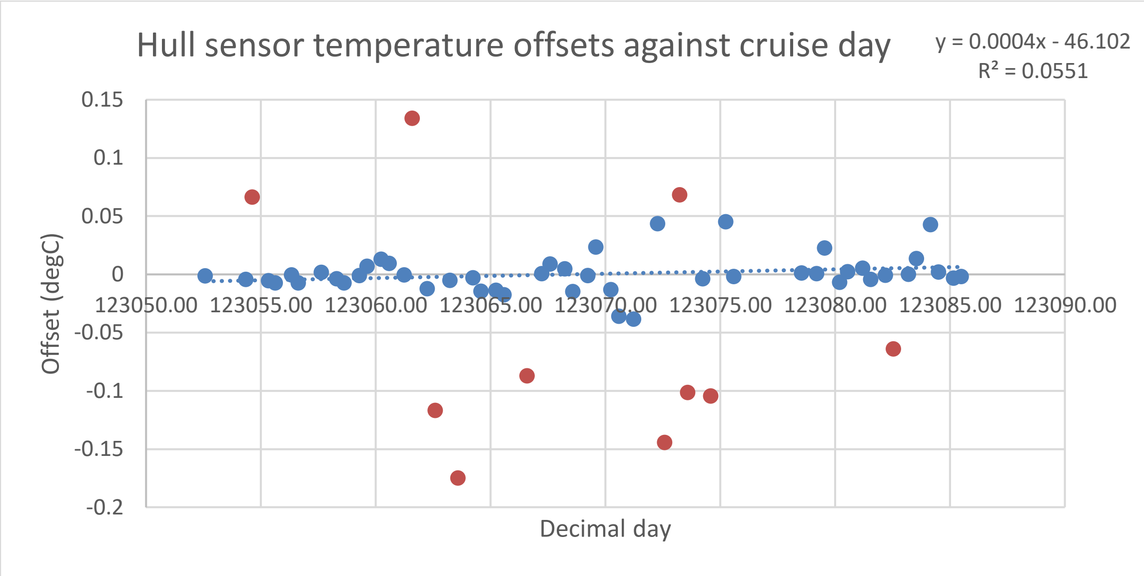


Fig. 9: Hull sensor temperature offsets against cruise day.

- Salinity

The TSG sensor salinity data were calibrated against samples collected and analysed with a bench salinometer. Up to four samples were collected each day at approximately 8am, 12pm, 4pm and 8pm, ships time. The offset between bench salinity and underway TSG salinity sensor value was calculated. Several outliers were identified when plotting offset against bench salinity and cruise day (figures 12 and 13), which were excluded from the calibration dataset. There was no significant regression of the offset with bench salinity measurement ($n = 109$; $r^2 = 0.03416$; $p > 0.05$), the regression between cruise day and offset was significant ($n = 109$; $r^2 = 0.06098$; $p < 0.05$). The regression equation for the trend with time was applied:

$$\text{Salinity}_{[\text{calibrated}]} = [a + (b*\text{day})] + \text{Salinity}_{[\text{uncalibrated}]}$$

Where:
a= 50.70203,
b= -0.00041

The offsets with the newly adjusted values were re-calculated and regression analysis performed; the relationship with cruise day was improved ($n = 109$; $r^2 = \sim 0$; $p > 0.05$), but a weak but significant relationship with bench salinity ($n = 109$; $r^2 = 0.10835$; $p < 0.05$) had been introduced. The combined regression equation for both trends was applied:

$$\text{Salinity}_{[\text{calibrated}]} = (ca + d) + (cb*\text{day}) + (c * \text{Salinity}_{[\text{uncalibrated}]})$$

Where:
a=50.70203092,
b=-0.000412775,
c=1.003575336,
d=-0.22705825,

The offsets with the newly adjusted values were re-calculated and regression analysis performed; there was now no relationship between offset and bench salinity ($n = 109$; $r^2 = 0.02104$; $p > 0.05$) or offset against cruise day ($n = 109$; $r^2 = 0.01178$; $p > 0.05$), so no further calibration was necessary.

The correction will be applied during BODC processing after the cruise before the data is made available online.

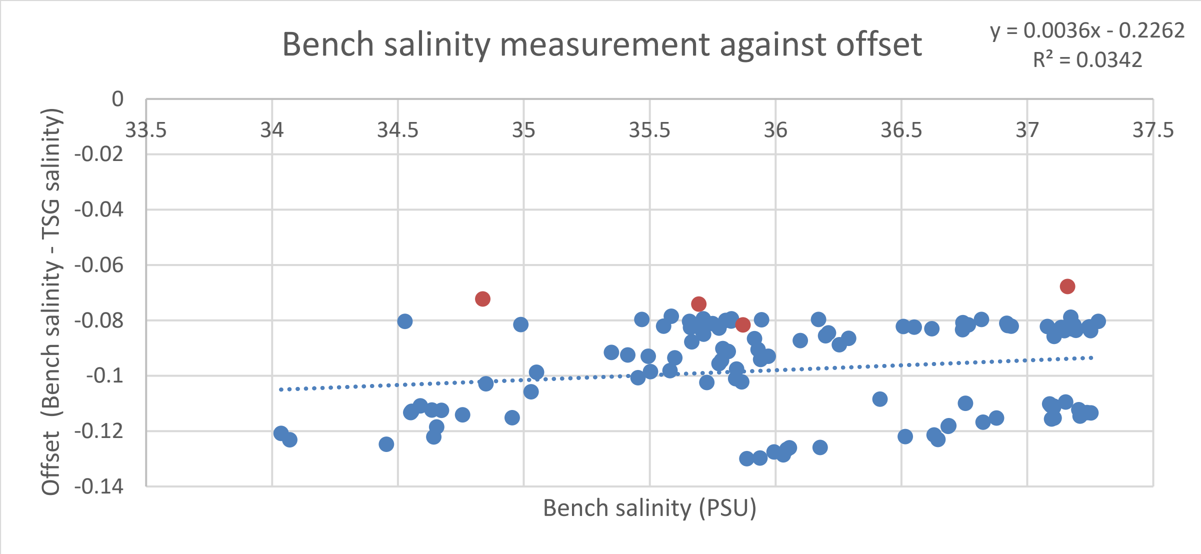


Fig. 10: Salinity offsets against bench salinometer measurements on discrete underway samples.

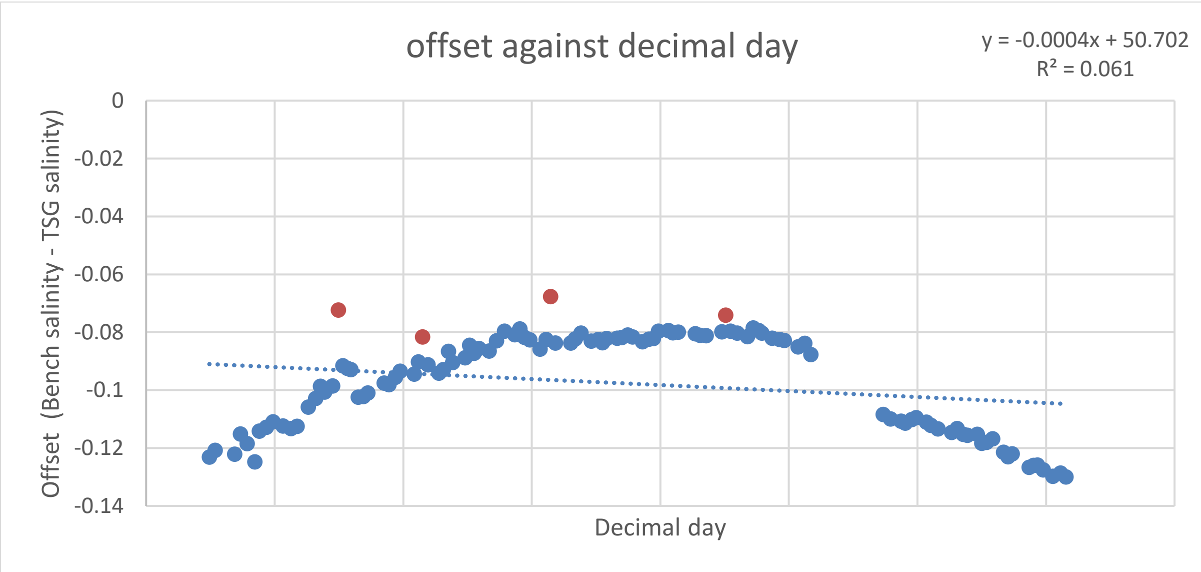


Fig. 11: Salinity offsets against cruise day

- Fluorometer

The underway fluorometer data will be calibrated against AC-9 and HPLC data generated during the cruise back at PML. The correction will be applied during BODC processing after the cruise before the data are made available online.

Dissolved Inorganic Nutrients

Sarah Breimann
Plymouth Marine Laboratory

OBJECTIVES:

To investigate the spatial and temporal variations of the micro-molar nutrient species Nitrate, Nitrite, Phosphate, and Silicate during the research cruise along the Atlantic Meridional Transect (AMT) cruise track, departing from Immingham, UK and sailing through the North Atlantic Gyre (NAG), south to the equator, through the South Atlantic Gyre (SAG), before turning south-west to end the cruise at Port Stanley Falkland Islands.

SAMPLING and METHODOLOGY

Micro-molar nutrient analysis was carried out using a 4 channel (nitrate (Brewer & Riley, 1965), nitrite (Grasshoff,K., 1976), phosphate, silicate (Kirkwood, D.S., 1989) . Bran & Luebbe AAIII segmented flow, colourimetric, auto-analyser. Established, proven analytical protocols were used.

Water samples were taken from a 24 x 20 litre bottle stainless steel framed CTD / Rosette system (Seabird), typically every unique depth was sampled from each CTD cast. These were sub-sampled into clean (acid-washed) 60ml HDPE (Nalgene) sample bottles, which were rinsed x3 with sample seawater prior to filling.

CTD SAMPLES ANALYSED

A total of **56** vertical profiles were analysed along the axis of the AMT and are listed in the table below, (CTD geographic positions and corrected bottle firing depths being available from the CTD Log.)

AMT 30 - Station & CTD Sampling Summary - Nutrients

Date and time	CTD.	Stn	Latitude	Longitude	Niskin bottles sampled
23/02/2023 09:10	001	1	-46.0977	-48.7387	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
23/02/2023 15:45	002	2	-45.5035	-47.8289	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
24/02/2023 09:06	003	3	-44.0323	-45.6601	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
24/02/2023 15:56	004	4	-43.3659	-44.6701	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
25/02/2023 09:06	005	5	-41.2469	-43.8903	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
25/02/2023 15:48	006	6	-40.3469	-43.8436	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
26/02/2023 18:55	007	7	-38.4519	-42.7585	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
27/02/2023 08:04	008	8	-37.4253	-40.7476	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
27/02/2023 16:02	009	9	-36.7968	-39.6892	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
28/02/2023 07:41	010	10	-35.5321	-37.5865	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
28/02/2023 15:53	011	11	-34.9163	-36.4330	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
01/03/2023 06:37	012	12	-33.9350	-34.4534	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01

01/03/2023 14:43	013	13	-33.2734	-33.3372	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
02/03/2023 06:36	014	14	-31.8717	-31.2926	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
02/03/2023 14:52	015	15	-31.2745	-30.1955	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
03/03/2023 06:32	016	16	-30.1545	-28.1721	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
03/03/2023 14:53	017	17	-29.5629	-27.1319	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
04/03/2023 06:28	018	18	-28.3845	-25.0823	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
04/03/2023 15:03	019	19	-27.3137	-24.5237	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
05/03/2023 06:25	020	20	-25.1578	-24.4914	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
05/03/2023	021	21	-24.0732	-24.5003	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
06/03/2023 06:27	022	22	-21.9612	-24.4950	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
06/03/2023 14:58	023	23	-20.8471	-24.4963	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
07/03/2023 14:45	024	24	-18.0231	-25.0635	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
08/03/2023 06:28	025	25	-16.0148	-25.0613	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
08/03/2023 14:59	026	26	-14.8966	-25.0546	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
09/03/2023 06:33	027	27	-12.8046	-25.0533	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
09/03/2023 14:56	028	28	-11.8945	-25.0517	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
10/03/2023 06:38	029	29	-9.8640	-25.0426	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
10/03/2023 15:00	030	30	-8.7440	-25.1568	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
11/03/2023 06:35	031	31	-6.6825	-25.1912	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
11/03/2023	032	32	-5.6501	-25.1669	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
12/03/2023 06:22	033	33	-3.6400	-25.1645	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
13/03/2023 07:17	034	34	-0.0011	-25.1370	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
13/03/2023 14:54	035	35	0.9298	-25.3773	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
14/03/2023 06:32	036	36	3.0185	-25.4177	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
14/03/2023	037	37	4.1562	-25.4058	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
15/03/2023 06:28	038	38	6.1781	-25.3688	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
15/03/2023 14:57	039	39	7.2689	-25.3455	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
16/03/2023 06:33	040	40	9.2644	-25.3121	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
16/03/2023 14:56	041	41	10.4225	-25.2911	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01

19/03/2023 13:52	042	42	20.6988	-24.9978	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
20/03/2023 05:33	043	43	22.6149	-25.0040	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
20/03/2023 13:53	044	44	23.7294	-24.9999	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
21/03/2023 05:34	045	45	25.7005	-25.0011	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
21/03/2023 13:46	046	46	26.6516	-24.9962	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
22/03/2023 05:37	047	47	28.3483	-24.1476	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
22/03/2023 13:57	048	48	29.2721	-23.6775	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
23/03/2023 05:25	049	49	31.0507	-22.7711	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
23/03/2023 13:40	050	50	32.1055	-22.2235	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
24/03/2023 05:30	051	51	34.0653	-21.1885	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
24/03/2023 13:55	052	52	35.0978	-20.6301	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
25/03/2023 04:34	053	53	36.7942	-19.4606	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
25/03/2023 12:58	054	54	37.7968	-18.7806	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
26/03/2023 04:39	055	55	39.6611	-17.5260	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01
26/03/2023 12:50	056	56	40.5371	-16.9181	24,23,22,21,20,19,18,17,16,15,14,13,12, 11,10,09,08,07,06,05,04,03,02,01

References:

Brewer & Riley, 1965. The automatic determination of nitrate in seawater. *Deep Sea Research*, 12: 765-772

Grasshoff, K., 1976. Methods of sea-water analysis, *Verlag Chemie*, Weiheim: pp.317.

Kirkwood, D.S. 1989. Simultaneous determination of selected nutrients in sea-water, *ICES CM* 1989/C:29

Carbonate System: pH, Dissolved Inorganic Carbon (DIC) and pC0₂

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Rationale and Method

Seawater pH is one of four carbonate system parameters. The other parameters are: pCO2 (CO2 partial pressure- µatm), DIC (Dissolved Inorganic Carbon) and TA (Total Alkalinity - µmol/L or µmol/kg)). If we know any two of the four, we can calculate the remaining two. These measurements will contribute to our understanding of the distribution of C sources and sinks in the Atlantic Ocean and the capacity of the ocean to take up anthropogenic CO2. Dissolved CO_2 reacts with water to form carbonic acid (H_2CO_3). H_2CO_3 dissociates to bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) with the concomitant release of H^+, causing a reduction in pH. Samples for the determination of pH and DIC were collected in order to constrain the carbonate system along the cruise track. These samples are complemented by underway surface measurements of CO_2 partial pressure (pCO_2) measured with the PML, *Live-pCO₂* system.

DIC samples were collected in 500 mL borosilicate glass bottles with glass stoppers (Schott, Duran) and preserved with 100 µL of saturated $HgCl_2$ and returned to PML for analysis. The glass stoppers were greased with Apiezon-M grease.

pH samples were collected in 500 mL amber glass bottles and placed in a water bath at 25 ^oC. and allowed pH was determined using spectrophotometric pH system (PMl asset no 590) using the m-cresol-purple dye (Dickson et al., 2007). The dye has two absorbance maxima at 434 nm and 578 nm, the ratio of which is pH-, T- and salinity-dependent. A reference spectrum was run at the start of every days CTD's and the end of each CTD's samples the system was flushed with MiliQ water. The calculations and corrections were applied within the R-script. The pH method employed here has typical precision in the low 10^{-3} to 10^{-4} pH-unit range.

A figure of preliminary pH results can be seen in figure 1.

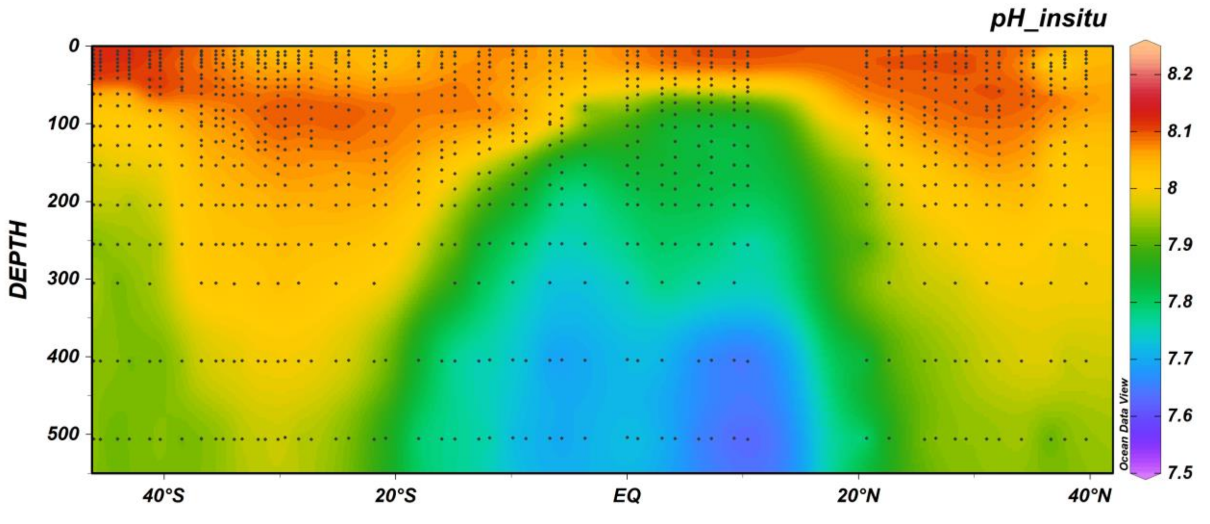

Figure 1: Preliminary pH data along-track for AMT 30 (DY157).

Samples collected from CTD hydrocast

CTD No	Lat	Long	Niskins	Depths
1	-46.09772	-48.73868	1,3,4,5,6,7,8,9,10,11,11,14,16,17,18,19,20,21,	505,405,305,254,204,153,127,102,61,42,36,31,26,21,21,15,10,5,
2	-45.50343	-47.82893	1,2,3,4,5,6,7,8,9,10,11,16,17,19,20,21,	506,405,255,204,153,127,102,76,62,41,3,26,20,16,11,6
3	-44.03232	-45.66007	1,3,4,5,6,7,8,9,10,11,12,13,16,18,19,20,21,	505,405,305,255,204,153,128,102,76,61,41,31,26,21,16,10,6,
4	-43.03258	-44.67005	1,2,3,4,5,6,7,8,9,10,11,16,17,19,20,21,22,	505,405,254,204,152,127,102,76,62,41,36,31,26,21,15,11,5
5	-41.24682	-42.89010	1,3,4,5,6,7,8,9,10,13,14,15,16,18,19,20,21,	506,406,306,255,205,154,128,103,83,63,53,43,27,22,17,12,7
6	-40.34687	-43.84360	1,2,3,4,5,6,7,8,9,10,13,14,16,17,19,20,21,	506,405,254,204,153,127,102,82,61,52,41,31,25,21,15,10,5
7	-38.45182	-42.75852	1,2,3,4,5,6,7,8,11,12,13,14,16,17,19,20,22,	505,405255,204,153,128,103,83,57,52,42,31,27,22,16,11,6.
8	-36.79677	-39.68922	1,3,4,5,6,7,8,9,10,13,14,15,16,17,18,19,20,21,	505,405,305,255,204,153,128,102,87,77,61,51,36,26,20,17,12,7
9	-36.79677	-39.68922	1,2,3,4,5,6,7,8,11,12,14,13,15,17,18,20,21,	505,404,254,204,178,143,121,103,97,76,61,51,41,26,21,11,5
10	-35.53267	-37.58667	1,3,4,5,6,7,8,9,10,13,14,15,16,17,18,19,20,21,	505,405,305.255,204,153,123,102,92,82,61,51,41,31,21,16,11,6.
11	-34.91625	-36.43297	1,2,3,4,5,6,7,8,12,13,14,15,16,17,18,20,22,	505,405,255,204,179,143,122,103,93,82,63,53,43,27,22,11,6
12	-33.93498	-34.45183	1,3,4,5,6,7,8,9,12,13,14,15,16,17,18,19,20,21,	506,406,306,255,205,154,128,113,97,83,63,52,41,32,22,17,12,6.
13	-33.27333	-33.33717	1,2,3,4,5,6,7,8,11,12,13,14,15,17,18,20,22,	505,405,254,204,178,153,131,122,107,82,61,50,40,26,21,11,6.
14	-31.87167	-31.29255	1,3,4,5,6,7,10,11,12,13,14,15,16,17,18,19,20,21,	506,405,305,255,205,179,133,123,103,83,63,52,42,32,22,17,11,7.
15	-31.27455	-30.19548	1,2,3,4,5,6,7,8,11,12,13,14,15,17,18,20,22,	506,405,255,206,179,154,133,123,113,93,78,53,42,27,22,12,7
16	-30.15452	-28.17208	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,21,	50,406,305,255,205,164,144,129,103,78,63,52,43,32,22,18,12,7.
17	-29.56295	-27.13195	1,2,3,4,5,6,7,10,11,12,13,14,15,17,18,19,20,22,	504,404,254,204,179,153,133,118,103,93,77,52,42,27,22,22,12,6.
18	-28.38447	-25.08233	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,22,	506,405,305,255,204,151,133,112,102,76,62,52,42,832,22,17,12,6.

19	-27.30000	-24.52368	1,2,3,4,5,6,7,8,11,12,13,14,15,17,19,20,22,	506,405,255,204,179,153,128,118,109,94,78,53,42,27,22,12,7.
20	-25.16077	-24.49142	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,21,	505,405,305,255,204,179,153,128,103,78,62,52,42,32,21,16,12,7.
21	-24.07318	-24.50032	1,2,3,4,5,6,7,9,10,11,12,13,14,15,17,18,20,22,	505,404,254,204,178,163,137,137,124,103,82,62,51,41,26,21,11,6
22	-21.85437	-24.49497	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,21,	506,406,305,255,205,184,164,146,123,103,84,63,53,42,32,22,13,6.
23	-20.84708	-24.49500	1,2,3,4,5,6,9,10,11,12,13,14,15,16,17,19,21,	506,404,254,204,178,163,148,137,122,102,82,62,42,26,22,12,6.7
24	-18.02310	-25.06348	1,2,3,4,5,6,9,10,11,12,13,14,15,16,17,19,21,	505,404,254,204,188,173,158,138,122,103,82,62,42,26,22,12,6
25	-16.01475	-25.06132	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,21,	506,405,255,205,174,159,143,133,123,104,84,63,43,27,23,22,12,8
26	-14.89660	-25.54600	1,2,3,4,5,6,7,9,10,11,12,13,14,15,16,17,19,22,	505,405,305,255,205,184,164,138,123,103,83,63,53,43,32,122,12,8
27	-12.80457	-25.05328	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,21,	505,405,305,255,205,184,164,138,123,103,83,63,53,43,32,22,12,8
28	-11.89435	-25.05172	1,2,3,4,5,6,7,8,11,12,13,14,15,16,17,19,22,	504,404,254,203,183,162,132,116,107,92,81,61,42,26,20,11,5
29	-9.86395	-25.04257	1,3,4,5,6,7,8,11,12,13,14,15,16,17,18,19,20,21,	504,404,304,254,203,178,152,122,112,101,82,62,51,41,31,21,10,5
30	-8.74402	-25.15680	1,2,3,4,5,6,7,9,12,13,14,15,16,14,18,19,22,	505,405,254,204,184,163,143,122,112,93,83,62,42,27,22,12,7
31	-6.68253	-25.19117	1,3,4,5,6,7,8,9,10,13,14,15,16,17,18,19,20,21,	505,404,304,254,204,178,153,127,97,100,87,62,52,41,32,21,11,6
32	-5.65007	-25.16690	1,2,3,4,5,6,7,8,9,12,13,14,15,16,17,18,19,22,	504,404,254,203,183,162,142,122,112,102,92,77,62,41,26,21,11,6
33	-3.63997	-25.16452	1,3,4,5,6,7,8,9,10,11,12,14,16,17,18,19,20,21,	504,404,30,254,204,178,153,127,102,82,77,62,52,41,31,21,11,6
34	-0.00105	-25.13700	1,3,4,5,6,7,8,9,10,11,12,14,16,17,18,19,20,21,	503,403,304,254,203,178,153,128,102,82,77,66,51,42,32,21,11,6
35	0.92975	-25.37732	1,2,3,4,5,6,7,8,9,10,14,15,16,17,18,19,22,	505,404,254,204,184,163,143,123,104,82.647,62,51,42,26,22,12,7

36	3.01847	-25.41765	1,3,4,5,6,7,8,10,11,12,13,15,17,18,19,20,21,	504,404,304,254,203,178,153,102,83,72,61,54,41,31,21,11,6.
37	4.15618	-25.41765	1,3,4,5,6,7,8,9,10,11,12,15,16,17,18,19,21,	505,254,204,184,163,143,122,104,88,73,62,49,41,27,22,12,6
38	6.17672	-25.36872	1,3,4,5,6,7,8,9,10,11,12,14,16,17,18,19,20,21,	505,405,305,255,204,179,153,128,102,82,72,60,52,42,32,22,11,7.
39	7.26885	-25.34545	1,2,3,4,5,6,7,8,9,10,11,12,15,16,17,18,19,22,	505,404,254,204,183,163,142,122,102,88,72,62,50,41,27,21,11,6

Measurements of optical properties

Gavin Tilstone[1], Federico Ienna[2] and John Gittings[3]

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Goal

- To determine surface and depth-resolved optical properties along the transect in support of satellite calibration/validation activities.

Methods

- Particulate optical backscattering coefficient (470, 532, 700 nm), beam-attenuation and absorption coefficients (400–750 nm) were determined quasi-continuously from the ship's underway water following methods detailed in Dall'Olmo et al. (2009).
- In-situ optical properties were also collected by means of a profiling package mounting a SBE CTD and a WETLAbs AC-S to determine the particulate absorption and attenuation coefficients over the upper 250 m. The profiling package was deployed once a day simultaneously with the noon time CTD cast. On station optical deployments are given in Table 1 with two deployments per station. In Table 1, IOP is Inherent Optical Property; Bulk is for total particulate material + coloured dissolved organic matter (CDOM); Filtered is CDOM only.
- Above-water radiometric measurements were taken quasi-continuously using a Satlantic HyperSAS system. The HyperSAS optical remote-sensing system provided hyperspectral measurements of spectral water-leaving radiance and downwelling spectral irradiance, from which the above-water remote-sensing reflectance can be computed. The 136-channel HyperOCR radiance and irradiance sensors were mounted onboard the ship to simultaneously view the sea surface and sky.

References

Dall'Olmo et al. (2009) Significant contribution of large particles to optical backscattering in the open ocean. Biogeosciences, 6, 947–967.

List of in-water optical deployments.

STATION#	DATE	TIME (GMT)	LAT (Degrees)	LONG (Degrees)	IOP*
Optics Rig 1	24/02/2023	15:09	-43.61	-44.73	Abandoned
Optics Rig 2	25/02/2023	15:00	-40.56	-44.01	Bulk (Data Logger Malfunction)
Optics Rig 3	27/02/2023	15:09	-37.01	-39.78	Bulk
Optics Rig 3	27/02/2023	15:31	-37.01	-39.78	Filtered
Optics Rig 4	28/02/2023	15:07	-35.17	-36.69	Bulk
Optics Rig 5	01/03/2023	13:58	-33.38	-33.40	Bulk
Optics Rig 5	01/03/2023	14:20	-33.38	-33.40	Filtered
Optics Rig 6	02/03/2023	14:00	-31.40	-30.39	Bulk
Optics Rig 6	02/03/2023	14:21	-31.40	-30.39	Filtered
Optics Rig 7	03/03/2023	13:56	-29.76	-27.37	Bulk
Optics Rig 7	03/03/2023	14:18	-29.76	-27.37	Filtered
Optics Rig 8	04/03/2023	13:59	-27.53	-24.63	Bulk
Optics Rig 8	04/03/2023	14:19	-27.53	-24.63	Filtered
Optics Rig 9	05/03/2023	13:57	-24.18	-24.50	Bulk

Optics Rig 9	05/03/2023	14:15	-24.18	-24.50	Filtered
Optics Rig 10	06/03/2023	13:56	-21.06	-24.70	Bulk
Optics Rig 10	06/03/2023	14:16	-21.06	-24.70	Filtered
Optics Rig 11	07/03/2023	14:00	-18.12	-25.28	Bulk
Optics Rig 11	07/03/2023	14:22	-18.12	-25.28	Filtered
Optics Rig 12	08/03/2023	14:04	-15.19	-25.13	Bulk
Optics Rig 12	08/03/2023	14:24	-15.19	-25.13	Filtered
Optics Rig 13	09/03/2023	13:58	-12.15	-25.08	Bulk
Optics Rig 13	09/03/2023	14:20	-12.15	-25.08	Filtered
Optics Rig 14	10/03/2023	13:59	-8.91	-25.26	Bulk
Optics Rig 14	10/03/2023	14:19	-8.91	-25.26	Filtered
Optics Rig 15	11/03/2023	13:58	-5.98	-25.17	Bulk
Optics Rig 15	11/03/2023	14:17	-5.98	-25.17	Filtered
Optics Rig 16	13/03/2023	14:00	1.17	-25.55	Bulk
Optics Rig 16	13/03/2023	14:22	1.17	-25.55	Filtered
Optics Rig 17	14/03/2023	13:59	4.25	-25.50	Bulk
Optics Rig 17	14/03/2023	14:19	4.25	-25.50	Filtered
Optics Rig 18	15/03/2023	13:56	7.30	-25.54	Bulk
Optics Rig 18	15/03/2023	14:16	7.30	-25.54	Filtered
Optics Rig 19	16/03/2023	13:56	10.51	-25.41	Bulk
Optics Rig 19	16/03/2023	14:16	10.51	-25.41	Filtered
Optics Rig 20	19/03/2023	12:57	20.94	-25.23	Bulk
Optics Rig 20	19/03/2023	13:19	20.94	-25.23	Filtered
Optics Rig 21	20/03/2023	12:54	24.00	-25.26	Bulk
Optics Rig 21	20/03/2023	13:14	24.00	-25.26	Filtered
Optics Rig 22	21/03/2023	12:54	26.68	-25.20	Bulk
Optics Rig 22	21/03/2023	13:14	26.68	-25.20	Filtered
Optics Rig 23	22/03/2023	12:54	29.36	-23.85	Bulk
Optics Rig 23	22/03/2023	13:15	29.36	-23.85	Filtered
Optics Rig 24	23/03/2023	12:59	32.25	-22.41	Bulk
Optics Rig 24	23/03/2023	13:20	32.25	-22.41	Filtered
Optics Rig 25	24/03/2023	12:56	36.32	-20.84	Bulk
Optics Rig 25	24/03/2023	13:20	36.32	-20.84	Filtered
Optics Rig 26	25/03/2023	11:54	38.01	-18.47	Bulk
Optics Rig 26	25/03/2023	12:19	38.01	-18.47	Filtered
Optics Rig 27	26/03/2023	12:17	40.60	-16.94	Bulk (Data logger malfunction)
Optics Rig 27	26/03/2023	12:35	40.60	-16.94	Filtered (Data logger malfunction)

Bio-Optical and Biogeochemical Measurements in Support of NASA Ocean Colour Orbital Sensors Validation

Joaquín E. Chaves and Harrison Smith

NASA Goddard Space Flight Center, Ocean Ecology Laboratory, Field Support Group

The National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC), Field Support Group participated in the 30th occupation of the Atlantic Meridional Transect (AMT30) campaign on board the RRS Discovery, which departed from Port Stanley, Falkland Islands, on February 20, 2023, and arrived in Southampton, UK, on March 30, 2023. Measurements were conducted mainly along a 25° W transect that traversed across the Atlantic Ocean major oceanic provinces, including the productive waters of the Falklands Shelf, the Equatorial upwelling, and off the coasts of Northeast Africa and the Iberian Peninsula. The campaign also traversed the very clear waters of the oligotrophic South Atlantic Gyre.

NASA Science Objectives

The AMT30 campaign presented a valuable opportunity to collect optical measurements concurrently with phytoplankton pigments (collected by PML Optics group) and other biogeochemical and optical parameters to support NASA's ocean colour sensor validation across a wide dynamic range of water optical properties.

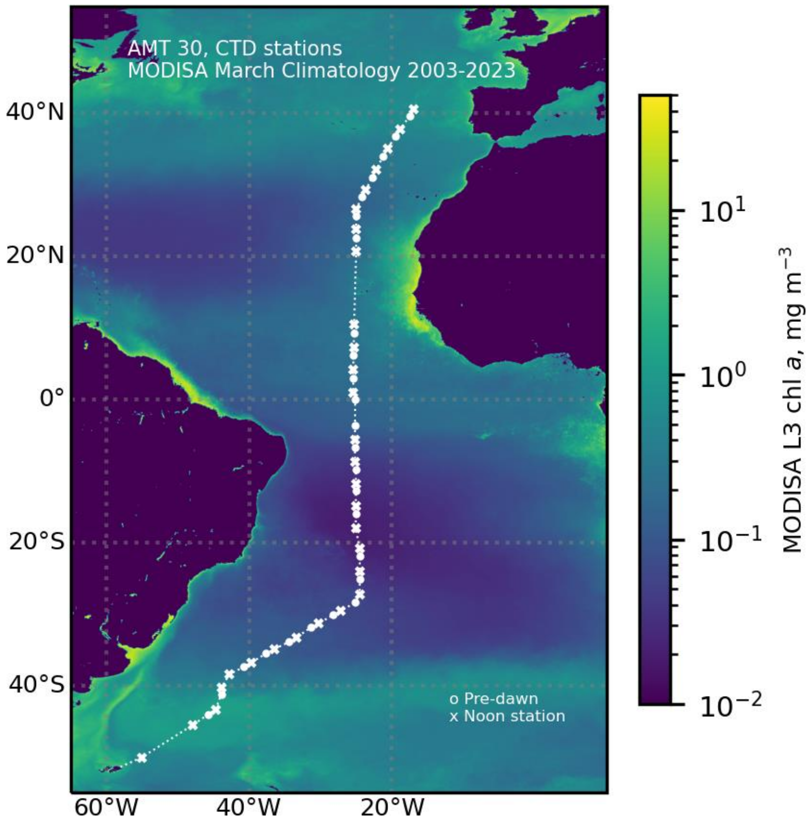

Figure 1. Location of AMT30 CTD stations. NASA team collected biogeochemical samples at ‘noon’ stations only. No NASA sampling was performed during pre-dawn stations. MODISA chlorophyll-a March climatology shown.

Methods:

Biogeochemical and optical properties measurements

Water samples were collected from the CTD rosette Niskin bottles at 60 discrete depth locations from all the 'noon' stations at 5 m, and from one additional depth within one optical depth (i.e., light attenuation 1/*e*), which for most of the campaign were estimated at being approximately within 15-25 m. Samples will be analysed for the concentrations of total suspended material (TSM), particulate organic carbon (POC), particulate inorganic carbon (PIC), dissolved organic carbon (DOC), and the spectral absorptions by particulates (a_p), and by chromophoric dissolved organic matter (CDOM; a_g). All filtration and cold sample preservation were conducted on board. Samples were filtered onboard under a low vacuum pressure (< 20 kPa) in a HEPA filtered atmosphere to reduce contamination by foreign particles. Samples were transported to NASA-GSFC for further analyses. The summary and full list of all sample replicates collected for each parameter are presented in Tables 1 and 4, respectively.

Table 1: Discrete optical and biogeochemical samples collected during the AMT30 campaign by the NASA team.

Parameter		Number of samples
a_p		116
a_g		60
DOC		120
POC		240*
PIC		82*
TSM		96
	Total	714

*Includes blanks

POC samples were filtered onto 25mm GF-75 (0.3 um nominal pore size) and stored in pre-combusted (450 °C, 4h) aluminium foil pouches and stored in liquid nitrogen (LN) promptly after filtration. The filtration was performed using a closed, in-line filter setup, where the first filter collects the sample particulates and the additional filter downstream serves as the 'filtrate blank' (IOCCG, 2021). POC analysis will be carried out at GSFC on a Elementar Vario Cube high temperature oxidation CHNS elemental analyser. PIC samples were filtered through 47mm polyethylsulfone (Sartorius). Prior to storage filters were rinsed with 3mM borate buffer and stored in LN. TSM samples were collected onto 47mm, pre-weighed GF-75 filters and stored at -20 °C. TSM content will be determined gravimetrically at GSFC. Samples for a_p were collected on 25mm GF-75 and stored in LN. The spectral absorption by particles will be determined in the laboratory using a benchtop spectrophotometer equipped with an integrating sphere. Samples for DOC and CDOM were filtered through 47mm GFF filters and stored into pre-combusted dark glass 30 and 250mL glass containers, respectively. DOC samples were preserved with 80uL of 4N HCl and stored along with the CDOM samples at 8°C.

Underway Above-Water Optical Measurements

Continuous underway measurements of apparent optical properties (AOPs; surface irradiance,E_s, uw cm^{-2} s; sky radiance, L_i, uw cm^{-2} sr; water leaving radiance, L_t, uw cm^{-2} sr) were conducted from the ship's bow 'met tower' using a Satlantic, Sea Bird Scientific HyperSAS radiometer array and a set of Trios RAMSES radiometers. Both sets of radiometers were controlled by the "PySAS" Sun-tracking software package developed by the University of Maine bio-optical group. The system operated from Feb 21 – March 27, except for our transit through the Cape Verde EEZ.

Underway Clean Science Water and CTD Bio-Optical Measurements

Measurements of inherent optical properties (IOPs; i.e., absorption and scattering) were conducted on samples procured from the ship's clean underway science sea water system, and the CTD rosette. Spectral particle backscatter was measured continuously while underway with a hyperspectral backscatter meter (Hyper-bb; In Situ Marine Optics, Inc.). The seawater was first passed through a Vortex Debubbler (Stony Brook University) to remove the optical signature of bubbles before reaching the sensor. The flow rate to the instrument was measured manually once per day with a 1L measuring cylinder container and timer. The Hyper-bb instrument measures spectral backscattering at wavelengths from 430 to 700 nm. Except for the Cape Verde EEZ transit and times specified below, the Hyper-BB was continuously recording throughout the campaign. The Instrument also did not record for around an hour each day from 0730 local ship time to 0830 to allow for data download. Once per week the instrument, de-bubbler, and connecting tubing were disassembled and cleaned with deionized water – resulting in around 4 hours of data not being logged. The dates of disassembly and cleaning were Feb 28, Mar 7, Mar 14, Mar 17 (within Cape Verde EEZ), and Mar 21. After the Mar 7 cleaning a valve was added between the supply of bubble free seawater and the intake of the Hyper-BB instrument chamber to allow a more ideal flow rate to both components. Before the valve was added the flow rate averaged ~ 5L m^{-1}.The flow rate after this valve was added averaged ~ 3L m^{-1}. Beginning on Feb 25, UTC 1830 contamination consisting of reflective metal particles was noticed in the transparent tubes that connected the underway system to the instruments. It was later confirmed that the particles were stainless steel of unknown provenance. In addition to the contamination, the chamber in which measurements are taken would release bubbles when disturbed or gently shaken. It is unknown at this time whether the bubbles released during agitation will affect the measurement of backscattering because they could be formed or lodged outside of the field of view of the sensor. Further data processing can reveal the effect that the dislodged bubbles had on measurement as all intentional instances of vibration were logged and can be used in data quality control.

Discrete Absorption Measurements with the WET Labs-Seabird AC-S Meter

Light absorption measurements were conducted on a WET Labs-Seabird AC-S meter (399-709 nm) once per day from water collected from the midday CTD at 5 meters and an additional depth within the first optical thickness, usually 25m but sometimes shallower. Due to time and water budget constraints, the deeper sample was sometimes not measured. The sample was transferred from the (3x sample rinsed) collection carboy to a 400mL glass beaker rinsed with sample, then slowly poured into the AC-S absorption '*a*' tube with a sample-rinsed plastic funnel to take one measurement. Immediately before measurement the temperature was measured for temperature correction during further post processing. Whenever possible measurements of GFF-filtered sample water were made to determine the absorption by CDOM. The instrument was cleaned with DI water and lint-free optical wipes between measurements of different depth samples. This involved removing and cleaning absorption tube and collars, cleaning and drying the transmitter and receiver windows, inspecting for residue, and reassembly. The instrument was calibrated with DI water approximately once a week to track the internal drift of the instrument. Calibration is performed by measuring DI water to within 0.003 m^{-1} on selected wavelength channels. The instrument is fully cleaned between each measurement of DI water during calibration to ensure independent measurements. This calibration occurred on Feb 22, Feb 28, Mar 7, Mar 14, Mar 21, and Mar 26. In total 113 measurements of absorption by the ACS were taken, of which 17 were filtered, 24 were from 25m depth, and the remaining 72 were from 5m depth (TableX+1).

Table 2: Discrete optical absorption (ACS-meter) measurements conducted on CTD water samples during AMT30 by NASA

Station	Date 2023	Depths	*n,* whole	*n*, filtered
004	Feb 24	5m	2	0
006	Feb 25	5m	2	0
009	Feb 27	5m, 25m	3, 3	0
015	Mar 2	5m, 25m	3, 3	3, 0
017	Mar 3	5m	3	3
019	Mar 4	5m	3	3
021	Mar 5	5m	3	2
023	Mar 6	5m	3	3
024	Mar 7	5m	3	3
026	Mar 8	5m	3	3
028	Mar 9	5m	2	0
030	Mar 10	5m	3	0
032	Mar 11	5m	3	0
035	Mar 13	5m, 25m	3, 3	0
037	Mar 14	5m, 25m	3, 3	0
039	Mar 15	5m, 25m	3, 3	0
041	Mar 16	5m, 25m	3, 3	0
042	Mar 19	5m	3	0
044	Mar 20	5m	3	0
048	Mar 22	5m	3	0
050	Mar 23	5m, 25m	3, 3	0
052	Mar 24	5m, 25m	3, 3	0
054	Mar 25	5m	3	0
056	Mar 26	5m	2	0

Absorption Measurements with the Point Source Integrating Cavity Absorption Meter

Additional optical absorption measurements were conducted on CTD rosette samples using a Point Source Integrating Cavity Absorption Meter (PSICAM, Sunstone Scientific LLC), which measures whole water spectral absorption inside a spherical integrating cavity. Table X+2 shows the location of PSICAM measurements.

Table 3: Discrete optical absorption (PSICAM) measurements conducted on CTD water samples during AMT30 by NASA

Station	Date 2023	Depths	*n,* whole	*n*, filtered
002	Feb 23	5m	2	0
009	Feb 27	5m, 25m	3, 3	0
013	Mar 1	5m, 25m	3, 3	0
015	Mar 2	0	0	0, 0
017	Mar 3	5m, 25m	2, 2	2, 0
019	Mar 4	5m, 25m	3, 3	1, 1
021	Mar 5	5m, 25m	1, 3	1, 1
023	Mar 6	5m, 25m	1, 2	2, 1
024	Mar 7	0	0	0
026	Mar 8	5m, 25m	1, 1	1, 2
028	Mar 9	5m, 25m	3, 3	0, 0
030	Mar 10	5m, 20m	3, 2	0, 0
032	Mar 11	5m	3	0, 0
035	Mar 13	5m, 25m	3, 2	0, 0
037	Mar 14	5m, 25m	3, 3	3, 0
039	Mar 15	5m, 25m	3, 3	0, 0
041	Mar 16	5m, 25m	3, 3	2, 0
042	Mar 19	5m, 25m	3, 3	0, 0
044	Mar 20	5m, 25m	3, 3	0, 0
046	Mar 21	5m, 25m	3, 2	0, 0
048	Mar 22	5m, 25m	3, 2	0, 0
050	Mar 23	5m, 25m	3, 3	0, 0
052	Mar 24	5m, 25m	3, 3	2, 0
054	Mar 25	5m, 25m	3, 2	2, 0
056	Mar 26	5m, 15m	3, 3	0, 0

Table 4. Biogeochemical and optical properties discrete samples collected by NASA during AMT 30							
Parameter	**station**	**date**	**time**	**Niskin**	**depth**	**lat**	**lon**
POC	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
DOC	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
DOC	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
CDOM	0	Feb 21 2023	13:45:40	23;24	5	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
POC	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
DOC	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
DOC	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
CDOM	0	Feb 21 2023	13:45:40	19;20	25	-50.0708	-55.0122
POC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
a_p	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
a_p	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
PIC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
PIC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
PIC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
TSM	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
TSM	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
TSM	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
DOC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
DOC	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
CDOM	2	Feb 23 2023	14:50:27	21;23	5	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
POC	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
DOC	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
DOC	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
CDOM	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
a_p	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
a_p	2	Feb 23 2023	14:50:27	15	25	-45.5032	-47.8290
POC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
a_p	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
a_p	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
PIC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
PIC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
TSM	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
TSM	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
DOC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
DOC	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
CDOM	4	Feb 24 2023	14:59:24	21;23	5	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
POC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
a_p	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
a_p	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
DOC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
DOC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
CDOM	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
PIC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
PIC	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
TSM	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
TSM	4	Feb 24 2023	14:59:24	15	25	-43.3658	-44.6702
TSM blank	4	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
TSM blank	4	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
POC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
a_p	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
a_p	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
PIC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)

Parameter	station	date	time	Niskin	depth	lat	lon
PIC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
TSM	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
TSM	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
DOC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
DOC	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
CDOM	6	Feb 25 2023	14:53:39	21;23	5	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
POC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
a_p	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
a_p	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
PIC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
PIC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
PIC blank	6	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
TSM	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
TSM	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
TSM blank	6	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
DOC	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
CDOM	6	Feb 25 2023	14:53:39	15;16	25	-40.3468	-43.8437
POC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
a_p	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
a_p	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
PIC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
PIC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
TSM	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
TSM	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
DOC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
DOC	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
CDOM	7	Feb 26 2023	15:00:03	21;23	5	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
POC	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
a_p	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
a_p	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
TSM	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
TSM	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
TSM blank	7	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
DOC	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
CDOM	7	Feb 26 2023	15:00:03	15;16	25	-38.4518	-42.7585
PIC	7	Feb 26 2023	15:00:03	15	25	-38.4518	-42.7585
PIC	7	Feb 26 2023	15:00:03	15	25	-38.4518	-42.7585
POC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
a_p	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
a_p	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
PIC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
PIC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
TSM	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
TSM	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
DOC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
DOC	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
CDOM	9	Feb 27 2023	14:58:43	21;23;24	5	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
POC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
a_p	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
a_p	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
PIC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
PIC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
TSM	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
TSM	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
TSM blank	9	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)							
Parameter	**station**	**date**	**time**	**Niskin**	**depth**	**lat**	**lon**
DOC	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
CDOM	9	Feb 27 2023	14:58:43	16;17	25	-36.7968	-39.6892
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
POC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
a_p	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
a_p	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
PIC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
PIC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
TSM	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
TSM	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
DOC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
DOC	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
CDOM	11	Feb 28 2023	14:58:27	21;23;24	5	-34.9162	-36.4330
a_p	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
a_p	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
PIC	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
PIC	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
TSM	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
TSM	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
TSM blank	11	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
DOC	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
CDOM	11	Feb 28 2023	14:58:27	16;17	25	-34.9162	-36.4330
POC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
a_p	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
a_p	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
PIC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
PIC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
TSM	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
TSM	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
DOC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
DOC	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
CDOM	13	Mar 01 2023	13:56:02	21;23;24	5	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
POC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
a_p	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
a_p	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
PIC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
PIC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
TSM	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
TSM	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
TSM blank	13	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
DOC	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
CDOM	13	Mar 01 2023	13:56:02	16;17	25	-33.2735	-33.3372
POC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
a_p	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
a_p	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
PIC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
PIC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
TSM	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
TSM	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
DOC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
DOC	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
CDOM	15	Mar 02 2023	13:58:17	21;23;24	5	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
POC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)							
Parameter	**station**	**date**	**time**	**Niskin**	**depth**	**lat**	**lon**
a_p	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
a_p	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
PIC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
PIC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
TSM	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
TSM	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
TSM blank	15	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
DOC	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
CDOM	15	Mar 02 2023	13:58:17	16;17	25	-31.2745	-30.1955
POC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
a_p	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
a_p	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
PIC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
PIC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
TSM	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
TSM	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
DOC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
DOC	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
CDOM	17	Mar 03 2023	13:58:17	21;23	5	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
POC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
a_p	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
a_p	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
PIC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
PIC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
TSM	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
TSM	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
TSM blank	17	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
DOC	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
CDOM	17	Mar 03 2023	13:58:17	16;17	25	-29.5628	-27.1320
POC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
a_p	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
a_p	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
PIC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
PIC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
TSM	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
TSM	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
DOC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
DOC	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
CDOM	19	Mar 04 2023	13:53:03	21;23	5	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
POC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
a_p	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
a_p	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
PIC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
PIC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
PIC blank	19	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
TSM	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
TSM	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
TSM blank	19	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
DOC	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
CDOM	19	Mar 04 2023	13:53:03	16;17	25	-27.3137	-24.5237
POC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
a_p	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
a_p	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
PIC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
PIC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)

Parameter	station	date	time	Niskin	depth	lat	lon
DOC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
DOC	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
CDOM	21	Mar 05 2023	13:58:32	21	5	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
POC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
a_p	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
a_p	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
PIC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
PIC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
DOC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
DOC	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
CDOM	21	Mar 05 2023	13:58:32	16;17	25	-24.0732	-24.5003
POC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
a_p	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
a_p	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
PIC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
PIC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
TSM	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
TSM	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
DOC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
DOC	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
CDOM	23	Mar 06 2023	13:58:44	20;21;23	5	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
POC	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
a_p	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
a_p	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
TSM	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
DOC	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
DOC	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
CDOM	23	Mar 06 2023	13:58:44	16	25	-20.8472	-24.4963
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
a_p	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
a_p	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
PIC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
PIC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
TSM	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
TSM	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
DOC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
DOC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
CDOM	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
POC	24	Mar 07 2023	13:54:49	20;21;23	5	-18.0228	-25.0633
a_p	24	Mar 07 2023	13:54:49	16	25	-18.0228	-25.0633
a_p	24	Mar 07 2023	13:54:49	16	25	-18.0228	-25.0633
DOC	24	Mar 07 2023	13:54:49	16	25	-18.0228	-25.0633
DOC	24	Mar 07 2023	13:54:49	16	25	-18.0228	-25.0633
CDOM	24	Mar 07 2023	13:54:49	16	25	-18.0228	-25.0633
POC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
POC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
POC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
POC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
a_p	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
a_p	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
PIC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
PIC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
TSM	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
TSM	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
DOC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
DOC	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
CDOM	26	Mar 08 2023	13:59:36	20;21;23	5	-14.8967	-25.0547
POC	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)

Parameter	station	date	time	Niskin	depth	lat	lon
POC	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
POC	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
POC	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
a_p	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
a_p	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
DOC	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
DOC	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
CDOM	26	Mar 08 2023	13:59:36	16	25	-14.8967	-25.0547
POC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
a_p	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
a_p	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
PIC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
PIC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
TSM	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
TSM	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
DOC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
DOC	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
CDOM	28	Mar 09 2023	13:59:03	20;21;23	5	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
POC	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
a_p	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
a_p	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
DOC	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
DOC	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
CDOM	28	Mar 09 2023	13:59:03	16	25	-11.8945	-25.0517
POC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
a_p	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
a_p	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
PIC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
PIC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
TSM	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
TSM	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
TSM blank	30	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
DOC	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
CDOM	30	Mar 10 2023	13:59:03	20;21;23	5	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
POC	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
a_p	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
a_p	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
DOC	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
DOC	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
CDOM	30	Mar 10 2023	13:59:03	17	25	-8.7440	-25.1568
POC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
a_p	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
a_p	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
PIC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
PIC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
TSM	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
TSM	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
DOC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
DOC	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
CDOM	32	Mar 11 2023	13:51:08	20;21;23	5	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
POC	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
a_p	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
a_p	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
DOC	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)

Parameter	station	date	time	Niskin	depth	lat	lon
DOC	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
CDOM	32	Mar 11 2023	13:51:08	17	25	-5.6500	-25.1670
POC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
a_p	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
a_p	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
PIC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
PIC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
TSM	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
TSM	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
TSM blank	35	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
DOC	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
CDOM	35	Mar 13 2023	13:54:22	20;21;23	5	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
POC	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
a_p	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
a_p	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
DOC	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
DOC	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
CDOM	35	Mar 13 2023	13:54:22	17	25	0.9297	-25.3773
POC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
a_p	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
a_p	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
PIC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
PIC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
TSM	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
TSM	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
TSM blank	37	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
DOC	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
CDOM	37	Mar 14 2023	13:54:05	20;21;23	5	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
POC	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
a_p	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
a_p	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
DOC	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
DOC	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
CDOM	37	Mar 14 2023	13:54:05	17	25	4.1562	-25.4058
POC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
a_p	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
a_p	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
PIC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
PIC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
TSM	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
TSM	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
DOC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
DOC	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
CDOM	39	Mar 15 2023	13:54:16	20;21;23	5	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
POC	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
a_p	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
a_p	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
DOC	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
DOC	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
CDOM	39	Mar 15 2023	13:54:16	17	25	7.2688	-25.3455
POC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
POC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
POC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)							
Parameter	**station**	**date**	**time**	**Niskin**	**depth**	**lat**	**lon**
POC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
a_p	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
a_p	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
PIC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
PIC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
TSM	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
TSM	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
TSM blank	41	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
DOC	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
CDOM	41	Mar 16 2023	13:53:25	20;21;23	5	10.4225	-25.2910
POC	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
POC	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
POC	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
POC	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
a_p	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
a_p	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
DOC	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
DOC	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
CDOM	41	Mar 16 2023	13:53:25	17	25	10.4225	-25.2910
POC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
a_p	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
a_p	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
PIC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
PIC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
TSM	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
TSM	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
TSM blank	42	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
DOC	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
CDOM	42	Mar 19 2023	12:55:41	20;21;23	5	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
POC	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
a_p	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
a_p	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
DOC	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
DOC	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
CDOM	42	Mar 19 2023	12:55:41	17	25	20.6988	-24.9978
POC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
a_p	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
a_p	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
PIC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
PIC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
TSM	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
TSM	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
TSM blank	44	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
DOC	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
CDOM	44	Mar 20 2023	12:51:23	20;21;23	5	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
POC	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
a_p	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
a_p	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
DOC	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
DOC	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
CDOM	44	Mar 20 2023	12:51:23	17	25	23.7292	-24.9998
POC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
a_p	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
a_p	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
PIC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)							
Parameter	**station**	**date**	**time**	**Niskin**	**depth**	**lat**	**lon**
PIC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
TSM	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
TSM	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
TSM blank	46	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
DOC	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
CDOM	46	Mar 21 2023	12:52:18	20;21;23	5	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
POC	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
a_p	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
a_p	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
DOC	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
DOC	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
CDOM	46	Mar 21 2023	12:52:18	17	25	26.6517	-24.9962
POC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
a_p	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
a_p	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
PIC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
PIC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
TSM	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
TSM	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
TSM blank	48	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
DOC	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
CDOM	48	Mar 22 2023	12:54:21	20;21;23	5	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
POC	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
a_p	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
a_p	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
DOC	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
DOC	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
CDOM	48	Mar 22 2023	12:54:21	17	25	29.2720	-23.6775
POC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
a_p	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
a_p	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
PIC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
PIC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
TSM	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
TSM	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
TSM blank	50	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
DOC	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
CDOM	50	Mar 23 2023	12:49:37	20;21;23	5	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
POC	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
a_p	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
a_p	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
DOC	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
DOC	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
CDOM	50	Mar 23 2023	12:49:37	17	25	32.1053	-22.2233
POC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
a_p	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
a_p	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
PIC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
PIC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
PIC blank	52	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
TSM	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
TSM	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302

Table 4. Biogeochemical and optical properties samples collected by NASA during AMT 30 (cont.)

Parameter	station	date	time	Niskin	depth	lat	lon
TSM blank	52	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
DOC	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
CDOM	52	Mar 24 2023	12:56:14	20;21;23	5	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
POC	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
a_p	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
a_p	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
DOC	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
DOC	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
CDOM	52	Mar 24 2023	12:56:14	17	25	35.0978	-20.6302
POC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
a_p	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
a_p	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
PIC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
PIC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
TSM	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
TSM	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
DOC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
DOC	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
CDOM	54	Mar 25 2023	11:56:56	20;21;23	5	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
POC	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
a_p	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
a_p	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
DOC	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
DOC	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
CDOM	54	Mar 25 2023	11:56:56	14	25	37.7968	-18.7807
POC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
a_p	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
a_p	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
PIC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
PIC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
TSM	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
TSM	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
TSM blank	56	-9999	-9999	-9999	-9999	-9999.0000	-9999.0000
DOC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
DOC	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
CDOM	56	Mar 26 2023	11:44:55	19;21;23	5	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
POC	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
a_p	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
a_p	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
DOC	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
DOC	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182
CDOM	56	Mar 26 2023	11:44:55	19	15	40.5372	-16.9182

Sea-surface microlayer composition and air-sea gas transfer

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Objectives

1. Determine spatial variability in total surfactant activity and dissolved organic matter composition of the sea-surface microlayer and subsurface water.
2. Explore the microbiological community control of total surfactant pool composition variability.
3. Determine spatial variability in air-sea gas exchange throughout the cruise transect using eddy covariance and gas transfer efficiency estimates.
4. Explore correlation of variability in organic matter composition in the sea-surface microlayer and underlying water column with air-sea gas transfer velocity.

Methods

Sampling methods

Discrete sample details are outlined in Table 1. At each solar noon cast, sea-surface microlayer (SML; ~1000 µm depth) samples (n = 29) were collected manually deploying a Garrett Screen over the starboard mid-deck of the ship. Subsurface water (SSW; ~30 cm depth) samples were collected using a peristaltic pump provided by Joaquin Chaves (NASA), which was deployed manually over the starboard mid-deck of the ship. Underway water (UDW; ~6 m depth) was collected from the ship's non-toxic seawater supply from either the Deck Lab (n = 6) or the Met Lab (n = 22). Additional samples were collected from CTD niskin bottles, from 5 m (n = 3), deep chlorophyll maximum (n = 22) and 400 m (n = 22) depths.

CTD and discrete samples collected at respective solar noon stations; discrete samples were collected from the sea-surface microlayer (SML; ~1000 µm depth), subsurface water (SSW; ~30 cm depth) and underway water (~6 m depth) from the Deck Lab (UDWd) and Met Lab (UDWm).

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (+ve E)	CTD depths sampled (m)	Rosette bottle numbers	Other depths sampled
23/02/2023	15:45	STN02	CTD02	-45.5035	-47.8289	-	-	SML, UDWd
24/02/2023	15:56	STN04	CTD04	-43.3659	-44.6701	-	-	SML, UDWd
25/02/2023	15:48	STN06	CTD06	-40.3469	-43.8436	5	23	SML, UDWd
26/02/2023	15:49	STN07	CTD07	-38.4519	-42.7585	5	23	SML, UDWd
27/02/2023	16:02	STN09	CTD09	-36.7968	-39.6892	5	23	SML, UDWd
28/02/2023	15:53	STN11	CTD11	-34.9162	-36.433	-	-	SML, SSW, UDWd
01/03/2023	14:41	STN13	CTD13	-33.2734	-33.3372	-	-	SML, SSW, UDWd
02/03/2023	14:54	STN15	CTD15	-31.2746	-30.1955	DCM, 400	10, 2	SML, SSW, UDWm
03/03/2023	14:51	STN17	CTD17	-29.5629	-27.1319	DCM, 400	9, 2	SML,

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (+ve E)	CTD depths sampled (m)	Rosette bottle numbers	Other depths sampled
								SSW, UDWm
04/03/2023	14:54	STN19	CTD19	-27.3137	-24.5237	DCM, 400	10, 2	SML, SSW, UDWm
05/03/2023	14:42	STN21	CTD21	-24.0732	-24.5003	DCM, 400	8, 2	SML, SSW, UDWm
06/03/2023	14:57	STN23	CTD23	-20.8471	-24.4963	DCM, 400	8, 2	SML, SSW, UDWm
07/03/2023	14:47	STN24	CTD24	-18.0231	-25.0635	DCM, 400	8, 2	SML, SSW, UDWm
08/03/2023	14:57	STN26	CTD26	-14.8966	-25.0546	DCM, 400	8, 2	SML, SSW, UDWm
09/03/2023	14:57	STN28	CTD28	-11.8945	-25.0517	DCM, 400	10, 2	SML, SSW, UDWm
10/03/2023	14:57	STN30	CTD30	-8.7440	-25.1568	DCM, 400	11, 2	SML, SSW, UDWm
11/03/2023	14:48	STN32	CTD32	-5.6501	-25.1669	DCM, 400	11, 2	SML, SSW, UDWm
13/03/2023	14:53	STN35	CTD35	0.9298	-25.3773	DCM, 400	13, 2	SML, SSW, UDWm
14/03/2023	15:00	STN37	CTD37	4.1562	-25.4058	DCM, 400	14, 2	SML, SSW, UDWm
15/03/2023	14:55	STN39	CTD39	7.2689	-25.3455	DCM, 400	14, 2	SML, SSW, UDWm
16/03/2023	14:54	STN41	CTD41	10.4225	-25.2911	DCM, 400	13, 2	SML, SSW, UDWm
19/03/2023	13:54	STN42	CTD42	20.6988	-24.9978	DCM, 400	12, 2	SML, SSW, UDWm
20/03/2023	13:56	STN44	CTD44	23.7294	-24.9999	DCM, 400	14, 2	SML, SSW, UDWm
21/03/2021	13:41	STN46	CTD46	26.6516	-24.9962	DCM, 400	11, 2	SML, SSW, UDWm

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (+ve E)	CTD depths sampled (m)	Rosette bottle numbers	Other depths sampled
22/03/2023	13:57	STN48	CTD48	29.2721	-23.6775	DCM, 400	11, 2	SML, SSW, UDWm
23/03/2023	13:40	STN50	CTD50	32.1055	-22.2235	DCM, 400	11, 2	SML, SSW, UDWm
24/03/2023	13:56	STN52	CTD52	35.0978	-20.6301	DCM, 400	13, 2	SML, SSW, UDWm
25/03/2023	12:59	STN54	CTD54	37.7968	-18.7806	DCM, 400	15, 2	SML, SSW, UDWm
26/03/2023	12:49	STN56	CTD56	40.5371	-16.9181	DCM, 400	16, 2	SML, SSW, UDWm

Analytical methods

Air-sea gas exchange

Measurements of fast underway pCO_2 and gas exchange efficiency were made with two segmented flow coil equilibration (SFCE) systems (located in the Met Lab), described fully in Yang et al. (2021). This gas exchange efficiency will be related to the direct air-sea CO_2 flux measurements by the eddy covariance method (installed on the Met Platform); both methods were operational 24 hours per day where permitted. Discrete samples (SML, SSW, DCM and 400 m depth) were processed through the gas exchange efficiency system on an approximate daily basis. These analyses were undertaken in collaboration with Mingxi Yang and Tom Bell (both Plymouth Marine Laboratory).

Biogeochemical analyses

From each discrete sample, 60 ml unfiltered and filtered (0.7 µm GF/F) aliquots were taken and frozen at -80 ℃ for later analysis for total surfactant activity (unfiltered), dissolved surfactant activity (0.45 µm filtered) and dissolved organic matter composition (0.45 µm filtered; LC-OCD-UVD-OND). Aliquots of 150-1250 ml were filtered (0.7 µm GF/F) for solid phase extraction of dissolved organic matter (SPE-DOM); the loaded SPE-DOM cartridges were frozen at -20 ℃ for later processing with FT-IRMS. Where available, aliquots of 1-2 L were also filtered (0.1 µm sterile) for later DNA analysis; the filters were frozen at -80 ℃.

Analysis is currently underway of collected samples with first results expected in 2024.

Funding

Philippa's participation with AMT30, and associated collaborative work, was funded by the European Research Council starting grant 2020: Breathing Oceans: Understanding the Ocean's organic skin that modulates transfer of greenhouse gases between the atmosphere and Ocean (BOOGIE) project (PI: Ryan Pereira, *The Lyell Centre, Heriot-Watt University*).

References

Yang et al. (2021) Natural variability in air–sea gas transfer efficiency of CO_2, *Nature Scientific Reports*, 11:13584, doi.org/10.1038/s41598-021-92947-w

Abundance and Composition of Microbial Plankton Communities by flow cytometry

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Objective

To determine the distribution, abundance and community structure of nano- and picophytoplankton and heterotrophic bacteria from CTD casts by flow cytometry.

Phytoplankton community structure and abundance by flow cytometry.

Fresh seawater samples were collected in clean 250 mL polycarbonate bottles using a Seabird CTD system containing a 24 bottle rosette of 20 L Niskin bottles from 200 m to the surface at predawn and solar noon CTD casts. Samples were stored in a refrigerator and analysed within 2 hours of collection. Fresh samples were measured using a Becton Dickinson FACSort flow cytometer which characterised and enumerated *Prochlorococcus* sp. and *Synechococcus* sp. (cyanobacteria) and pico- and eukaryote phytoplankton, based on their light scattering and autofluorescence properties. Data were saved in listmode format and analysed during the cruise. Table 1 summarises the CTD casts sampled and analysed during the cruise.

Heterotrophic bacteria community structure and abundance by flow cytometry.

Samples for bacteria enumeration were collected in clean 250 mL polycarbonate bottles using a Seabird CTD system containing a 24 bottle rosette of 20 L Niskin bottles from 200 m to the surface at predawn and solar noon CTD casts. 0.5 mL samples were fixed with glutaraldehyde solution (Sigma-Aldrich, 50%, Grade 1. 0.5% final concentration, 30 mins at 4^{o}C) within half an hour of surfacing. Samples (see below) were stained for 1 h at room temperature in the dark with the DNA stain SYBR Green I (Thermo-Fisher) in order to separate particles in suspension based on DNA content and light scattering properties. This enabled bacteria to be discriminated from other particles and enumerated. Samples were analysed flow cytometrically, within 3 hours of surfacing. Stained samples were measured using a Becton Dickinson FACSort flow cytometer. Data were saved in listmode format and analysed during the cruise. Table 1 summarises the CTD casts sampled and analysed during the cruise.

CTD casts sampled for phytoplankton and heterotrophic bacteria community structure & abundance.

DATE	STATION	CTD	TIME on deck (GMT)	LAT +N, -S	LONG E	DEPTHS *NISKIN BOTTLES*
21-Feb	Test	Test	14:53	-50.07	-55.01	5 10 25 50 75 100 125 150 175 200 *23 21 19 17 15 13 11 9 7 5*
23-Feb	1	1	09:09	-46.10	-48.74	5 10 15 20 25 30 35 40 60 100 125 150 200 *21 20 19 18 16 15 12 11 10 9 8 7 6*
23-Feb	2	2	15:45	-45.50	-47.83	5 10 15 20 25 30 40 60 75 100 125 150 200 *22 20 19 18 16 11 10 9 8 7 6 5 4*
24-Feb	3	3	09:06	-44.03	-45.66	5 10 15 20 25 30 40 60 75 100 125 150 200 *21 20 19 18 16 13 12 11 10 9 8 7 6*
24-Feb	4	4	15:56	-43.37	-44.67	5 10 15 20 25 30 35 40 60 75 100 125 150 200 *22 20 19 17 16 14 11 10 9 8 7 6 5 4*
25-Feb	5	5	09:07	-41.25	-43.89	5 10 15 20 25 40 50 60 80 100 125 150 200 *21 20 19 18 16 15 14 13 10 9 8 7 6*

25-Feb	6	6	15:49	-40.35	-43.84	5 10 15 20 25 30 40 50 60 80 100 125 150 200 *22 20 19 17 16 14 13 12 9 8 7 6 5 4*
26-Feb	7	7	15:49	-38.45	-42.76	5 10 15 20 25 30 40 50 55 80 100 125 150 200 *22 19 17 16 14 13 12 9 8 7 6 5 4*
27-Feb	8	8	08:05	-37.43	-40.75	5 10 15 20 25 35 50 60 75 85 100 125 150 200 *21 20 19 18 17 16 15 14 13 10 9 8 7 6*
27-Feb	9	9	16:02	-36.80	-39.69	5 10 20 25 40 50 60 75 95 100 120 140 175 200 *22 20 18 17 15 14 13 12 9 8 7 6 5 4*
28-Feb	10	10	07:41	-35.53	-37.59	5 10 15 20 30 40 50 60 80 100 120 150 200 *21 20 19 18 17 16 15 14 13 10 9 8 7 6*
28-Feb	11	11	15:53	-34.92	-36.43	5 10 20 25 40 50 60 80 90 100 120 140 175 200 *22 20 18 17 15 14 13 12 9 8 7 6 5 4*
01-Mar	12	12	06:37	-33.94	-34.45	5 10 15 20 30 40 50 60 80 95 110 125 150 200 *21 20 19 18 17 16 15 14 13 12 9 8 7 6*
01-Mar	13	13	14:41	-33.27	-33.34	5 10 15 20 25 40 50 60 80 105 120 130 150 175 200 *22 20 18 17 15 14 13 12 9 8 7 6 5 4*
02-Mar	14	14	06:36	-31.87	-31.29	5 10 15 20 30 40 50 60 80 100 120 130 175 200 *21 20 19 18 17 16 15 14 13 12 11 10 7 6*
02-Mar	15	15	14:54	-31.27	-30.20	5 10 20 25 40 50 75 90 110 120 130 150 175 200 *22 20 18 17 15 14 13 12 9 8 7 6 5 4*
03-Mar	16	16	06:32	-30.15	-28.17	5 10 15 20 30 40 50 60 75 100 125 140 160 200 *21 20 19 18 17 16 15 14 13 12 11 8 7 6*
03-Mar	17	17	14:51	-29.56	-27.13	5 10 20 25 40 50 75 90 100 115 130 150 175 200 *22 20 18 17 15 14 13 12 11 8 7 6 5 4*
04-Mar	18	18	06:28	-28.38	-25.08	5 10 15 20 30 40 50 60 75 100 110 130 150 200 *21 20 19 18 17 16 15 14 13 12 11 8 7 6*
04-Mar	19	19	14:54	-27.31	-24.52	5 10 20 25 40 50 75 90 105 115 125 150 175 200 *22 20 18 17 15 14 13 12 9 8 7 6 5 4*
05-Mar	20	20	06:25	-25.16	-24.49	5 10 15 20 30 40 50 60 75 100 125 150 175 200 *21 19 18 17 16 15 14 13 12 11 8 7 9*
05-Mar	21	21	14:42	-24.07	-24.50	5 10 20 25 40 50 60 80 100 120 135 160 175 200 *22 20 18 17 15 14 13 12 11 10 7 6 5 4*
06-Mar	22	22	06:27	-21.96	-24.49	5 10 20 30 40 50 60 80 100 120 145 160 180 200 *21 20 19 18 17 16 15 14 13 12 11 8 7 6*
06-Mar	23	23	14:57	-20.85	-24.50	5 10 20 25 40 60 80 100 120 135 145 160 175 200 *22 19 17 16 15 14 13 12 11 10 7 6 5 4*
07-Mar	24	24	14:47	-18.02	-25.06	5 10 20 25 40 60 80 100 120 135 155 170 185 200 *22 19 17 16 15 14 13 12 11 10 7 6 5 4*
08-Mar	25	25	06:28	-16.01	-25.06	5 10 20 30 40 50 60 80 100 120 140 160 180 200 *21 20 19 18 17 16 15 14 13 12 11 8 7 6*
08-Mar	26	26	14:57	-14.90	-25.05	5 10 20 25 40 60 80 100 120 130 140 155 170 200 *22 19 17 16 15 14 13 12 11 10 7 6 5 4*
09-Mar	27	27	06:33	-12.80	-28.30	5 10 20 30 40 50 60 80 100 120 135 160 180 200 *21 20 19 18 17 16 15 14 13 12 11 8 7 6*
09-Mar	28	28	14:57	-11.89	-25.05	5 10 20 25 40 60 80 90 105 115 130 160 180 200 *22 19 17 16 15 14 13 12 9 8 7 6 5 4*
10-Mar	29	29	06:38	-9.86	-25.04	5 10 20 30 40 50 60 80 100 115 120 150 175 200 *21 20 19 18 17 16 15 14 13 12 11 8 7 6*
10-Mar	30	30	14:57	-8.74	-25.16	5 10 20 25 40 60 80 90 110 120 140 160 180 200 *22 19 18 17 16 15 14 13 10 9 7 6 5 4*
11-Mar	31	31	06:35	-6.68	-25.19	5 10 20 30 40 50 60 85 95 98 25 150 175 200 *21 20 19 18 17 16 15 14 10 12 9 8 7 6*
11-Mar	32	32	14:48	-5.65	-25.17	5 10 20 25 40 60 75 90 100 110 120 140 160 180 200 *22 19 18 17 16 15 14 13 10 9 8 7 6 5 4*
12-Mar	33	33	06:22	-3.64	-25.16	5 10 20 30 40 50 60 75 80 100 125 150 175 200 *21 20 19 18 17 16 14 12 11 10 9 8 7 6*
13-Mar	34	34	07:17	0.00	-25.14	5 10 20 30 40 50 65 75 80 100 125 150 175 200 *21 20 19 18 17 16 14 12 11 10 9 8 7 6*
13-Mar	35	35	14:53	0.93	-25.38	5 10 20 25 40 50 60 80 100 120 140 160 180 200 *22 19 18 17 16 15 12 10 9 8 7 6 5 4*

14-Mar	36	36	06:31	3.02	-25.42	5 10 20 30 40 52 60 70 80 100 125 150 175 200 *21 20 19 18 17 15 13 12 11 10 9 8 7 6*
14-Mar	37	37	15:00	4.16	-25.41	5 10 20 25 40 47 60 70 85 100 120 140 160 180 200 *22 19 18 17 16 13 12 11 10 9 8 7 6 5 4*
15-Mar	38	38	06:30	6.18	-25.37	5 10 20 30 40 50 58 70 80 100 125 150 175 200 *21 20 19 18 17 16 13 12 11 10 9 8 7 6*
15-Mar	39	39	14:55	7.27	-25.35	5 10 20 25 40 48 60 70 85 100 120 140 160 180 200 *22 19 18 17 16 13 12 11 10 9 8 7 6 5 4*
16-Mar	40	40	06:33	9.26	-25.31	5 10 20 30 40 50 63 70 80 100 125 150 175 200 *21 20 19 18 17 16 14 12 11 10 9 8 7 6*
16-Mar	41	41	14:54	10.42	-25.29	5 10 20 25 40 50 56 70 80 100 125 150 175 200 *22 19 18 17 16 15 12 11 10 8 7 6 5 4*
19-Mar	42	42	13:54	20.70	-25.00	5 10 20 25 40 50 70 83 100 110 125 150 175 200 *22 19 18 17 16 15 14 11 10 8 7 6 5 4*
20-Mar	43	43	05:33	22.61	-25.00	5 10 20 30 40 50 75 90 95 110 125 150 175 200 *21 20 19 18 17 16 15 12 11 10 9 8 7 6*
20-Mar	44	44	13:56	23.73	-25.00	5 10 20 25 40 55 70 78 90 100 115 125 150 175 200 *22 19 18 17 16 15 14 11 10 9 8 7 6 5 4*
21-Mar	45	45	05:34	25.70	-25.00	5 10 20 30 40 50 75 85 95 110 125 150 175 200 *21 20 19 18 17 16 15 13 11 10 9 8 7 6*
21-Mar	46	46	13:41	26.65	-25.00	5 10 20 25 40 55 70 80 90 100 120 135 150 175 200 *22 19 18 17 16 15 14 13 10 9 8 7 6 5 4*
22-Mar	47	47	05:37	28.35	-24.15	4 10 20 30 40 50 75 90 100 110 125 150 175 200 *21 20 19 18 17 16 15 14 12 10 9 8 7 6*
22-Mar	48	48	13:57	29.27	-23.68	5 10 20 25 40 55 70 90 112 120 135 150 175 200 *22 19 18 17 16 15 14 13 10 9 7 6 5 4*
23-Mar	49	49	05:25	31.00	-22.77	5 10 20 30 40 50 75 80 95 110 125 150 175 200 *21 20 19 18 17 16 15 14 12 10 9 8 7 6*
23-Mar	50	50	13:40	32.11	-22.22	5 10 20 25 40 55 70 80 88 100 120 135 150 175 200 *22 19 18 17 16 15 14 13 10 9 8 7 6 5 4*
24-Mar	51	51	05:30	34.07	-21.19	5 10 20 30 40 50 60 73 85 100 125 150 175 200 *21 20 19 18 17 16 15 13 11 10 9 8 7 6*
24-Mar	52	52	13:56	35.10	-20.63	5 10 20 25 40 55 62 75 90 100 120 135 150 175 200 *22 19 18 17 16 15 12 11 10 9 8 7 6 5 4*
25-Mar	53	53	04:34	36.79	-19.46	5 10 20 25 30 40 48 55 60 80 100 135 150 200 *21 20 19 18 17 16 15 12 11 10 9 8 7 6*
25-Mar	54	54	12:59	37.80	-18.78	5 10 15 25 40 50 75 90 100 120 135 150 175 200 *22 19 18 17 14 13 12 11 10 9 8 7 6 5 4*
26-Mar	55	55	04:39	39.66	-17.53	5 10 15 20 30 35 40 50 60 80 100 125 150 200 *21 20 19 18 17 16 13 12 11 10 9 8 7 6*
26-Mar	56	56	12:49	40.54	-16.92	5 10 15 20 30 40 50 75 90 100 120 135 150 175 200 *22 20 18 15 14 13 12 11 10 9 8 7 6 5 4*

Additional flow cytometry.

Enumeration of algae and bacteria in iodine incubation experiments

Live 4 mL samples collected in cryovials were provided by Kirsten Fentzke of Michigan State University to test for bottle effects in on-deck incubation experiments. Samples were treated and analysed as per phytoplankton and bacteria community structure samples in previous sections. See relevant section in this cruise report for summary of incubation experiments.

Microplankton Community Size Structure and abundance

Glen Tarran, *Plymouth Marine Laboratory, Plymouth*

Methods:

11 L seawater samples from 20 m and the deep chlorophyll maximum (DCM) were collected from solar noon CTD casts into polyethylene carboys and brought into the Main Lab. 50mm diameter plastic pipes with 20 µm mesh fitted to the end were inserted into the carboys and then siphon tubes were inserted into the filtering pipes. Seawater was then siphoned out of the carboys through the 20µm mesh, a technique known as reverse filtration, leaving a concentrated seawater sample containing plankton >20 µm in size. Samples were topped up to 150 mL using the seawater filtrate and transferred to amber glass bottles, followed by 3 mL of acid Lugol's solution to preserve the plankton. Samples were then stored in the walk-in cold room at 4^{o}C. Back in the UK, samples will be analysed using a FlowCAM to provide information on taxonomic composition, size distribution and abundance.

Details of microplankton reverse filtration samples

DATE	CTD	LAT (N+, S-)	LONG W	DEPTH SAMPLED (m)	FINAL SAMPLE VOL. mL	PRESERVED SAMPLE NAME
23-Feb	2	-45.50	-47.83	20	150	A30M_0223_20
23-Feb	2	-45.50	-47.83	30	150	A30M_0223_30
24-Feb	4	-43.37	-44.67	20	150	A30M_0224_20
24-Feb	4	-43.37	-44.67	30	150	A30M_0224_30
25-Feb	6	-40.35	-43.84	20	150	A30M_0225_20
25-Feb	6	-40.35	-43.84	60	150	A30M_0225_60
26-Feb	7	-38.45	-42.76	20	150	A30M_0226_20
26-Feb	7	-38.45	-42.76	55	150	A30M_0226_55
27-Feb	9	-36.80	-39.69	20	150	A30M_0227_20
27-Feb	9	-36.80	-39.69	95	150	A30M_0227_95
28-Feb	11	-34.92	-36.43	20	150	A30M_0228_20
28-Feb	11	-34.92	-36.43	90	150	A30M_0228_90
01-Mar	13	-33.27	-33.34	20	150	A30M_0301_20
01-Mar	13	-33.27	-33.34	105	150	A30M_0301_105
02-Mar	15	-31.27	-30.20	20	150	A30M_0302_20
02-Mar	15	-31.27	-30.20	110	150	A30M_0302_110
03-Mar	17	-29.56	-27.13	20	150	A30M_0303_20
03-Mar	17	-29.56	-27.13	115	150	A30M_0303_115
04-Mar	19	-27.31	-24.52	20	150	A30M_0304_20
04-Mar	19	-27.31	-24.52	105	150	A30M_0304_105
06-Mar	23	-20.85	-24.50	20	150	A30M_0306_20
06-Mar	23	-20.85	-24.50	145	150	A30M_0306_145
08-Mar	26	-14.90	-25.05	20	150	A30M_0308_20
08-Mar	26	-14.90	-25.05	140	150	A30M_0308_140
09-Mar	28	-11.89	-25.05	20	150	A30M_0309_20
09-Mar	28	-11.89	-25.05	105	150	A30M_0309_105
10-Mar	30	-8.74	-25.16	20	150	A30M_0310_20
10-Mar	30	-8.74	-25.16	110	150	A30M_0310_110
11-Mar	32	-5.65	-25.17	20	150	A30M_0311_20

11-Mar	32	-5.65	-25.17	100	150	A30M_0311_100
13-Mar	35	0.93	-25.38	30	150	A30M_0313_20
13-Mar	35	0.93	-25.38	60	150	A30M_0313_60
14-Mar	37	4.16	-25.41	20	150	A30M_0314_20
14-Mar	37	4.16	-25.41	47	150	A30M_0314_47
15-Mar	39	7.27	-25.35	20	150	A30M_0315_20
15-Mar	39	7.27	-25.35	48	150	A30M_0315_48
16-Mar	41	10.42	-25.29	20	150	A30M_0316_20
16-Mar	41	10.42	-25.29	56	150	A30M_0316_56
19-Mar	42	20.70	-25.00	20	150	A30M_0319_20
19-Mar	42	20.70	-25.00	83	150	A30M_0319_83
20-Mar	44	23.73	-25.00	20	150	A30M_0320_20
20-Mar	44	23.73	-25.00	78	150	A30M_0320_78
21-Mar	46	26.65	-25.00	20	150	A30M_0321_20
21-Mar	46	26.65	-25.00	90	150	A30M_0321_90
22-Mar	48	29.27	-23.68	20	150	A30M_0322_20
22-Mar	48	29.27	-23.68	112	150	A30M_0322_112
23-Mar	50	32.11	-22.22	20	150	A30M_0323_20
23-Mar	50	32.11	-22.22	88	150	A30M_0323_88
24-Mar	52	35.10	-20.63	20	150	A30M_0324_20
24-Mar	52	35.10	-20.63	62	150	A30M_0324_62
25-Mar	54	37.80	-18.78	10	150	A30M_0325_10
25-Mar	54	37.80	-18.78	25	150	A30M_0325_25
26-Mar	56	40.54	-16.92	10	150	A30M_0326_10
26-Mar	56	40.54	-16.92	20	150	A30M_0326_20

Extraction of phytoplankton pigments for High Performance Liquid Chromatography (HPLC) analysis

Andreia Tracana[1] and Gavin Tilstone[2]
[1]University of Lisbon, [2]Plymouth Marine Laboratory

Objectives

- To examine the horizontal and vertical phytoplankton pigment composition along the AMT30 transect (at the surface and at the subsurface chlorophyll maximum) (NERC-NC AMT).
- The continuation of a 21-year spatially extensive and internally consistent time series of observations on the pigment structure of phytoplankton in the Atlantic Ocean (NERC-NC AMT).
- Collecting phytoplankton pigment data for the development and validation of remote-sensing algorithms and marine ecosystem models designed to predict and model the phytoplankton biomass and community structure at basin scales.
- Collecting phytoplankton pigment data for the validation of remote-sensing algorithms for estimating phytoplankton pigment concentration on the newly-launched European Space Agency (ESA) Sentinel-3A and -3B satellites (AMT4CO2Flux).

Equipment

- 25 mm glass fibre filters (GF/F)
- 1 and 2 litre measuring cylinders
- Millipore forceps
- Cryovials
- Cryo-pen
- Filtration rig
- Gloves
- Liquid nitrogen for flash freezing.

Methods

Seawater samples were collected from the pre-dawn and noon CTD casts, and from the ship's underway system. Seawater was sampled into 9.5 L polypropylene carboys covered in black plastic to keep out light. Using forceps, GF/F filters were placed on the filter rig with the smoother side facing down. Filter papers were fully covered over sintered glass circles such that there were no gaps and water could only pass through GF/F filters. Seawater samples were mixed to avoid issues with sedimentation. 2-4 L samples (depending on phytoplankton biomass, e.g. 2 L in productive waters and 4-5 L in the oligotrophic gyres) were measured using the rinsed measuring cylinders, and then decanted into rinsed polypropylene bottles with siphon tubes and inverted into a 4 port vacuum filtration rig. Samples were filtered using a low-medium vacuum setting on the vacuum pump. When the last of the water passed through the filter paper, taps on the vacuum pump were closed and the resulting sample filters were folded into 2 mL cryovials and flash frozen in liquid nitrogen and stored in the -80ºC freezer. For each station, 2 samples were taken at the surface (~5m), and around the subsurface chlorophyll maximum (which varied between 23m-162m). In addition there were three CTD stations that occurred at 10:00am local time, to coincide with Sentinel-3 overpass, and water was collected at 5 and 20m. Duplicate HPLC measurements were taken at both depths for every station (except the 10:00 stations, and on occasions when a CTD bottle misfired and there was not enough water to do a duplicate). Two daily samples were also taken using the ships underway system around the time of each station (to compare with surface CTD samples and for calibrating the ACS optics instrument). Frozen samples are to be analysed using HPLC methods at University of Lisbon and NASA after the cruise. Table 1 shows the locations and stations of the HPLC samples for ULisbon (total 113) and table 2 for PML/ NASA. (Total 180).

Station locations of HPLC samples for University of Lisbon

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)
50° 4.234' S	55°0.69'	21/02/2023	13:31	-	CTD	test 00	5	2
46° 5.863' S	48° 44.321'	23/02/2023	8:24	1	CTD	1	5	2
46° 5.863' S	48° 44.321'	23/02/2023	8:24	1	CTD	1	30	4
45° 30.20808' S	47° 49.73694'	23/02/2023	15:02	2	CTD	2	5	2
45° 30.20808' S	47° 49.73694'	23/02/2023	15:02	2	CTD	2	30	2
44° 1.939' S	45° 39.604'	24/02/2023	8:11	3	CTD	3	5	3
44° 1.939' S	45° 39.604'	24/02/2023	8:11	3	CTD	3	25	3
43° 21.954' S	44° 40.207'	24/02/2023	15:06	4	CTD	4	5	2
43° 21.954' S	44° 40.207'	24/02/2023	15:06	4	CTD	4	30	2
41° 14.809' S	43° 53.409'	25/02/2023	8:07	5	CTD	5	5	2.5
41° 14.809' S	43° 53.409'	25/02/2023	8:07	5	CTD	5	60	2
40° 20.812' S	43° 50.616'	25/02/2023	15:00	6	CTD	6	5	4
40° 20.812' S	43° 50.616'	25/02/2023	15:00	6	CTD	6	60	2
38°27.109'S	42° 45.511'	26/02/2023	15:04	7	CTD	7	5	4
38°27.109'S	42° 45.511'	26/02/2023	15:04	7	CTD	7	55	4
37° 23.517' S	40° 44.85558'	27/02/2023	7:11	8	CTD	8	5	4
37° 23.517' S	40° 44.85558'	27/02/2023	7:11	8	CTD	8	75	4
36° 47.806' S	39° 41.354'	27/02/2023	15:03	9	CTD	9	5	4
36° 47.806' S	39° 41.354'	27/02/2023	15:03	9	CTD	9	95	4
35° 31.928' S	37° 35.191'	28/02/2023	6:51	10	CTD	10	5	4
35° 31.928' S	37° 35.191'	28/02/2023	6:51	10	CTD	10	80	4
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	CTD	11	5	4
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	CTD	11	90	4
33° 56.099' S	34° 27.211'	01/03/2023	5:46	12	CTD	12	5	4
33° 56.099' S	34° 27.211'	01/03/2023	5:46	12	CTD	12	95	4
33° 16.405' S	33° 20.230'	01/03/2023	14:01	13	CTD	13	5	4
33° 16.405' S	33° 20.230'	01/03/2023	14:01	13	CTD	13	105	4
31° 52.301' S	31° 17.554'	02/03/2023	5:46	14	CTD	14	5	4
31° 52.301' S	31° 17.554'	02/03/2023	5:46	14	CTD	14	130	4
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	CTD	15	5	4
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	CTD	15	110	4
30° 9.271' S	28° 10.325'	03/03/2023	5:40	16	CTD	16	5	4
30° 9.271' S	28° 10.325'	03/03/2023	5:40	16	CTD	16	125	4
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	CTD	17	5	4
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	CTD	17	115	4
28° 23.068' S	25° 4.940'	04/03/2023	5:34	18	CTD	18	5	4
28° 23.068' S	25° 4.940'	04/03/2023	5:34	18	CTD	18	110	4
27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	CTD	19	5	4
27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	CTD	19	105	3
25° 09.470' S	24° 29.490'	05/03/2023	5:35	20	CTD	20	5	4

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)
25° 09.470' S	24° 29.490'	05/03/2023	5:35	20	CTD	20	125	4
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	CTD	21	5	4
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	CTD	21	135	4
21° 57.672' S	24° 29.698'	06/03/2023	5:35	22	CTD	22	5	4
21° 57.672' S	24° 29.698'	06/03/2023	5:35	22	CTD	22	145	4
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	CTD	23	5	4
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	CTD	23	145	4
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	CTD	24	5	4
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	CTD	24	155	4
16° 0.886' S	25° 3.679'	08/03/2023	05:37	25	CTD	25	5	4
16° 0.886' S	25° 3.679'	08/03/2023	05:37	25	CTD	25	140	4
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	CTD	26	5	4
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	CTD	26	140	4
12° 48.274' S	25° 3.197'	09/03/2023	5:40	27	CTD	27	5	4
12° 48.274' S	25° 3.197'	09/03/2023	5:40	27	CTD	27	135	4
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	CTD	28	5	4
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	CTD	28	105	4
09° 51.837' S	25° 2.554'	10/03/2023	5:42	29	CTD	29	5	4
09° 51.837' S	25° 2.554'	10/03/2023	5:42	29	CTD	29	120	4
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	CTD	30	5	3
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	CTD	30	110	2.8
06° 40.951' S	25° 11.471'	11/03/2023	5:39	31	CTD	31	5	3
06° 40.951' S	25° 11.471'	11/03/2023	5:39	31	CTD	31	98	2
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	CTD	32	5	3
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	CTD	32	100	2
03° 38.398' S	25° 9.871'	12/03/2023	5:32	33	CTD	33	5	3
03° 38.398' S	25° 9.871'	12/03/2023	5:32	33	CTD	33	60	2
0° 0.064' N	25° 8.220'	13/03/2023	6:25	34	CTD	34	5	3
0° 0.064' N	25° 8.220'	13/03/2023	6:25	34	CTD	34	65	2
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	CTD	35	5	2
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	CTD	35	65	2
3° 1.109' N	25° 25.060'	14/03/2023	5:36	36	CTD	36	5	2
3° 1.109' N	25° 25.060'	14/03/2023	5:36	36	CTD	36	52	2
4° 9.370' N	25° 24.350'	14/03/2023	13:59	37	CTD	37	5	2
4° 9.370' N	25° 24.350'	14/03/2023	13:59	37	CTD	37	47	1
6° 10.680' N	25° 22.130'	15/03/2023	5:33	38	CTD	38	5	2
6° 10.680' N	25° 22.130'	15/03/2023	5:33	38	CTD	38	59	2
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	CTD	39	5	2
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	CTD	39	48	1
9° 15.863' N	25° 18.728'	16/03/2023	5:41	40	CTD	40	5	2
9° 15.863' N	25° 18.728'	16/03/2023	5:41	40	CTD	40	63	1

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)
10° 25.350' N	25° 17.9460'	16/03/2023	13:59	41	CTD	41	5	2
10° 25.350' N	25° 17.9460'	16/03/2023	13:59	41	CTD	41	56	1
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	CTD	42	5	3
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	CTD	42	83	3
22° 36.896' N	25° 0.244'	20/03/2023	4:38	43	CTD	43	5	3
22° 36.896' N	25° 0.244'	20/03/2023	4:38	43	CTD	43	90	3
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	CTD	44	5	4
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	CTD	44	70	3
24° 42.029' N	25° 0.064'	21/03/2023	4:40	45	CTD	45	5	4
24° 42.029' N	25° 0.064'	21/03/2023	4:40	45	CTD	45	85	3
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	CTD	46	5	4
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	CTD	46	90	3
28° 28.896' N	24° 8.857'	22/03/2023	4:47	47	CTD	47	5	3
28° 28.896' N	24° 8.857'	22/03/2023	4:47	47	CTD	47	100	3
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	CTD	48	5	3
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	CTD	48	112	3
31° 3.040' N	22° 46.226'	23/03/2023	4:33	49	CTD	49	5	3
31° 3.040' N	22° 46.226'	23/03/2023	4:33	49	CTD	49	95	3
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	CTD	50	5	3
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	CTD	50	88	3
36° 47.653' N	19° 27.634'	24/03/2023	4:37	51	CTD	51	5	3
36° 47.653' N	19° 27.634'	24/03/2023	4:37	51	CTD	51	73	3
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	CTD	52	5	3
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	CTD	52	62	2
36° 47.653' N	19° 27.634'	25/03/2023	3:41	53	CTD	53	5	3
36° 47.653' N	19° 27.634'	25/03/2023	3:41	53	CTD	53	48	3
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	CTD	54	5	2
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	CTD	54	25	2
39° 39.666' N	17° 31.558'	26/03/2023	3:43	55	CTD	55	5	1
39° 39.666' N	17° 31.558'	26/03/2023	3:43	55	CTD	55	35	2
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	CTD	56	5	2
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	CTD	56	20	2

Station locations of HPLC samples on AMT 30 for PML/NASA

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)	Rep.
47° 46.74432' S	51° 19.12674'	22/02/2023	11:35	-	UW	UW	UW	1	
47° 33.38490' S	50° 58.11162'	22/02/2023	13:51	-	UW	UW	UW	2	
47° 16.79250' S	50° 33.17766'	22/02/2023	18:54	-	UW	UW	UW	2	
46° 5.90616' S	48° 44.21556'	23/02/2023	7:59	-	UW	UW	UW	2	
45° 48.35850' S	48° 17.30910'	23/02/2023	12:01	-	UW	UW	UW	2	
45° 30.20808' S	47° 49.73694'	23/02/2023	15:09	-	UW	UW	UW	2	
45° 30.20808' S	47° 49.73694'	23/02/2023	15:02	2	CTD	2	5	2	A
45° 30.20808' S	47° 49.73694'	23/02/2023	15:02	2	CTD	2	30	2	
45° 30.20808' S	47° 49.73694'	23/02/2023	15:02	2	CTD	2	5	2	B
45° 09.33294' S	47° 19.09086'	23/02/2023	19:14	-	UW	UW	UW	2	
43° 20.46564' S	44° 38.45256'	24/02/2023	16:28	-	UW	UW	UW	2	
43° 21.954' S	44° 40.207'	24/02/2023	15:06	4	CTD	4	5	2	
43° 21.954' S	44° 40.207'	24/02/2023	15:06	4	CTD	4	30	2	
42° 57.39198' S	44° 27.45294'	24/02/2023	19:01	-	UW	UW	UW	2	
41° 14.81520' S	43° 53.41602'	25/02/2023	8:03	-	UW	UW	UW	2	
40° 46.99518' S	43° 44.454'	25/02/2023	12:01	-	UW	UW	UW	2.7	
40° 20.81346' S	43° 50.61666'	25/02/2023	14:57	-	UW	UW	UW	3.6	
40° 20.812' S	43° 50.616'	25/02/2023	15:00	6	CTD	6	5	3.6	
40° 20.812' S	43° 50.616'	25/02/2023	15:00	6	CTD	6	60	2	
39° 53.11668' S	44° 4.666'	25/02/2023	18:59	-	UW	UW	UW	2	
38° 56.6' S	43° 4.6'	26/02/2023	7:00	-	UW	UW	UW	3.6	
38° 38.59320' S	43° 9.50640'	26/02/2023	12:01	-	UW	UW	UW	3	
38° 27.10932'S	42° 45.51240'	26/02/2023	15:00	-	UW	UW	UW	4	
38°27.109'S	42° 45.511'	26/02/2023	15:04	7	CTD	7	5	4	
38°27.109'S	42° 45.511'	26/02/2023	15:04	7	CTD	7	55	4	
38° 14.6156' S	42° 18.53460'	26/02/2023	19:14	-	UW	UW	UW	4	
37° 25.51752' S	40° 44.85558'	27/02/2023	7:50	-	UW	UW	UW	4	
37° 3.91824' S	40° 8.17464'	27/02/2023	12:03	-	UW	UW	UW	4	
36° 47.80830' S	39° 41.35566'	27/02/2023	15:09	-	UW	UW	UW	4	
36° 47.806' S	39° 41.354'	27/02/2023	15:03	9	CTD	9	5	4	
36° 47.806' S	39° 41.354'	27/02/2023	15:03	9	CTD	9	95	4	
36° 29.23788' S	39° 13.83480'	27/02/2023	19:15	-	UW	UW	UW	4	
35° 31.92540' S	37° 35.19144'	28/02/2023	7:14	-	UW	UW	UW	4	
35° 9.96612' S	36° 55.79814'	28/02/2023	12:01	-	UW	UW	UW	4	
34° 54.97542' S	36° 25.97844'	28/02/2023	15:04	-	UW	UW	UW	4	A
34° 54.97542' S	36° 25.97844'	28/02/2023	15:04	-	UW	UW	UW	4	B
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	CTD	11	5	4	
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	CTD	11	90	4	
34° 38.05890'	35 53.32338'	28/02/2023	19:21	-	UW	UW	UW	4	
33° 33.78534' S	33° 49.90392'	01/03/2023	11:00	-	UW	UW	UW	4	

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)	Rep.
33° 16.40202' S	33° 20.13678'	01/03/2023	14:33	-	UW	UW	UW	4	
33° 16.405' S	33° 20.230'	01/03/2023	14:01	13	CTD	13	5	4	
33° 16.405' S	33° 20.230'	01/03/2023	14:01	13	CTD	13	105	4	A
33° 16.405' S	33° 20.230'	01/03/2023	14:01	13	CTD	13	105	4	B
32° 57.085' S	32° 51.543'	01/03/2023	17:57	-	UW	UW	UW	4	
31° 16.474' S	30° 11.729'	02/03/2023	11:00	-	UW	UW	UW	4	
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	CTD	15	5	4	
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	CTD	15	110	4	
31° 1.5755' S	29° 45.1196'	02/03/2023	17:59	-	UW	UW	UW	4	
29° 50.54784' S	27° 38.21622'	03/03/2023	10:43	-	UW	UW	UW	4	
29° 33.77202' S	27° 7.91646'	03/03/2023	14:37	-	UW	UW	UW	4	
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	CTD	17	5	4	
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	CTD	17	115	4	
29° 17.36544' S	26° 39.10188'	03/03/2023	18:00	-	UW	UW	UW	4	
27° 44.81688' S	24° 45.34920'	04/03/2023	11:00	-	UW	UW	UW	4	
27° 18.82128' S	24° 31.42062'	04/03/2023	14:48	-	UW	UW	UW	4	
27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	CTD	19	5	4	
27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	CTD	19	105	3	
26° 48.5007' S	24° 31.8533'	04/03/2023	18:02	-	UW	UW	UW	4	A
26° 48.5007' S	24° 31.8533'	04/03/2023	18:02	-	UW	UW	UW	3.6	B
24° 32.47392' S	24° 30.08844'	05/03/2023	10:49	-	UW	UW	UW	4	
24° 4.39218' S	24° 30.01854'	05/03/2023	14:45	-	UW	UW	UW	3.9	
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	CTD	21	5	4	
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	CTD	21	135	4	
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	CTD	21	160	4	
23° 35.89644' S	24° 30.03732'	05/03/2023	17:53	-	UW	UW	UW	4	
21° 18.22554' S	24° 30.05646'	06/03/2023	10:58	-	UW	UW	UW	4	
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	CTD	23	5	4	
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	CTD	23	145	4	
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	CTD	23	175	4	
20° 50.82636' S	24° 29.78028'	06/03/2023	14:37	-	UW	UW	UW	4	
20° 23.42178' S	24° 37.50426'	06/03/2023	18:01	-	UW	UW	UW	2	
18° 31.92408' S	25° 5.35266'	07/03/2023	10:32	-	UW	UW	UW	2	A
18° 1.39296' S	25° 3.79296'	07/03/2023	13:51	-	UW	UW	UW	4	
18° 31.92408' S	25° 5.35266'	07/03/2023	10:32	-	UW	UW	UW	4	B
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	CTD	24	5	4	
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	CTD	24	155	4	
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	CTD	24	185	3.3	
17° 33.87846' S	25° 3.53682'	07/03/2023	18:19	-	UW	UW	UW	4	
15° 21.48666' S	25° 3.52578'	08/03/2023	10:56	-	UW	UW	UW	4	
14° 53.796' S	25° 3.276'	08/03/2023	14:35	-	UW	UW	UW	4	

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)	Rep.
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	CTD	26	5	4	
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	CTD	26	140	4	
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	CTD	26	170	3	
14° 28.24530' S	25° 3.53550'	08/03/2023	17:41	-	UW	UW	UW	4	
12° 21.508' S	25° 3.281'	09/03/2023	10:52	-	UW	UW	UW	4	
11° 53.658' S	25° 3.179'	09/03/2023	11:46	-	UW	UW	UW	4	
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	CTD	28	5	4	
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	CTD	28	105	4	
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	CTD	28	130	4	
11° 28.2355' S	25° 3.0628'	09/03/2023	17:52	-	UW	UW	UW	4	
09° 11.121' S	25° 2.965'	10/03/2023	11:05	-	UW	UW	UW	4	
08° 44.642' S	25° 9.408'	10/03/2023	14:14	-	UW	UW	UW	4	
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	CTD	30	5	3	
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	CTD	30	110	2.8	
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	CTD	30	140	4	
08° 16.755' S	25° 9.939'	10/03/2023	17:55	-	UW	UW	UW	4	
06° 5.668' S	25° 10.017'	11/03/2023	10:55	-	UW	UW	UW	3	
05° 35.893' S	25° 10.0808'	11/03/2023	15:20	-	UW	UW	UW	3	
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	CTD	32	5	3	
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	CTD	32	100	2	
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	CTD	32	120	3	
05° 2.9597' S	25° 9.746'	11/03/2023	19:20	-	UW	UW	UW	3	
03° 3.442' S	25° 10.095'	12/03/2023	10:35	-	UW	UW	UW	2	
0° 26.253' N	25° 16.004'	13/03/2023	10:42	-	UW	UW	UW	2	A
0° 26.253' N	25° 16.004'	13/03/2023	10:42	-	UW	UW	UW	2	B
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	CTD	35	5	2	
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	CTD	35	65	2	
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	CTD	35	80	3	
0° 55.756' N	25° 22.636'	13/03/2023	13:51	-	UW	UW	UW	3	
1° 29.736' N	25° 26.922'	13/03/2023	18:34	-	UW	UW	UW	2	
3° 42.966' N	25° 24.474'	14/03/2023	11:05	-	UW	UW	UW	2	
4° 9.370' N	25° 24.350'	14/03/2023	13:59	37	CTD	37	5	2	
4° 9.370' N	25° 24.350'	14/03/2023	13:59	37	CTD	37	47	1	
4° 9.370' N	25° 24.350'	14/03/2023	13:59	37	CTD	37	70	2	
4° 9.371' N	25° 24.348'	14/03/2023	14:37	-	UW	UW	UW	2	
4° 34.158' N	25° 23.616'	14/03/2023	17:49	-	UW	UW	UW	2	
6° 38.842' N	25° 20.591'	15/03/2023	9:56	-	UW	UW	UW	2	
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	CTD	39	5	2	A
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	CTD	39	48	1	
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	CTD	39	70	2	
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	CTD	39	5	2	B

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)	Rep.
7° 21.273' N	25° 20.550'	15/03/2023	16:00	-	UW	UW	UW	2	
7° 49.196' N	25° 20.377'	15/03/2023	19:11	-	UW	UW	UW	2	
9° 57.394' N	25° 17.940'	16/03/2023	11:00	-	UW	UW	UW	2	
10° 25.350' N	25° 17.9460'	16/03/2023	13:59	41	CTD	41	5	2	
10° 25.350' N	25° 17.9460'	16/03/2023	13:59	41	CTD	41	56	1	
10° 25.350' N	25° 17.9460'	16/03/2023	13:59	41	CTD	41	80	2	
10° 25.350' N	25° 17.9460'	16/03/2023	12:57	-	UW	UW	UW	2	
11° 1.050' N	25° 16.904'	16/03/2023	18:57	-	UW	UW	UW	2	
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	CTD	42	5	3	
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	CTD	42	83	3	
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	CTD	42	110	4	
22° 37.546' N	25° 0.036'	20/03/2023	5:49	-	UW	UW	UW	2	
23° 32.869' N	24° 59.966'	20/03/2023	11:40	-	UW	UW	UW	2	
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	CTD	44	5	4	
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	CTD	44	70	3	
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	CTD	44	110	4	
24° 9.493' N	24° 59.749'	20/03/2023	16:53	-	UW	UW	UW	4	
24° 42.029' N	25° 0.064'	21/03/2023	5:01	-	UW	UW	UW	3	
26°29.543' N	24° 59.977'	21/03/2023	11:40	-	UW	UW	UW	4	
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	CTD	46	5	4	
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	CTD	46	90	3	
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	CTD	46	110	4	
27° 7.361' N	24° 45.476'	21/03/2023	17:10	-	UW	UW	UW	3	
28° 28.896' N	24° 8.857'	22/03/2023	5:10	-	UW	UW	UW	4	
29° 7.023' N	23° 45.496'	22/03/2023	11:40	-	UW	UW	UW	2	A
29° 7.023' N	23° 45.496'	22/03/2023	11:40	-	UW	UW	UW	2	B
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	CTD	48	5	3	
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	CTD	48	112	3	
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	CTD	48	135	4	
29° 47.890' N	23° 24.910'	22/03/2023	18:00	-	UW	UW	UW	4	
31° 3.040' N	22° 46.226'	23/03/2023	5:06	-	UW	UW	UW	4	
31° 55.875' N	22° 18.755'	23/03/2023	11:38	-	UW	-	UW	4	
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	CTD	50	5	3	
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	CTD	50	88	3	
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	CTD	50	135	4	
32° 46.948' N	21° 51.983'	23/03/2023	18:12	-	UW	UW	UW	4	
34° 3.916' N	21° 11.31078'	24/03/2023	4:56	-	UW	UW	UW	3	
34° 54.726' N	20° 43.882'	24/03/2023	11:35	-	UW	UW	UW	4	
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	CTD	52	5	2.9	
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	CTD	52	62	2	
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	CTD	52	90	4	

Lat	Lon (W)	Date	Time (GMT)	Station	Type	CTD	Depth (m)	Volume (L)	Rep.
35° 43.422' N	20° 10.473'	24/03/2023	18:25	-	UW	UW	UW	2	
36° 47.654' N	19° 27.634'	25/03/2023	4:15	-	UW	UW	UW	3	
37° 37.606' N	18° 53.270'	25/03/2023	11:40	-	UW	UW	UW	2	
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	CTD	54	5	2	
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	CTD	54	25	2	
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	CTD	54	50	3	
39° 39.667' N	17° 31.557'	25/03/2023	3:45	-	UW	UW	UW	2	
39° 39.667' N	17° 31.557'	25/03/2023	3:45	-	UW	UW	UW	2	A
39° 39.667' N	17° 31.557'	26/03/2023	3:45	-	UW	UW	UW	2	B
40° 28.036' N	16° 57.510'	26/03/2023	10:45	-	UW	UW	UW	2	
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	CTD	56	5	2	
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	CTD	56	20	2	
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	CTD	56	40	2	
41° 20.673' N	16° 19.157'	26/03/2023	18:22	-	UW	UW	UW	2	
42° 59.569' N	14° 55.845'	27/03/2023	5:20	-	UW	UW	UW	2	
43° 47.822' N	14° 15.605'	27/03/2023	10:42	-	UW	UW	UW	2	
44° 41.977' N	13° 30.444'	27/03/2023	16:48	-	UW	UW	UW	2	

Acknowledgements

profiles on the noon CTD were funded by Natural Environment Research Council National Capability (NERC-NC) the Atlantic Meridional Transect (AMT) and NASA.

DNA sample collection

Roseanna Wright[1] for Andy Rees[2]

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Cruise Objectives

DNA materials of seawater samples were collected for Plymouth Marine Laboratory (PML) DNA archives.

Methods

Each pre-dawn CTD cast, 5.8L of seawater was collected into a sampling carboy from the 0.1% light level depth Niskin bottle from the CTD-rosette. Each noon cast, 5.8L of seawater was collected into sampling carboys from the surface (5m); Deep Chlorophyll Maximum (DCM); and the 0.1% light level depth Niskin bottle from the CTD-rosette. Sampling carboys were rinsed three times with sample water before sampling. Sampling carboys and the filtration tubes were rinsed/flushed with Milli-Q after filtration, and periodically with 10% HCl. In total, 114 samples in were collected during the cruise from 56 CTD casts as shown in Table 1.

Seawater samples were filtered through Millipore Sterivex-GP, 0.22µm sterile vented filter units (SVGP01050) by using a Cole-Palmer MasterFlex L/S Multichannel Pump (Model 7535-08). After filtration, samples were preserved by adding 0.5mL of RNAlater Solution (Invitrogen by Thermo Fisher Scientific). Afterwards, all Sterivex units were sealed with tube sealing compound and Cole-Palmer Male Luer Lock plugs and stored at -80˚C in a freezer until return to PML for laboratory analysis.

Summary of samples taken for DNA analysis at PML

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (+ve E)	Depths sampled (m)	Rosette bottle numbers
23.02.2023	08:24	1	1	-46.098	-48.739	60	10
23.02.2023	15:02	2	2	-45.503	-47.829	5, 30, 60	34, 11, 9
24.02.2023	08:11	3	3	-44.032	-45.660	40	12
24.02.2023	15:06	4	4	-43.366	-44.670	5, 30, 60	24, 12, 9
25.02.2023	08:07	5	5	-41.247	-43.890	80	10
25.02.2023	15:00	6	6	-40.347	-43.844	5, 60, 80	23, 11, 8
26.02.2023	15:04	7	7	-38.452	-42.759	7, 55, 80	23, 11, 8
27.02.2023	07:11	8	8	-37.425	-40.748	85	10
27.02.2023	15:03	9	9	-36.797	-39.689	5, 95, 140	23, 11, 6
28.02.2023	06:51	10	10	-35.532	-37.587	120	8
28.02.2023	15:02	11	11	-34.916	-36.433	5, 90, 140	23, 11, 6
01.03.2023	05:46	12	12	-33.935	-34.454	125	22
01.03.2023	14:01	13	13	-33.273	-33.337	5, 105, 150	13, 8, 6
02.03.2023	05:46	14	14	-31.872	-31.293	175	7
02.03.2023	14:02	15	15	-31.275	-30.195	5, 110, 150	23, 11, 6
03.03.2023	05:40	16	16	-30.155	-28.172	160	7
03.03.2023	14:02	17	17	-29.563	-27.132	5, 115, 150	23, 10, 6

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (+ve E)	Depths sampled (m)	Rosette bottle numbers
04.03.2023	05:34	18	18	-28.384	-25.082	150	7
04.03.2023	14:01	19	19	-27.314	-24.524	5, 105, 150	23, 11, 6
05.03.2023	05:35	20	20	-25.158	-24.491	175	7
05.03.2023	14:01	21	21	-24.073	-24.500	5, 135, 160	22, 9, 6
06.03.2023	05:35	22	22	-21.961	-24.495	180	7
06.03.2023	14:02	23	23	-20.847	-24.495	5, 135, 175	23, 9, 6
07.03.2023	14:02	24	24	-18.023	-25.063	5, 155, 185	23, 9, 5
08.03.2023	05:37	25	25	-16.015	-25.061	180	7
08.03.2023	14:03	26	26	-14.897	-25.055	5, 140, 170	23, 9, 5
09.03.2023	05:40	27	27	-12.805	-25.053	160	8
09.03.2023	14:03	28	28	-11.894	-25.052	5, 105, 150	23, 11, 7
10.03.2023	05:42	29	29	-9.864	-25.043	150	8
10.03.2023	14:03	30	30	-8.744	-25.157	5, 110, 140	23, 12, 7
11.03.2023	05:39	31	31	-6.683	-25.187	125	9
11.03.2023	13:56	32	32	-5.650	-25.167	5, 100, 120	23, 12, 8
12.03.2023	5.32	33	33	-3.640	-25.165	5	11
13.03.2023	06:25	34	34	-0.001	-25.137	80	11
13.03.2023	13:59	35	35	0.930	-25.377	5, 65, 80	23, 14, 10
14.03.2023	05:36	36	36	3.018	-25.418	70	12
14.03.2023	13:59	37	37	4.156	-25.406	5, 47, 70	23, 15, 11
15.03.2023	05:33	38	38	6.177	-25.369	58	11
15.03.2023	13:59	39	39	7.269	-25.345	5, 48, 80	23, 15, 11
16.03.2023	05:41	40	40	9.264	-25.312	80	11
16.03.2023	13:58	41	41	10.423	-25.291	5, 56, 80	23, 14, 10
19.03.2023	12:58	42	42	20.699	-24.998	5, 83, 110	23, 13, 8
20.03.2023	04:58	43	43	22.615	-25.004	110	10
20.03.2023	13:00	44	44	23.729	-25.000	5, 78, 115	23, 13, 8
21.03.2023	04:40	45	45	25.700	-25.001	110	10
21.03.2023	12:56	46	46	26.652	-24.996	5, 90, 120	23, 12, 8
22.03.2023	04:46	47	47	28.348	-24.148	100	9
22.03.2023	12:59	48	48	29.272	-23.677	5, 112, 135	23, 12, 7
23.03.2023	04:33	49	49	31.001	-22.771	125	9
23.03.2023	12:55	50	50	32.106	-22.223	5, 88, 135	23, 12, 7
24.03.2023	04:37	51	51	34.065	-21.188	100	22
24.03.2023	13:01	52	52	35.098	-20.630	5, 62, 90	23, 14, 10
25.03.2023	03:41	53	53	36.628	-19.461	80	10
25.03.2023	12:02	54	54	37.797	-18.781	5, 25, 50	23, 16, 12
26.03.2023	10:19	55	55	39.661	-17.526	60	11
26.03.2023	11:52	56	56	40.537	-16.918	5, 20, 40	23, 17, 13

DNA and virus sample collection

Roseanna Wright[1] for Jed Fuhrman[2]

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Cruise Objectives

Collection of seawater samples for determination of DNA and viruses for the University of Southern California

Methods

Each pre-dawn CTD cast, 5.8L of seawater was collected into sampling carboys from the surface (5m) and Deep Chlorophyll Maximum (DCM) Niskin bottles from the CTD-rosette. Sampling carboys were rinsed three times with sample water before sampling, Milli-Q after filtration, and periodically rinsed with 10% HCl. In total, 54 samples were collected during the cruise from 27 CTD casts for DNA analysis as shown in Table 1, and 48 samples from 24 CTD casts for determination of viruses as shown in Table 2.

Seawater samples were filtered through Millipore Sterivex-GV, 0.22µm sterile vented filter units (SVGVL10RC) and Whatman Anotop 25 0.02µm (6809-2102) using a Cole-Palmer MasterFlex L/S Multichannel Pump (7535-08). Anotop filters were removed when filtration speed was significantly reduced. The amount of sample filtered through the Anotop filters was measured using a measuring cylinder. The remaining sample was allowed to filter through the Sterivex filter only. Sterivex and Anotop filters were preserved by adding 0.5mL and 0.1mL, respectively, of DNA/RNA Shield Solution (Zymo research). Afterwards, all Sterivex and Anotop units were sealed with Parafilm, placed together in a sealed Whirlpack bag for each sampling depth, and stored at -80˚C in a freezer until return to the University of Southern California for analysis.

Summary of samples filtered through Sterivex 0.22µm filters for DNA analysis at the University of Southern California.

TIME (UTC)	LATITUDE	LONGITUDE	Station	CTD No.	Bottle No.	DEPTH (m)	Volume filtered (L)
23/02/2023 08:24	-46.098	-48.739	1	1	21	5	3.3
23/02/2023 08:24	-46.098	-48.739	1	1	15	30	3.6
24/02/2023 08:11	-44.032	-45.660	3	3	21	5	4.75
24/02/2023 08:11	-44.032	-45.660	3	3	16	25	5.14
25/02/2023 08:07	-41.247	-43.890	5	5	22	5	5.8
25/02/2023 08:07	-41.247	-43.890	5	5	13	60	5.8
27/02/2023 07:11	-37.425	-40.748	8	8	22	5	5.8
27/02/2023 07:11	-37.425	-40.748	8	8	13	75	5.8
28/02/2023 06:51	-35.532	-37.587	10	10	22	5	5.8
28/02/2023 06:51	-35.532	-37.587	10	10	13	80	5.8
01/03/2023 05:46	-33.935	-34.454	12	12	22	5	5.8
01/03/2023 05:46	-33.935	-34.454	12	12	12	95	5.8
02/03/2023 05:46	-31.872	-31.293	14	14	22	5	5.8
02/03/2023 05:46	-31.872	-31.293	14	14	10	130	5.8
03/03/2023 05:40	-30.155	-28.172	16	16	22	5	5.8
03/03/2023 05:40	-30.155	-28.172	16	16	11	125	5.8
04/03/2023 05:34	-28.384	-25.082	18	18	22	5	5.8
04/03/2023 05:34	-28.384	-25.082	18	18	11	110	5.8

TIME (UTC)	LATITUDE	LONGITUDE	Station	CTD No.	Bottle No.	DEPTH (m)	Volume filtered (L)
05/03/2023 05:35	-25.158	-24.491	20	20	22	5	5.8
05/03/2023 05:35	-25.158	-24.491	20	20	11	125	5.8
06/03/2023 05:35	-21.961	-24.495	22	22	22	5	5.8
06/03/2023 05:35	-21.961	-24.495	22	22	11	145	5.8
08/03/2023 05:37	-16.015	-25.061	25	25	22	5	5.8
08/03/2023 05:37	-16.015	-25.061	25	25	11	140	5.8
09/03/2023 05:40	-12.805	-25.053	27	27	22	5	5.8
09/03/2023 05:40	-12.805	-25.053	27	27	11	135	5.8
10/03/2023 05:42	-9.864	-25.043	29	29	22	5	5.8
10/03/2023 05:42	-9.864	-25.043	29	29	11	120	5.8
11/03/2023 05:39	-6.683	-25.187	31	31	22	5	5.8
11/03/2023 05:39	-6.683	-25.187	31	31	12	98	5.8
17/03/2023 07:40	-3.640	-25.165	33	33	22	5	5.8
17/03/2023 07:40	-3.640	-25.165	33	33	14	60	5.8
13/03/2023 06:25	-0.001	-25.137	34	34	22	5	5.8
13/03/2023 06:25	-0.001	-25.137	34	34	14	65	5.8
14/03/2023 05:36	3.018	-25.418	36	36	22	5	5.8
14/03/2023 05:36	3.018	-25.418	36	36	14	52	5.8
15/03/2023 05:33	6.177	-25.369	38	38	22	5	5.8
15/03/2023 05:33	6.177	-25.369	38	38	14	58	5.8
16/03/2023 05:41	9.264	-25.312	40	40	22	5	5.8
16/03/2023 05:41	9.264	-25.312	40	40	14	63	5.8
20/03/2023 04:38	22.615	-25.004	43	43	23	5	5.8
20/03/2023 04:38	22.615	-25.004	43	43	13	90	5.8
21/03/2023 04:40	25.700	-25.001	45	45	22	5	5.8
21/03/2023 04:40	25.700	-25.001	45	45	13	85	5.8
22/03/2023 04:46	28.348	-24.148	47	47	22	5	5.8
22/03/2023 04:46	28.348	-24.148	47	47	12	100	5.8
23/03/2023 04:33	31.001	-22.771	49	49	22	5	5.8
23/03/2023 04:33	31.001	-22.771	49	49	12	95	5.8
24/03/2023 04:37	34.065	-21.188	51	51	22	5	5.8
24/03/2023 04:37	34.065	-21.188	51	51	13	73	5.8
25/03/2023 03:41	36.628	-19.461	53	53	22	5	5.8
25/03/2023 03:41	36.628	-19.461	53	53	14	48	5.8
29/03/2023 10:19	39.661	-17.526	55	55	22	5	5.8
29/03/2023 10:19	39.661	-17.526	55	55	17	40	5.8

Summary of samples filtered through Anotop 0.02µm filters for analysis of viruses at the University of Southern California.

TIME (UTC)	LATITUDE	LONGITUDE	Station	CTD No.	Bottle No.	DEPTH (m)	Volume filtered (L)
27/02/2023 07:11	-37.425	-40.748	8	8	22	5	0.615
27/02/2023 07:11	-37.425	-40.748	8	8	13	75	0.600
28/02/2023 06:51	-35.532	-37.587	10	10	22	5	0.670
28/02/2023 06:51	-35.532	-37.587	10	10	13	80	0.600
01/03/2023 05:46	-33.935	-34.454	12	12	22	5	0.660
01/03/2023 05:46	-33.935	-34.454	12	12	12	95	0.660
02/03/2023 05:46	-31.872	-31.293	14	14	22	5	0.620
02/03/2023 05:46	-31.872	-31.293	14	14	10	130	0.600
03/03/2023 05:40	-30.155	-28.172	16	16	22	5	0.620
03/03/2023 05:40	-30.155	-28.172	16	16	11	125	0.760
04/03/2023 05:34	-28.384	-25.082	18	18	22	5	0.550
04/03/2023 05:34	-28.384	-25.082	18	18	11	110	0.610
05/03/2023 05:35	-25.158	-24.491	20	20	22	5	0.620
05/03/2023 05:35	-25.158	-24.491	20	20	11	125	0.770
06/03/2023 05:35	-21.961	-24.495	22	22	22	5	0.700
06/03/2023 05:35	-21.961	-24.495	22	22	11	145	0.740
08/03/2023 05:37	-16.015	-25.061	25	25	22	5	0.720
08/03/2023 05:37	-16.015	-25.061	25	25	11	140	0.730
09/03/2023 05:40	-12.805	-25.053	27	27	22	5	0.650
09/03/2023 05:40	-12.805	-25.053	27	27	11	135	0.710
10/03/2023 05:42	-9.864	-25.043	29	29	22	5	0.800
10/03/2023 05:42	-9.864	-25.043	29	29	11	120	0.750
11/03/2023 05:39	-6.683	-25.187	31	31	22	5	0.650
11/03/2023 05:39	-6.683	-25.187	31	31	12	98	0.800
17/03/2023 07:40	-3.640	-25.165	33	33	22	5	0.600
17/03/2023 07:40	-3.640	-25.165	33	33	14	60	0.650
13/03/2023 06:25	-0.001	-25.137	34	34	22	5	0.750
13/03/2023 06:25	-0.001	-25.137	34	34	14	65	0.650
14/03/2023 05:36	3.018	-25.418	36	36	22	5	0.800
14/03/2023 05:36	3.018	-25.418	36	36	14	52	0.600
15/03/2023 05:33	6.177	-25.369	38	38	22	5	0.800
15/03/2023 05:33	6.177	-25.369	38	38	14	58	0.700
16/03/2023 05:41	9.264	-25.312	40	40	22	5	0.750
16/03/2023 05:41	9.264	-25.312	40	40	14	63	0.600
20/03/2023 04:38	22.615	-25.004	43	43	23	5	0.750
20/03/2023 04:38	22.615	-25.004	43	43	13	90	0.750
21/03/2023 04:40	25.700	-25.001	45	45	22	5	0.660
21/03/2023 04:40	25.700	-25.001	45	45	13	85	0.750
22/03/2023 04:46	28.348	-24.148	47	47	22	5	0.750
22/03/2023 04:46	28.348	-24.148	47	47	12	100	0.800
23/03/2023 04:33	31.001	-22.771	49	49	22	5	0.710
23/03/2023 04:33	31.001	-22.771	49	49	12	95	0.820

TIME (UTC)	LATITUDE	LONGITUDE	Station	CTD No.	Bottle No.	DEPTH (m)	Volume filtered (L)
24/03/2023 04:37	34.065	-21.188	51	51	22	5	0.800
24/03/2023 04:37	34.065	-21.188	51	51	13	73	0.850
25/03/2023 03:41	36.628	-19.461	53	53	22	5	0.750
25/03/2023 03:41	36.628	-19.461	53	53	14	48	0.800
29/03/2023 10:19	39.661	-17.526	55	55	22	5	0.650
29/03/2023 10:19	39.661	-17.526	55	55	17	40	0.700

Constraining the atmospheric fluxes of mineral dust-derived soluble trace elements to the Atlantic Ocean using thorium isotopes

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Objectives

1. Characterise the solubility of Th in aerosols over the Atlantic Ocean, and the influence of atmospheric transport and dust source / mineralogy on Th solubility
2. Establish the controls on the empirical relationships between trace element solubility and (i) particle size and (ii) atmospheric transport
3. Complete gaps in the spatial coverage of ^{232}Th and ^{230}Th measurements in surface waters of the Atlantic Ocean
4. Model ^{232}Th and ^{230}Th in the Atlantic Ocean to assess the influence of marginal sources on open ocean ^{232}Th concentrations
5. Construct maps of dust and soluble Fe (and other trace element) fluxes to the Atlantic Ocean based on Th and Al observations with quantified uncertainties

Methods

Aerosol sampling

Three aerosol samplers (Tisch Environmental) and two rain samplers (UEA in-house construction) were located on the monkey island of the RRS Discovery (Fig. 1). The aerosol samplers were sector (+/- 60° from the bow) and wind speed (< 0.5 m/s) controlled such that if the wind direction or speed failed to meet either criterion the samplers would automatically be shut off, thus, preventing sample contamination from the ship's exhaust. Samples were collected over 23-72 h periods. Longer collection periods were necessary where dust input was expected to be low, i.e., south of 25 °S. On recovery, aerosol samples were immediately frozen at -20°C.

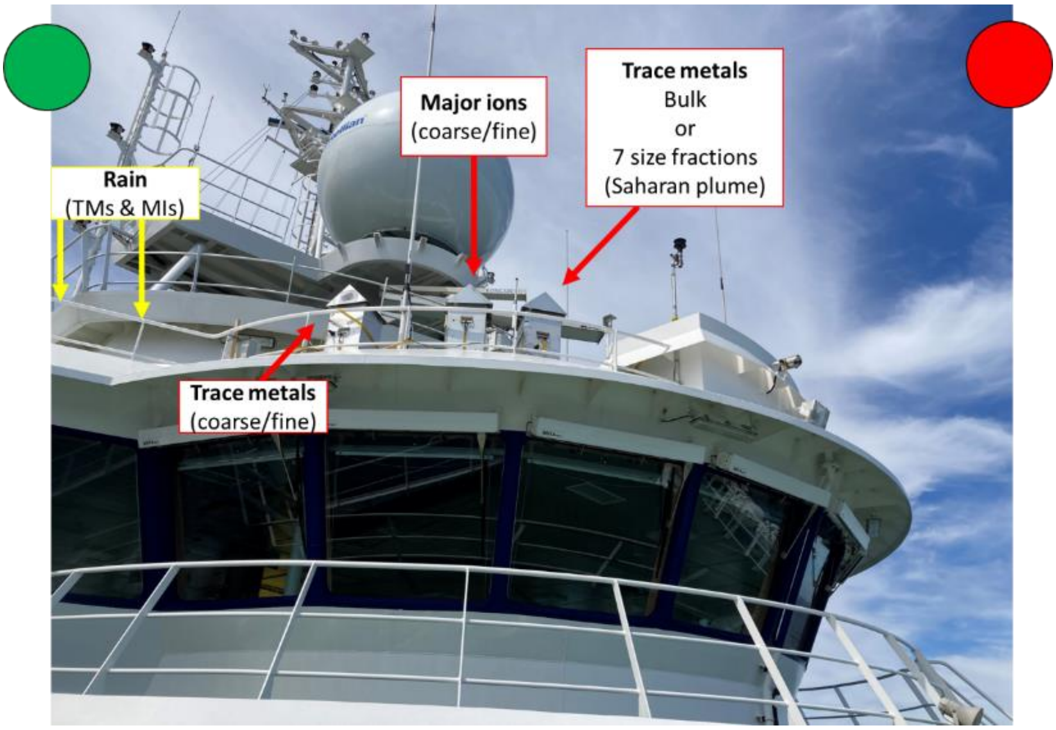


Figure 1. Location of the aerosol and rain samplers on the monkey island of RRS Discovery during AMT30

Table 1. Dates and locations of aerosol collections for trace metals (TM) and Major ions (MI)

		Sampling start			Sampling end		
Sample (trace metal)	Sample (major ion)	Date	Lat (N)	Long (E)	Date	Lat (N)	Long (E)
TM01	MI01	22/02/2023	-47.34	-50.64	24/02/2023	-43.37	-44.67
TM02		22/02/2023	-47.34	-50.64	25/02/2023	-40.35	-43.84
TM03	MI02	24/02/2023	-43.37	-44.67	26/02/2023	-38.45	-42.76
TM04		25/02/2023	-40.35	-43.84	28/02/2023	-34.91	-36.43
TM05	MI03	26/02/2023	-38.45	-42.76	28/02/2023	-34.91	-36.43
TM06		28/02/2023	-34.80	-36.24	03/03/2023	-29.56	-27.13
TM07	MI04	28/02/2023	-34.80	-36.24	02/03/2023	-31.27	-30.20
TM08	MI05	02/03/2023	-31.27	-30.20	04/03/2023	-27.31	-24.52
TM09		03/03/2023	-29.56	-27.13	06/03/2023	-20.85	-24.50
TM10	MI06	04/03/2023	-27.31	-24.52	06/03/2023	-20.85	-24.50
TM11	MI07	06/03/2023	-20.85	-24.50	07/03/2023	-18.02	-25.06
TM12		06/03/2023	-20.85	-24.50	09/03/2023	-11.89	-25.05
TM13	MI08	07/03/2023	-18.02	-25.06	08/03/2023	-14.90	-25.05
TM14	MI09	08/03/2023	-14.90	-25.05	09/03/2023	-11.89	-25.05
TM15	MI10	09/03/2023	-11.89	-25.05	10/03/2023	-8.74	-25.16
TM16		09/03/2023	-11.89	-25.05	12/03/2023	-2.51	-25.17
TM17	MI11	10/03/2023	-8.74	-25.16	11/03/2023	-5.65	-25.17
TM18	MI12	11/03/2023	-5.65	-25.17	12/03/2023	-2.51	-25.17
TM19	MI13	12/03/2023	-2.40	-25.17	13/03/2023	0.93	-25.38
TM20		12/03/2023	-2.40	-25.17	13/03/2023	0.93	-25.38
TM21	MI14	13/03/2023	0.93	-25.38	14/03/2023	4.16	-25.41
TM22		13/03/2023	0.93	-25.38	14/03/2023	4.16	-25.41
TM23	MI15	14/03/2023	4.16	-25.41	15/03/2023	7.27	-25.35
TM24		14/03/2023	4.16	-25.41	15/03/2023	7.27	-25.35
TM25	MI16	15/03/2023	7.27	-25.35	16/03/2023	10.42	-25.29
TM26		15/03/2023	7.27	-25.35	16/03/2023	10.42	-25.29
TM27	MI17	16/03/2023	10.42	-25.29	16/03/2023	11.27	-25.28
TM28		16/03/2023	10.42	-25.29	16/03/2023	11.27	-25.28
TM29	MI18	19/03/2023	20.60	-25.00	20/03/2023	23.73	-25.00
TM30		19/03/2023	20.60	-25.00	20/03/2023	23.73	-25.00
TM31	MI19	20/03/2023	23.73	-25.00	21/03/2023	26.65	-25.00
TM32		20/03/2023	23.73	-25.00	22/03/2023	29.27	-23.68
TM33	MI20	21/03/2023	26.65	-25.00	22/03/2023	29.27	-23.68
TM34	MI21	22/03/2023	29.27	-23.68	24/03/2023	35.10	-20.63
TM35		22/03/2023	29.27	-23.68	24/03/2023	35.10	-20.63
TM36	MI22	24/03/2023	35.10	-20.63	25/03/2023	37.80	-18.78
TM37		24/03/2023	35.10	-20.63	25/03/2023	37.80	-18.78
TM38	MI23	25/03/2023	37.80	-18.78	26/03/2023	40.54	-16.92
TM39		25/03/2023	37.80	-18.78	26/03/2023	41.04	-16.57

Aerosol samples (Table 1) were collected for determination of trace elements (Al, P, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Cd, Sb, Ba, La, Pb, Ce, Nd, Th, U) and major ions (NO_3^-, PO_4^{3-}, Cl^{2-}, Br^{2-}, SO_4^{2-}, Na^+, K^+) at the University of East Anglia by ICP-MS and ion chromatography, respectively.

For trace metals (Whatman 41 filters):

- 23 samples were collected over 24-48 h periods for coarse / fine (>1 µm / < 1µm) aerosol fractions
- 12 samples were collected over 24-72 h periods for bulk aerosol
- 4 size-resolved samples of Saharan dust (identified as orange dust on filters) were collected over 24 h periods using a 6 stage Andersen style cascade impactor (particle size cut offs: 7.8, 3.3, 1.65, 1.09, 0.61, 0.36, > 0.36 µm)

Total trace elements will be determined following digestions of the aerosol samples with strong acids (nitric acid + hydrofluoric acid) (Shelley et al., 2018). In addition, trace element solubility (a proxy for the bioavailable fraction) will be investigated and calculated using data from a mild leach (ammonium acetate buffered to pH 4.7; Sarthou et al., 2003), and a stronger leach (25% acetic acid, approx. pH 2; Berger et al., 2008).

For major ions (glass fibre filters):

- 25 samples were collected over 24-48 h periods for coarse / fine (>- 1 µm / < 1µm) aerosol fractions

Water soluble major ions will be determined following leaches using ultrahigh purity water (18 MΩ.cm) (Baker et al., 2006).

Rain sampling

Table 2. Date and location of rain samples for trace metals (TM) and major ions (MI)

		Sampling start			Sampling end		
Sample (trace metal)	**Sample (major ion)**	**Date**	**Lat (N)**	**Long (E)**	**Date**	**Lat (N)**	**Long (E)**
R-TM01	R-MI01	25/02/2023	-39.84	-44.10	25/02/2023	-39.54	-44.00
R-TM02	R-MI02	28/02/2023	-35.21	-37.01	28/02/2023	-35.15	-36.89
R-TM03	R-MI03	05/03/2023	-25.16	-24.49	05/03/2023	-25.04	-24.50
R-TM04	R-MI04	06/03/2023	-21.89	-24.50	06/03/2023	-21.78	-24.50
R-TM05a&b	R-MI05a&b	12/03/2023	-0.76	-25.17	13/03/2023	-0.70	-25.17
R-TM06	R-MI06	13/03/2023	-0.53	-25.17	13/03/2023	-0.48	-25.17
R-TM07	R-MI07	13/03/2023	-0.23	-25.16	13/03/2023	-0.06	-25.16
R-TM08	R-MI08	13/03/2023	0.22	-25.22	13/03/2023	0.25	-25.22
R-TM09	R-MI09	14/03/2023	3.60	-25.41	14/03/2023	3.62	-25.41
R-TM010	R-MI10	21/03/2023	25.70	-25.00	21/03/2023	25.82	-25.00
R-TM011	R-MI11	21/03/2023	26.26	-25.00	21/03/2023	26.29	-25.00

Eleven paired rain samples (Table 2) were collected on an *ad hoc* basis. Most sampling occurred within the ITCZ, located at ~ 1 °S – 3 °N during AMT30, although some samples were collected outside of this latitudinal band (both in the South and North Atlantic). Paired samples were taken for trace metal and major ion determination. The same elements and major ions determined in the aerosol samples will be determined in the rainwater samples using the same analytical instruments. The samples for major ions were not filtered and were immediately frozen after collection. For trace metals, if volumes allowed, a small volume (10 mL) of the rainwater was sub-sampled and filtered (0.2 µm). All rainwater samples for trace metals (filtered and unfiltered) were acidified to 0.04 M with ultrapure nitric acid and stored double-bagged at room temperature.

Seawater sampling

Table 3. Sampling details for seawater samples. 5 L of seawater was collected at each depth.

Date	Time (UTC)	Station	Latitude (°N)	Longitude (°E)	Sample depth (m)	Niskin bottle no.
23/02/2023	08:24	1	-46.10	-48.74	500,200,100,25,1	1,6,9,16,21
26/02/2023	15:04	7	-38.45	-42.76	500,200,100,55,5	1,4,7,9,24
01/03/2023	05:46	12	-33.94	-34.45	500,200,95,25,5	2,6,10(11),17,21(22)
04/03/2023	14:01	19	-27.31	-24.52	500,200,105,25,10	1,4,9(10),17,20
07/03/2023	14:02	24	-18.02	-25.06	500,200,155,25,5	1,4,7,16,22
10/03/2023	14:03	30	-8.74	-25.16	500,200,110,25,5	1,4,10,17,24
13/03/2023	13:59	35	0.93	-25.38	500,200,60,25,5	1,4,12,17,24
16/03/2023	13:58	41	10.42	-25.29	500,200,56,25,5	1,4,12,17,24
19/03/2023	12:58	42	20.70	-25.00	500,200,83,25,5	1,4,11,17,24
22/03/2023	12:59	48	29.27	-23.68	500,200,112,25,5	1,4,11,17,24
24/03/2023	13:01	52	35.098	-20.63	500,200,62,25,5	1,4,12,17,24
26/03/2023	11:52	56	40.537	-16.918	500,200,100,20,5	1,4,9,15,24

( ) : The numbers in parentheses represent the second bottle at the same depth used for collection, when the water in the first bottle had run out.

Seawater samples were collected at 12 stations (Table 3) from ~ 46°S to ~ 40°N, thus covering the diverse biogeochemical provinces of the Atlantic Ocean. The sampling depths were set at 5, 25, 100, 200 and 500 m, with either the 25 or 100 m one replaced by the depth of the deep chlorophyll maximum (DCM), in order to facilitate the comparison between Th integration to the depth of DCM (Hayes et al., 2017) and to fixed depths (e.g., 200m, 500m) (Hayes et al., 2013b; Deng et al., 2014).

The seawater sampling followed the procedure suggested by GEOTRACES intercalibration work (Anderson et al., 2012). In brief, seawater samples of 5 L at each depth were directly filtered from Niskin bottles mounted on the stainless steel CTD rosette through Acropak™ capsules with Supor® membranes (0.45 µm pore size). Filtered seawater samples were collected into acid-cleaned HDPE plastic bottles and sealed with a screw cap and Parafilm to reduce evaporation and contamination. Samples were then double-bagged for storage in boxes on board the research vessel until further processing at the University of Oxford.

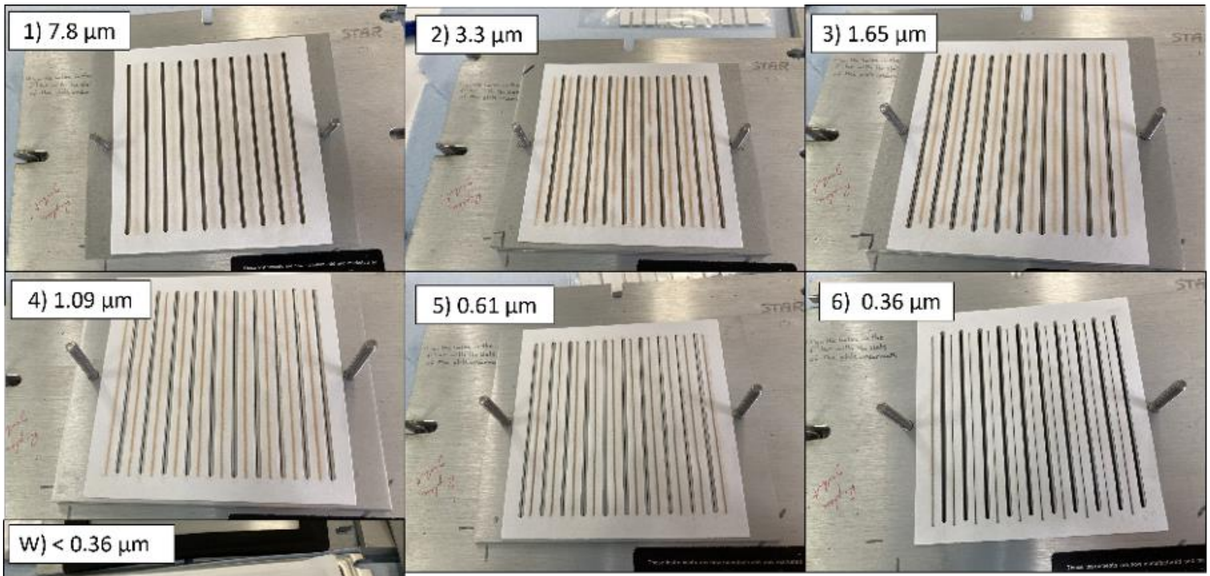
Post-cruise seawater processing and analysis

All seawater samples will be acidified with 7 mL of sub-boiled concentrated (~10 N) HCl per litre and left for equilibrium overnight prior to processing. Thorium will be precipitated from the seawater, separated and collected for isotope measurement (Robinson et al., 2004; Hsieh et al., 2011). Chemical separation of Th will be carried out using column chromatography (Edwards et al., 1987). Isotope measurement of ^{232}Th and ^{230}Th will be performed using a Nu Instrument multi-collector ICP-MS with protocols adapted from previous studies (Robinson et al., 2004; Mason and Gideon, 2010; Hsieh et al., 2011).

Observations

Sargassum spp. in the dusty Atlantic Ocean

During AMT30, extensive patches of *Sargassum spp*. were observed to coincide with the latitudinal band of Saharan dust (~3.5 – 11.5 °N, note that sampling stopped at 11.5 °N on entering the EEZ of Cape Verde). The Saharan dust was easily identifiable by its characteristic orange colour (Fig. 2), as well as from air mass back trajectory simulations and the visible haze in the lower atmosphere.



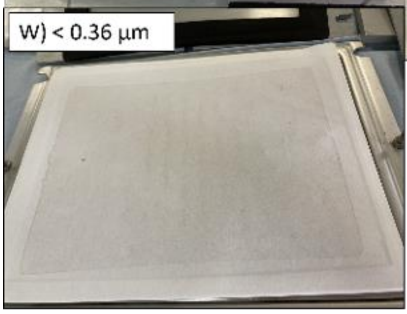


Figure 2. A size-resolved sample of Saharan dust collected on 14-15 March 2023 from 4.16 °N, 25.41 °W to7.27 °N, 25.35 °W. Note the change in colour from orange to grey in the finest three size fractions (stages 5, 6 and backing filter, W), indicative of the presence of anthropogenic and/or biomass burning aerosols mixed with the mineral dust.

References

Anderson, R. F., Fleisher, M. Q., Robinson, L. F.,Edwards, R. L., Hoff, J. A., Moran, S. B., Rutgers van der Loeff, M. R., Thomas, A. L., Roy-Barman, M., and Francois, R. (2012). GEOTRACES intercalibration of ^{230}Th, ^{232}Th, ^{231}Pa, and prospects: For ^{10}Be, Limnol. Oceanogr.-Meth., 10, 179–213. https://doi.org/10.4319/lom.2012.10.179

Baker, A., French, M., and Linge K.L. (2006). Trends in nutrient solubility along a west-east transect of the Saharan dust plume. Geophys. Res. Lett., 33. https://doi.org/10.1029/2005GL024764

Berger, J.M., Lippiatt, S.M., Lawrence, M.G., and Bruland, K.W. (2008). Application of a chemical leach technique for estimating labile particulate aluminum, iron, and manganese in the Columbia River plume and coastal waters off Oregon and Washington. J. Geophys. Res., 113(C00B01). https://doi.org/10.1029/2007JC004703

Deng, F., Thomas, A.L., Rijkenberg, M.J.A., Henderson, G.M., Nioz, R., Den Burg, A.B. (2014), Controls on seawater ^{231}Pa, ^{230}Th and ^{232}Th concentrations along the flow paths of deep waters in the Southwest Atlantic, Earth Planet. Sci. Lett., 390, 93–102. http://doi:10.1016/j.epsl.2013.12.038

Edwards, R.L., Chen, J.H., Wasserburg, G.J., 1987. U-238–U-234–Th-230–Th-232 systematics and the precise measurement of time over the past 500,000 years. Earth Planet. Sci. Lett. 81, 175–192.

Hayes, C. T., Anderson, R. F., Fleisher, M. Q., Serno, S., Winckler, G., Gersonde, R. (2013b), Quantifying lithogenic inputs to the North Pacific Ocean using the long-lived thorium isotopes, Earth Planet. Sci. Lett., 383, 16–25. http://doi:10.1016/j.epsl.2013.09.025

Hayes C. T., Rosen J., McGee D. and Boyle E. A. (2017) Thorium distributions in high- and low-dust regions and the significance for iron supply. Global Biogeochem. Cycles 31, 328–347. http://doi:10.1002/2016GB005511

Hsieh, Y.-T., Henderson, G.M., Thomas, A.L. (2011) Combining seawater ^{232}Th and ^{230}Th concentrations to determine dust fluxes to the surface ocean. Earth Planet. Sci. Lett. 312, 280–290. http://doi:10.1016/j.epsl.2011.10.022

Mason, A.J., Henderson, G.M., 2010. Correction of multi-collector-ICP-MS instrumental biases in high-precision uranium-thorium chronology. Int. J. Mass Spectrom. 295, 26–35. https://doi.org/10.1016/j.ijms.2010.06.016

Robinson, L. F., Belshaw, N. S., and Henderson, G. M. (2004). U and Th concentrations and isotope ratios in modern carbonates and wa- ters from the Bahamas, Geochim. Cosmochim. Ac., 68, 1777–1789. https://doi.org/10.1016/j.gca.2003.10.005

Sarthou, G., Baker, A.R., Blain, S., Achterberg, E.P., Boye, M., Bowie, A.R., Croot, P., Laan, P., de Baar, H.J.W., Jickells, T.D. and Worsfold, P.J. (2003). Atmospheric iron deposition and sea-surface dissolved iron concentrations in the eastern Atlantic Ocean. Deep Sea Res. I. 50: 1339-1352. https://doi.org/10.1016/S0967-0637(03)00126-2

Shelley, R.U., Landing, W.M., Ussher, S.J., Planquette, H., and Sarthou, G. (2018). Regional trends in the fractional solubility of Fe and other metals from North Atlantic aerosols (GEOTRACES cruises GA01 and GA03) following a two-stage leach. Biogeosciences, 15, 2271-2288. https://doi.org/10.5194/bg-15-2271-2018

Iodine incubation sample collection along the Atlantic

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Objectives

- To collect samples for the dissolved iodate and iodide concentrations across the transect as well as depth profiles.
- To observe rates and mechanisms of iodine oxidation and reduction using iodine concentration and isotope analysis in shipboard incubations.

Method

Seawater samples from the solar noon CTD niskin bottles were collected every three days, 12 samples (250mL each) for a depth profile ranging from 5m to 500m for iodine speciation analysis. In total 133 depth profile samples were collected along the transect. Once collected, samples were filtered using a 0.2µm filter with a 0.8µm pre-filter (Acropak™ 1500 Supor Capsule, Pall Corporation) and a Masterflex portable sampling pump place into opaque 60mL bottles then frozen and stored at -20° C (Moriyasu et al., 2023; Campos, 1997).

Another 4 samples (1-3L each) were collected from depths according to the light percentages (97%, 7%, 1%/DCM and 0.1%). Once collected samples were spiked— with a radioactive 80nM concentration sodium iodide solution (iodine-129)— and split into triplicate 250 mL incubations for each control, (e.g., Hardisty et al., 2020). Incubation samples collected every six days were subjected to one of four controls: unfiltered light, unfiltered dark, unfiltered with superoxide dismutase added, and filtered light. During the incubations four on deck incubators with continuous flow through via the underway system kept the samples at a consistent temperature. Screens to replicate light conditions at the depths from which the samples were taken sat atop each of the four incubators (97%, 7%, 1%, 0.1%). After 1.5 to 3 days a 60mL timepoint was taken and filtered using a 0.2µm Sterivex filter and frozen at -20° C. In total 827 incubation samples were collected for isotope analysis. Incubation conditions were monitored via pH and taxonomic analyses performed by Glen Tarran (PML).

References

Moriyasu, R., Bolster, K. M., Hardisty, D. S., Kadko, D. C., Stephens, M. P., & Moffett, J. W. Meridional survey of the Central Pacific reveals iodide accumulation in equatorial surface waters and benthic sources in the abyssal plain. *Global Biogeochemical Cycles*, e2021GB007300.

Campos, M. L. A. (1997). New approach to evaluating dissolved iodine speciation in natural waters using cathodic stripping voltammetry and a storage study for preserving iodine species. *Marine Chemistry*, *57*(1-2), 107-117.

Hardisty, D. S., T. J. Horner, S. D. Wankel, J. Blusztajn, and S. G. Nielsen. "Experimental observations of marine iodide oxidation using a novel sparge-interface MC-ICP-MS technique." *Chemical Geology* 532 (2020): 119360.

Funding

This work is supported by U.S. National Science Foundation Chemical Oceanography Award #1829406 to D.H.

Station	CTD	Niskin Bottle Number	Coordinates	Depth (m)	Date	Time (GMT)
2	2	23,9,12,19,1,3,4,5,7,9,10,13,16,18	lat. -45 30.206 long. -47 49.736	60,30,15,500,250,200,150,100,60,40,30,25,20,15,5	2/23/2023	15:02
7	7	23,20,19,16,14,12,10,8,7,5,3,1	Lat. -38 27.109 Long. -42 45.511	80,55,5,30,10,15,25,30,50,55,80,100,150,250,500	2/26/2023	15:04
13	13	23,13,9,6,20,19,12,9,8,7,6,3,2,1	Lat. -33 16.405 Long. -33 20.230	5,60,105,150,10,20,60,80,120,130,150,250,400,500	3/1/2023	14:01
19	19	6,10,13,23,22,19,15,12,9,8,6,5,3,2,1	Lat. -27 18.821 Long. -24 31.421	150,105,75,5,20,40,75,90,115,175,250,400,500	3/4/2023	14:01
24	24	23,12,7,5,22,19,18,15,13,7,6,5,3,2,1	Lat. -18 1.386 Long. -25 3.809	5,100,155,185,10,20,40,80,170,250,400,500	3/7/2023	14:02
30	30	7,11,90,5,22,19,18,16,14,13,3,2,1	Lat. -8 44.641 Long. -25 9.408	140,110,90,5,10,20,40,80,90,180,250,400,500	3/10/2023	14:03
35	35	23,16,13,10,22,19,18,9,8,5,3,2,1	Lat. 0 55.755 Long. -25 22.639	5,40,65,10,20,40,65,80,100,130,180,250,400,500	3/13/2023	13:59
41	41	10,13,16,23,22,19,18,11,10,8,6,3,2,1	Lat. 10 25.350 Long. -25 17.460	80,60,40,5,10,20,70,100,150,250,400,500	3/16/2023	13:58
42	42	23,15,12,8,22,19,18,16,6,4,3,2,1	Lat. 20 41.930 Long. -24 59.866	5,50,85,110,10,20,40,150,200,250,400,500	3/19/2023	12:58
48	48	7,11,15,23,19,17,14,9,7,5,3,2,1	Lat. 29 16.323 Long. -23 40.649	135,112,55,5,10,25,55,70,120,175,250,400,500	3/22/2023	12:59
54	54	23,12,15,18,19,13,10,8,5,3,2,1	Lat. 37 47.807 Long. -18 46.836	5,50,25,20,10,40,50,90,120,175,250,400,500	3/25/2023	12:02

Table 1. Each CTD where the samples originate from along with the associated niskin bottle and depth.

Investigating controls on Nitrogen Fixation in the North Atlantic

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Objectives

A comprehensive understanding of the factors governing the extent and magnitude of Nitrogen fixation in the North Atlantic is currently lacking. This cruise aims to collect samples for multiple types of analysis on organic and inorganic species involved in the process or regulation of nitrogen fixation. All analysis will be conducted after the cruise.

Methods

Sampling for nitrogen isotopes of nitrate and DON – All depths

Water from the CTD's niskin bottles was filtered through an AcroPak 500 (0.8/0.45µm) into 60ml HDPE bottles (acid cleaned in 10% HCl prior to cruise). Every depth was sampled. These bottles were immediately frozen at -20ºC for future analysis using the denitrifier method (Sigman *et al.,* 2001). The AcroPak was flushed with MQ and stored in the fridge until the next station.

Sampling for DON and DOC concentration measurements – Six depths

Prior to arrival on station the sample vials were prepared in a fume hood. 50µl of 85% orthophosphoric acid was pipetted into six 22ml borosilicate glass vials and closed with an injection seal. Six 20ml glass syringes with attached filter holders (both acid cleaned) containing an ashed GFF 0.7µm filter were prepared. Syringes and filters were washed with MQ to check for leaks.
On station, water from the CTD's niskin bottles was collected into six acid-cleaned 125ml HDPE bottles. Six depths were sampled that were consistent between stations: Surface, 100m, 200m, 400m, 500m and the Deep Chlorophyll Maximum (DCM). 20ml of these samples water was then transferred into the glass syringes (rinsing first) and filtered into the pre acidified glass vials and sealed. Vials were stored in the fridge for future analysis. Glass syringes and filter holders were placed in acid bath to clean in preparation for the next station.

Sampling for DOP measurements – Four to six depths

Using the same water sampled in the 125ml bottles and the same syringe filters, 60ml was filtered through the ashed GFF 0.7µm filter into 60ml acid cleaned HDPE bottles. These were immediately frozen at -20ºC for future analysis.

Sampling for PON and POC concentration and isotopic measurements – Five depths

Prior to arrival on station a filtration rig was prepared. This consisted of a vacuum pump and carboy and five cups leading each to a syringe filter holder containing an ashed GFF 0.7µm filter. The whole system was flushed with MQ to check for leaks. After taking water samples from the CTD for the above methods, five 20L carboys were rinsed and filled (until the niskin bottle was empty) using an acid washed tube. Five depths were sampled that were consistent between stations: Surface, 100m, 200m, 250m and DCM. These carboys were stored in the dark until the above methods had been carried out. Using 1L measuring cylinders, water from each carboy was measured out into the filtration cups and allowed to filter using the vacuum pump. Water was topped up periodically, recording each litre filtered. This was continued until a visible colour could be seen on the filter paper or until no more water could pass through.
The filter papers were removed from the holders in a laminar flow hood, their colours recorded and wrapped in ashed foil. They were then placed into labelled petri dishes, wrapped together and immediately frozen at -80ºC for future analysis.
The filter cups, tubing and filter holders were placed in an acid bath to clean in preparation for the next station.

References

Sigman, D. M., Casciotti, K. L., Andreani, M., Barford, C., Galanter, M., & Böhlke, J. K. (2001). A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Analytical Chemistry, 73(17), 4145–4153. https://doi.org/10.1021/AC010088E

Table 1 - Details of all samples collected over the duration of the cruise. Depth numbers is **bold** show where all types of samples were collected, *italics* is where only isotopes and PON/POC were collected and normal font style is where only isotope samples were collected

Date	**Station no.**	**Latitude**	**Longitude**	**Time in water (GMT)**	**Niskin bottles sampled**	**Depths sampled (m) - bold:** All parameters measured
23/02/2022	2	45° 30.208 S	47° 49.738 W	1502	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 16, 18, 19, 20, 22	**500, 400,** *250,* **200,** 150, 125, 100, 75, 60, 40, **30**, 25, 20, 15, 10, 5
24/02/2022	4	43° 21.954 S	44° 40.207 W	1506	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 16, 18, 19, 20, 22	**500, 400,** *250,* **200,** 150, 125, 100, 75, 60, 40, 35, **30**, 25, 20, 15, 10, 5,
25/02/2022	6	40° 20.810 S	43° 50.620 W	1500	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16, 17, 19, 20, 22	**500, 400,** *250,* **200,** 150, 125, 100, 80, **60**, 50, 40, 30, 25, 20, 15, 10, 5
26/02/2022	7	38° 27.108 S	42° 45.511 W	1504	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 16, 18, 19, 20, 22	**500, 400,** *250,* **200,** 150, 125, 100, 80, **55**, 50, 40, 30, 25, 20, 15, 10, 5
27/02/2022	9	36° 47.806 S	39° 41.354 W	1503	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 140, 120, 100, **95**, 75, 60, 50, 40, 25, 20, 10, 5
28/02/2022	11	34° 54.976 S	36° 25.979 W	1502	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 140, 120, 100, **90**, 80, 60, 50, 40, 25, 20, 10, 5
01/03/2022	13	33° 16.406 S	33° 20.233 W	1401	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 150, 130, 120, **105**, 80, 60, 50, 40, 25, 20, 10, 5
02/03/2022	15	31° 16.474 S	30° 11.730 W	1402	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 150, 130, 120, **110**, 90, 75, 50, 40, 25, 20, 10, 5
03/03/2022	17	29° 33.770 S	27° 07.920 W	1402	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 150, 130, **115**, 100,

						90, 75, 50, 40, 25, 20, 10, 5
04/03/2022	19	27° 18.822 S	24° 31.421 W	1401	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 150, 125, 115, **105**, 90, 75, 50, 40, 25, 20, 10, 5
05/03/2022	21	24° 04.392 S	24° 30.019 W	1401	1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, 19, 20, 22	**500, 400,** *250,* **200,** 175, 160, **135**, 120, 100, 80, 60, 50, 40, 25, 20, 10, 5
06/03/2022	23	20° 50.326 S	24° 29.780 W	1402	1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 22	**500, 400,***250,* **200,** 175, 160, **145**, 140, 120, 100, 80, 60, 40, 25, 20, 10, 5
07/03/2022	24	18° 01.387 S	25° 03.810 W	1402	1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 22	**500, 400,** *250,* **200,** 185, 170, **155**, 135, 120, 100, 80, 60, 40, 25, 20, 10, 5
08/03/2022	26	14° 53.796 S	23° 03.276 W	1403	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 18, 19, 22	**500, 400,** *250,* **200,** 170, 155, **140**, 130, 120, 100, 80, 60, 40, 25, 20, 10, 5
09/03/2022	28	11° 53.668 S	23° 03.103 W	1403	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 18, 19, 22	**500, 400,** *250,* **200,** 180, 160, 130, 115, **105**, 90, 80, 60, 40, 25, 20, 10, 5
10/03/2022	30	08° 44.641 S	25° 09.408 W	1403	1, 2, 3, 4, 5, 6, 7, 9, 12, 13, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 180, 160, 140, 120, **110**, 90, 80, 60, 40, 25, 20, 10, 5
11/03/2022	32	05° 39.004 S	25° 10.015 W	1356	1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 180, 160, 140, 120, 110, **100**, 80, 70, 60, 40, 25, 20, 10, 5
13/03/2022	35	00° 55.784 N	25° 22.639 W	1359	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 180, 160, 140, 120, 100, 80, **60**, 50, 40, 25, 20, 10, 5
14/03/2022	36	03° 01.108 N	25° 25.059 W	0536	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 22	**500, 400,** 300, *250,* **200,** 175, 150, 125, 100, 80, 70, 60, **52**, 40, 30, 20, 10, 5
14/03/2022	37	04° 09.370 N	25° 24.350 W	1359	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 180, 160, 140, 120, 100, 85, 60, **47**, 40, 25, 20, 10, 5
15/03/2022	38	06° 10.680 N	25° 22.150 W	0533	1, 3, 4, 5, 6, 7, 8, 9, 10, 11,	**500, 400,** 300, *250,* **200,** 175,

					12, 15, 16, 17, 18, 19, 22	150, 125, 100, 80, 70, **59**, 50, 40, 30, 20, 5
15/03/2022	39	07° 16.130 N	25° 20.730 W	1359	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 180, 160, 140, 120, 100, 85, 70, 60, **48**, 40, 25, 20, 10, 5
16/03/2022	40	09° 15.804 N	25° 18.728 W	0541	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19, 20, 22	**500, 400,** 300, *250,* **200,** 175, 150, 125, 100, 80, 70, **63**, 50, 40, 30, 20, 10, 5
16/03/2022	41	10° 25.350 N	25° 17.400 W	1358	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 125, 100, 80, 70, **60**, 50, 40, 25, 20, 10, 5
19/03/2022	42	20° 41.930 N	24° 59.870 W	1258	1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 125, 110, 100, **85**, 70, 50, 40, 25, 20, 10, 5
20/03/2022	44	23° 43.762 N	24° 59.995 W	1300	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 125, 115, 100, 90, **78**, 70, 55, 40, 25, 20, 10, 5
21/03/2022	46	26° 39.096 N	24° 59.773 W	1256	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 135, 120, 100, **90**, 70, 55, 40, 25, 20, 10, 5
22/03/2022	48	29° 16.320 N	23° 40.650 W	1259	1, 2, 3, 4, 5, 6, 7, 9, 11, 13, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 135, 120, **112**, 90, 70, 55, 40, 25, 20, 10, 5
23/03/2022	50	32° 06.331 N	22° 13.408 W	1255	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 135, 120, 100, **88**, 80, 70, 55, 40, 25, 20, 10, 5
24/03/2022	52	35° 05.889 N	20° 37.806 W	1301	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 135, 120, 100, 90, 75, **62**, 55, 40, 35, 20, 10, 5
25/03/2022	54	37° 47.808 N	18° 14.837 W	1202	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18, 19, 22	**500, 400,** *250,* **200,** 175, 150, 135, 120, 100, 90, 75, 50, 40, **25**, 20, 15, 10, 5
26/03/2022	56	40° 32.230 N	16° 55.087 W	1152	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 20, 22	**500, 400,** *250,* **200,** 175, 150, 135, 120, 100, 90, 75, 50, 40, 30, **20**, 15, 10, 5

Nitrogen Fixation

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Cruise Objectives

To determine the rates of nitrogen fixation in surface waters of the Atlantic during AMT30.

Methods

Seawater samples were collected at 4 depths, daily from predawn CTD into 2.4L Nalgene polycarbonate bottles. One bottle from every depth was immediately filtered and the suspended particles in each bottles collected by using gentle vacuum filtration through a 25mm pre-combusted GF/F filters to determine natural abundance of ^{15}N. On alternate days triplicate bottles were also collected and to each 2.4mL of ^{15}N-N_2 (98%+; Cambridge Isotopic Laboratories, Inc) were injected using a gas-tight syringe. All bottles were kept in dark and agitated for 30+ minutes following which caps were removed and gas bubbles replaced with seawater from appropriate depth. All bottles were then transferred to on-deck incubators with simulated light and ambient temperature. At the end of each experiment, the suspended particles in each bottles were collected by using gentle vacuum filtration through a 25mm pre-combusted GF/F filters. Filters were frozen at -20°C and returned to PML. Particulate nitrogen (PN) and ^{15}N atom% / ^{15}N natural abundance will be measured using continuous-flow stable isotope mass-spectrometry (Rees et al 2009) within 12 months. All data will be stored at BODC

References

Rees A.P., J. A. Gilbert, B. A. Kelly-Gerreyn (2009). Nitrogen fixation in the western English Channel (NE Atlantic Ocean). Mar. Ecol. Prog. Ser. 374, 7- 12. doi:10.3354/meps07771

Location of samples collected for N fixation rate

Date	Time	Lat	Long	CTD	CTD bottle	Depth (m)	N-Ab	NFix
01.03.2023	0546	-33 56.099	-34 27.211	12	8, 10, 15, 21	125, 95, 50, 5	Y	Y
02.03.2023	0546	-31 52.300	-31 17.553	14	7, 8, 15, 21	175, 130, 50, 5	Y	N
03.03.2023	0540	-30 9.271	-28 10.325	16	7, 9, 13, 21	160, 125, 75, 5	Y	Y
04.03.2023	0534	-28 23.068	-25 4.940	18	7, 9, 13, 21	150, 110, 75, 5	Y	Y Surface only
05.03.2023	0535	-25 9.464	-24 29.485	20	7, 9, 13, 21	175, 125, 75, 5	Y	Y
06.03.2023	0535	-21 57.672	-24 29.698	22	7, 9,14, 21	180, 145, 80, 5	Y	Y Surface only
08.03.2023	0537	-16 0.885	-25 3.679	25	7, 9, 14, 21	180, 140, 80, 5	Y	Y

09.03.2023	0540	-12 48.274	-25 3.197	27	8, 9, 14, 21	160, 135, 80, 5	Y	N
10.03.2023	0542	-9 51.837	-25 2.554	29	8, 9, 14, 21	150, 120, 80, 5	Y	Y
11.03.2023	0539	-6 40.952	-25 11.470	31	9, 13, 15, 21	125, 98, 60, 5	Y	Y Surface only
12.03.2023	0532	-3 38.398	-25 9.871	33	11, 15, 17, 21	80, 60, 40, 5	Y	Y Surface only
13.03.2023	0625	-0 0.063	-25 8.220	34	11, 15, 17, 21	80, 65, 40, 5	Y	Y
14.03.2023	0536	3 1.108	-25 25.059	36	12, 16, 18, 21	70, 52, 30, 5	Y	Y Surface only
15.03.2023	0533	6 10.603	-25 22.125	38	11, 15, 18, 21	80, 59, 30, 5	Y	Y
16.03.2023	0541	9 15.863	-25 18.728	40	11, 15, 18, 21	80, 63, 30, 5	Y	Y Surface only
20.03.2023	0438	22 36.896	-25 0.243	43	10, 14, 16, 21	110, 90, 50, 5	Y	Y
21.03.2023	0440	25 42.029	-25 0.064	45	10, 14, 16, 21	110, 85, 50, 5	Y	Y Surface only
22.03.2023	0446	28 20.896	-24 8.855	47	9, 13, 16, 21	125, 100, 50, 5	Y	Y
23.03.2023	0433	31 3.040	-22 46.266	49	9, 13, 16, 21	125, 95, 50, 5	Y	N
24.03.2023	0437	34 3.915	-21 11.309	51	10, 14, 17, 21	100, 73, 40, 5	Y	Y
25.03.2023	0341	36 37.654	-19 27.634	53	10, 14, 17, 21	80, 48, 30, 5	Y	N
26.03.2023	0343	39 39.666	-17 31.555	55	11, 16, 18, 21	60, 35, 20, 5	Y	

Phytoplankton communities distribution along the Atlantic

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Objectives

- To study the distribution of phytoplankton communities thriving in the Atlantic Ocean.
- To contribute to the validation of Phytoplankton Size Classes and Phytoplankton Functional Types obtained by remote sensing Ocean Colour with our *in situ* observations.

Method

Seawater samples were collected from the pre-dawn and noon CTD casts for surface and Deep Chlorophyll Maximum (DCM). 180 ml of sample is fixed with lugol's iodine neutral solution (~3mL) and 3% Formaldehyde (~10mL). Samples will be further analysed with an inverted microscope at MARE-FCUL for estimating the cells' abundance of phytoplankton species (>10 *μ*m). Samples will be analysed by optical microscopy, in Lisbon, following Utermöhl method.

Results from the microscope counts and from the flow cytometer will be treated jointly (estimating biovolume and carbon per cell content), in order to get a complete survey of phytoplankton groups, from picoplankton cells to diatoms, dinoflagellates and coccolithophores.

References

H. Utermöhl 1958. Zur Vervollkommnung der quantitativen Phytoplankton-Methodik. Mitt. Int. Vereinigung Theor. Angew. Limnol. 9:1–38.

Funding

Andreia's participation in AMT30 was also supported by INTERREG Atlantic Area Cross-border Cooperation Programme project "Innovation in the Framework of the Atlantic Deep Ocean" (iFADO, under contract EAPA 165/2016) funded by European Union Atlantic Area Interreg Programme.

Table 1. Time and location of water sampling on AMT30

Lat	Lon	Date	Time (GMT)	Station	CTD	Depth (m)	Type
50° 4.234 S	55°0.69'W	21/02/2023	13:31		test 00	5	Lugol/Formol
46° 5.863' S	48° 44.321'	23/02/2023	08:24	1	1	5	Lugol/Formol
46° 5.863' S	48° 44.321'	23/02/2023	08:24	1	1	30	Lugol/Formol
45° 30.206' S	47° 49.736'	23/02/2023	15:02	2	2	5	Lugol/Formol
45° 30.206' S	47° 49.736'	23/02/2023	15:02	2	2	30	Lugol/Formol

44° 1.939' S	45° 39.604'	24/02/2023	08:11	3	3	5	Lugol/Formol
44° 1.939' S	45° 39.604'	24/02/2023	08:11	3	3	25	Lugol/Formol
43° 21.954' S	44° 40.207'	24/02/2023	15:06	4	4	5	Lugol/Formol
43° 21.954' S	44° 40.207'	24/02/2023	15:06	4	4	30	Lugol/Formol
41° 14.809' S	43° 53.409'	25/02/2023	08:07	5	5	5	Lugol/Formol
Lat	**Lon**	**Date**	**Time (GMT)**	**Station**	**CTD**	**Depth (m)**	**Type**
41° 14.809' S	43° 53.409'	25/02/2023	08:07	5	5	60	Lugol/Formol
40° 20.812' S	43° 50.616'	25/02/2023	15:00	6	6	5	Lugol/Formol
40° 20.812' S	43° 50.616'	25/02/2023	15:00	6	6	60	Lugol/Formol
38°27.109'S	42° 45.511'	26/02/2023	15:04	7	7	5	Lugol/Formol
38°27.109'S	42° 45.511'	26/02/2023	15:04	7	7	55	Lugol/Formol
37° 23.517' S	40° 44.857'	27/02/2023	07:11	8	8	5	Lugol/Formol
37° 23.517' S	40° 44.857'	27/02/2023	07:11	8	8	75	Lugol/Formol
36° 47.806' S	39° 41.354'	27/02/2023	15:03	9	9	5	Lugol/Formol
36° 47.806' S	39° 41.354'	27/02/2023	15:03	9	9	95	Lugol/Formol
35° 31.928' S	37° 35.191'	28/02/2023	06:51	10	10	5	Lugol/Formol
35° 31.928' S	37° 35.191'	28/02/2023	06:51	10	10	80	Lugol/Formol
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	11	5	Lugol/Formol
33° 56.099' S	34° 27.211'	01/03/2023	05:46	12	12	5	Lugol/Formol
33° 16.405' S	33° 20.230'	01/03/2023	14:01	13	13	5	Lugol/Formol
31° 52.301' S	31° 17.554'	02/03/2023	05:46	14	14	5	Lugol/Formol
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	15	5	Lugol/Formol
30° 9.271' S	28° 10.325'	03/03/2023	05:40	16	16	5	Lugol/Formol
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	17	5	Lugol/Formol
28° 23.068' S	25° 4.940'	04/03/2023	05:34	18	18	5	Lugol/Formol

27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	19	5	Lugol/Formol
25° 09.470' S	24° 29.490'	05/03/2023	05:35	20	20	5	Lugol/Formol
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	21	5	Lugol/Formol
21° 57.672' S	24° 29.698'	06/03/2023	05:35	22	22	5	Lugol/Formol
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	23	5	Lugol/Formol
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	24	5	Lugol/Formol
16° 0.886' S	25° 3.679'	08/03/2023	05:37	25	25	5	Lugol/Formol
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	26	5	Lugol/Formol
12° 48.274' S	25° 3.197'	09/03/2023	5:40	27	27	5	Lugol/Formol
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	28	5	Lugol/Formol
09° 51.837' S	25° 2.554'	10/03/2023	5:42	29	29	5	Lugol/Formol
09° 51.837' S	25° 2.554'	10/03/2023	5:42	29	29	120	Lugol/Formol
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	30	5	Lugol/Formol
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	30	110	Lugol/Formol
06° 40.951' S	25° 11.471'	11/03/2023	5:39	31	31	5	Lugol/Formol
06° 40.951' S	25° 11.471'	11/03/2023	5:39	31	31	98	Lugol/Formol
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	32	5	Lugol/Formol
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	32	100	Lugol/Formol
03° 38.398' S	25° 9.871'	12/03/2023	05:32	33	33	5	Lugol/Formol
03° 38.398' S	25° 9.871'	12/03/2023	05:32	33	33	60	Lugol/Formol
0° 0.064' S	25° 8.220'	13/03/2023	06:25	34	34	5	Lugol/Formol
0° 0.064' S	25° 8.220'	13/03/2023	06:25	34	34	65	Lugol/Formol
0° 55.785' S	25° 22.639'	13/03/2023	13:59	35	35	5	Lugol/Formol
0° 55.785' S	25° 22.639'	13/03/2023	13:59	35	35	65	Lugol/Formol
Lat	**Lon**	**Date**	**Time (GMT)**	**Station**	**CTD**	**Depth (m)**	**Type**

3° 1.109' S	25° 25.060'	14/03/2023	05:36	36	36	5	Lugol/Formol
3° 1.109' S	25° 25.060'	14/03/2023	05:36	36	36	52	Lugol/Formol
4° 9.370' S	25° 24.350'	14/03/2023	13:59	37	37	5	Lugol/Formol
4° 9.370' S	25° 24.350'	14/03/2023	13:59	37	37	47	Lugol/Formol
6° 10.680' S	25° 22.130'	15/03/2023	05:33	38	38	5	Lugol/Formol
6° 10.680' S	25° 22.130'	15/03/2023	05:33	38	38	59	Lugol/Formol
7° 16.130' S	25° 20.730'	15/03/2023	13:59	39	39	5	Lugol/Formol
7° 16.130' S	25° 20.730'	15/03/2023	13:59	39	39	48	Lugol/Formol
9° 15.863' S	25° 18.728'	16/03/2023	05:41	40	40	5	Lugol/Formol
9° 15.863' S	25° 18.728'	16/03/2023	05:41	40	40	63	Lugol/Formol
10° 25.350' N	25° 17.9460'	16/03/2023	13:58	41	41	5	Lugol/Formol
10° 25.350' N	25° 17.9460'	16/03/2023	13:58	41	41	56	Lugol/Formol
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	42	5	Lugol/Formol
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	42	83	Lugol/Formol
22° 36.896' N	25° 0.244'	20/03/2023	04:38	43	43	5	Lugol/Formol
22° 36.896' N	25° 0.244'	20/03/2023	04:38	43	43	90	Lugol/Formol
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	44	5	Lugol/Formol
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	44	70	Lugol/Formol
24° 42.029' N	25° 0.064'	21/03/2023	04:40	45	45	5	Lugol/Formol
24° 42.029' N	25° 0.064'	21/03/2023	04:40	45	45	85	Lugol/Formol
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	46	5	Lugol/Formol
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	46	90	Lugol/Formol
28° 28.896' N	24° 8.857'	22/03/2023	4:47	47	47	5	Lugol/Formol
28° 28.896' N	24° 8.857'	22/03/2023	4:47	47	47	100	Lugol/Formol
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	48	5	Lugol/Formol

29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	48	112	Lugol/Formol
31° 3.040' N	22° 46.226'	23/03/2023	04:33	49	49	5	Lugol/Formol
31° 3.040' N	22° 46.226'	23/03/2023	04:33	49	49	95	Lugol/Formol
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	50	5	Lugol/Formol
32° 6.332' N	22° 13.408'	23/03/2023	12:59	50	50	88	Lugol/Formol
36° 47.653' N	19° 27.634'	24/03/2023	04:37	51	51	8	Lugol/Formol
36° 47.653' N	19° 27.634'	24/03/2023	04:37	51	51	73	Lugol/Formol
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	52	5	Lugol/Formol
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	52	62	Lugol/Formol
36° 47.653' N	19° 27.634'	25/03/2023	03:41	53	53	5	Lugol/Formol
36° 47.653' N	19° 27.634'	25/03/2023	03:41	53	53	48	Lugol/Formol
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	54	5	Lugol/Formol
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	54	25	Lugol/Formol
39° 39.666' N	17° 31.558'	26/03/2023	03:43	55	55	5	Lugol/Formol
39° 39.666' N	17° 31.558'	26/03/2023	03:43	55	55	35	Lugol/Formol
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	56	5	Lugol/Formol
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	56	20	Lugol/Formol

Phytoplankton Photosynthesis.

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OBJECTIVES.
During AMT30 Photosynthesis-irradiance curves were made at 22 stations at two to three depths in the water column (surface, Deep Chlorophyll Maximum and 0.1 % light depth). These measurements aim to fulfil the following objectives within:

- *The main deliverable is to provide a unique time series of spatially extensive and internally consistent observations on the structure and biogeochemical properties of planktonic ecosystems in the Atlantic Ocean that are required to validate models addressing questions related to the global carbon cycle. One of the key parameters is phytoplankton production. To this end I assessed the variation in photosynthesis in phytoplankton communities along the Atlantic Meridional transect.*

METHODS.
Photosynthesis-Irradiance Curves.
Photosynthesis-Irradiance experiments were conducted at 22 stations at two depths in the water column; surface and Chla maxima and 23 stations to phytoplankton absorption. The experiments were run in photosynthetrons illuminated by 50 W, 12 V tungsten halogen lamps for the surface waters and LEDs for the Chla maxima following the methods described in Tilstone et al. (2003). Each incubator houses 15 sub-samples in 60 ml polycarbonate bottles which were inoculated with between 185k Bq (5 µCi) and 370 kBq (15 µCi) of ^{14}C labelled bicarbonate. The samples were maintained at *in situ* temperature using the ships non-toxic supply for the surface samples and at ambient temperature at the Chla maxima with a Polyscience chiller. After 1 to 2 h of incubation, the suspended material were filtered onto 0.2µm polycarbonate filters to measure phytoplankton photosynthetic rates. The filters were exposed to concentrated HCl fumes for 8-12 h immersed in scintillation cocktail and ^{14}C disintegration time per minute (DPM) was measured on board using a Packard, Tricarb 2900 liquid scintillation counter and the external standard and the channel ratio methods to correct for quenching. The broadband light-saturated Chla-specific rate of photosynthesis P_m^B [mg C (mg chl a)$^{-1}$ h^{-1}] and the light limited slope α^B [mg C (mg chl a)$^{-1}$ h^{-1} (µmol m^{-2} s^{-1})$^{-1}$] was estimated by fitting the data to the model of Platt *et al.* (Platt et al., 1980).

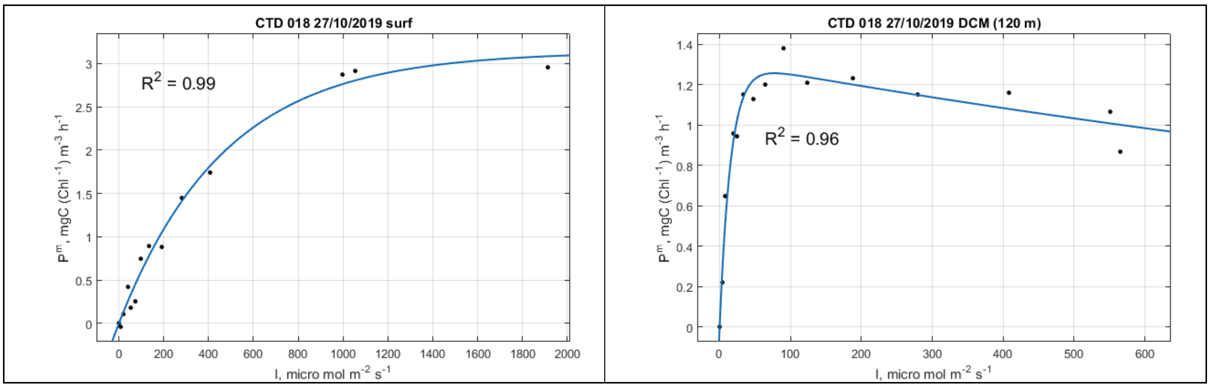
Results:
Table 1 gives the stations at which Photosynthesis-Irradiance curves were measured.
Table 2 gives the stations at phytoplankton absorption coefficients were sampled.

Table 1. Stations at which photosynthesis-irradiance curves were measured.

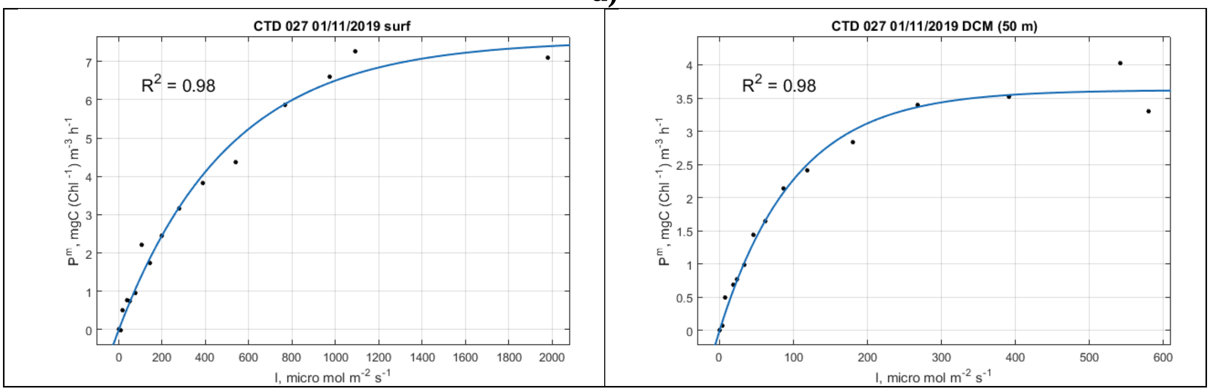
Latitude	Longitude	Date	Julian Day	Description	Depth	CTD Bottle Number
-31.27	-30.20	02-Mar-23	61	CTD015	5	24
-31.27	-30.20	02-Mar-23	61	CTD015	110	10
-29.56	-27.13	03-Mar-23	62	CTD017	5	24
-29.56	-27.13	03-Mar-23	62	CTD017	115	9
-27.31	-24.52	04-Mar-23	63	CTD019	5	24
-27.31	-24.52	04-Mar-23	63	CTD019	105	10
-24.07	-24.50	05-Mar-23	64	CTD021	5	24
-24.07	-24.50	05-Mar-23	64	CTD021	135	8
-24.07	-24.50	05-Mar-23	64	CTD021	160	6
-20.85	-24.50	06-Mar-23	65	CTD023	5	24
-20.85	-24.50	06-Mar-23	65	CTD023	145	8
-20.85	-24.50	06-Mar-23	65	CTD023	175	5
-18.02	-25.06	07-Mar-23	66	CTD024	5	24
-18.02	-25.06	07-Mar-23	66	CTD024	155	8
-18.02	-25.06	07-Mar-23	66	CTD024	185	5
-14.90	-25.05	08-Mar-23	67	CTD026	5	24
-14.90	-25.05	08-Mar-23	67	CTD026	140	8
-14.90	-25.05	08-Mar-23	67	CTD026	170	5
-11.89	-25.05	09-Mar-23	68	CTD028	5	24
-11.89	-25.05	09-Mar-23	68	CTD028	155	10
-11.89	-25.05	09-Mar-23	68	CTD028	180	7
-8.74	-25.16	10-Mar-23	69	CTD030	5	24
-8.74	-25.16	10-Mar-23	69	CTD030	110	11
-8.74	-25.16	10-Mar-23	69	CTD030	140	8
-5.65	-25.17	11-Mar-23	70	CTD032	5	24
-5.65	-25.17	11-Mar-23	70	CTD032	100	11
-5.65	-25.17	11-Mar-23	70	CTD032	120	8
0.93	-25.38	13-Mar-23	72	CTD035	5	24
0.93	-25.38	13-Mar-23	72	CTD035	60	13
0.93	-25.38	13-Mar-23	72	CTD035	80	11
4.16	-25.41	14-Mar-23	73	CTD037	5	24
4.16	-25.41	14-Mar-23	73	CTD037	47	14
4.16	-25.41	14-Mar-23	73	CTD037	70	11
7.27	-25.35	15-Mar-23	74	CTD039	5	24
7.27	-25.35	15-Mar-23	74	CTD039	48	14
7.27	-25.35	15-Mar-23	74	CTD039	70	11
10.42	-25.24	16-Mar-23	75	CTD041	5	24
10.42	-25.24	16-Mar-23	75	CTD041	56	13
10.42	-25.24	16-Mar-23	75	CTD041	80	9
20.69	-25.00	19-Mar-23	78	CTD042	5	24
20.69	-25.00	19-Mar-23	78	CTD042	83	12

20.69	-25.00	19-Mar-23	78	CTD042	110	9
23.73	-25.00	20-Mar-23	79	CTD044	5	24
23.73	-25.00	20-Mar-23	79	CTD044	70	14
23.73	-25.00	20-Mar-23	79	CTD044	115	8
26.65	-25.00	21-Mar-23	80	CTD046	5	24
26.65	-25.00	21-Mar-23	80	CTD046	90	12
26.65	-25.00	21-Mar-23	80	CTD046	120	8
29.27	-23.68	22-Mar-23	81	CTD048	5	24
29.27	-23.68	22-Mar-23	81	CTD048	112	12
29.27	-23.68	22-Mar-23	81	CTD048	135	8
32.11	-22.22	23-Mar-23	82	CTD050	5	24
32.11	-22.22	23-Mar-23	82	CTD050	88	12
32.11	-22.22	23-Mar-23	82	CTD050	135	7
36.10	-20.63	24-Mar-23	83	CTD052	5	24
36.10	-20.63	24-Mar-23	83	CTD052	62	14
36.10	-20.63	24-Mar-23	83	CTD052	90	10
37.80	-18.78	25-Mar-23	84	CTD054	0	24
37.80	-18.78	25-Mar-23	84	CTD054	25	16
37.80	-18.78	25-Mar-23	84	CTD054	50	12
40.54	-16.92	26-Mar-23	85	CTD056	0	24
40.54	-16.92	26-Mar-23	85	CTD056	20	17
40.54	-16.92	26-Mar-23	85	CTD056	40	13

Figure 2. Example Photosynthesis-Irradiance curves for the surface and Deep Chlorophyll Maximum at CTD018 on 27 October 2019 (a) and CTD 027 on 1 November 2019 (b).



a)



b)

Table 2. Stations at phytoplankton absorption coefficients were sampled

Lat	Lon (W)	Date	Time (GMT)	Station	CTD	Depth (m)	Volume (L)
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	11	5	4
34° 54.975' S	36° 25.978'	28/02/2023	15:02	11	11	90	4
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	15	5	4
31° 16.473' S	30° 11.729'	02/03/2023	14:02	15	15	110	4
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	17	5	4
29° 33.770' S	27° 7.920'	03/03/2023	14:02	17	17	115	4
27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	19	5	4
27° 18.822' S	24° 31.421'	04/03/2023	14:01	19	19	105	2.5
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	21	5	4
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	21	135	4
24° 4.391' S	24° 30.019'	05/03/2023	14:01	21	21	160	4
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	23	5	4
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	23	145	4
20° 50.826' S	24° 29.780'	06/03/2023	14:02	23	23	175	3
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	24	5	4
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	24	155	4
18° 1.369' S	25° 3.807'	07/03/2023	14:02	24	24	185	3.3
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	26	5	4
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	26	140	4
14° 53.796' S	25° 3.276'	08/03/2023	14:03	26	26	170	3
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	28	5	4
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	28	105	4
11° 53.611' S	25° 3.103'	09/03/2023	14:03	28	28	130	4
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	30	5	4
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	30	110	2.8
08° 44.641' S	25° 9.408'	10/03/2023	14:03	30	30	140	4
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	32	5	3
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	32	100	2
05° 33.004' S	25° 10.014'	11/03/2023	13:56	32	32	140	3
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	35	5	3
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	35	35	2
0° 55.785' N	25° 22.639'	13/03/2023	13:59	35	35	80	3
4° 9.370' N	25° 24.350'	14/03/2023	13:59	37	37	5	2
4° 9.370' S	25° 24.350'	14/03/2023	13:59	37	37	47	1
4° 9.370' S	25° 24.350'	14/03/2023	13:59	37	37	70	2
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	39	5	2
Lat	Lon (W)	Date	Time (GMT)	Station	CTD	Depth (m)	Volume (L)
7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	39	48	2

7° 16.130' N	25° 20.730'	15/03/2023	13:59	39	39	70	2
10° 25.350' N	25° 17.9460'	16/03/2023	13:58	41	41	5	2
10° 25.350' N	25° 17.9460'	16/03/2023	13:58	41	41	56	1
10° 25.350' N	25° 17.9460'	16/03/2023	13:58	41	41	80	2
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	42	5	2
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	42	83	2
20° 41.930' N	24° 59.490'	19/03/2023	12:58	42	42	110	4
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	44	5	4
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	44	70	2
23° 43.762' N	24° 59.965'	20/03/2023	13:00	44	44	110	3.2
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	46	5	4
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	46	90	3
26° 39.096' N	24° 59.773'	21/03/2023	12:56	46	46	120	3.21
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	48	5	2
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	48	112	2
29° 16.320' N	23° 40.650'	22/03/2023	12:59	48	48	135	4
32° 6.332' N	22° 12.408'	23/03/2023	12:55	50	50	5	4
32° 6.332' N	22° 12.408'	23/03/2023	12:55	50	50	88	2
32° 6.332' N	22° 12.408'	23/03/2023	12:55	50	50	135	4
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	52	5	3
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	52	62	2
35° 5.889' N	20° 37.856'	24/03/2023	13:01	52	52	90	4
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	54	5	2
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	54	25	2
37° 47.868' N	18° 46.837'	25/03/2023	12:02	54	54	50	3
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	56	5	2
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	56	20	2
40° 32.230' N	16° 35.087'	26/03/2023	11:52	56	56	40	2

References:

Platt, T., Gallegos, C.L. and Harrison, W.G., 1980. Photoinhibition of photosynthesis in natural assemblage of marine phytoplankton. J Mar Res, 38: 687-701.

Tilstone, G.H., Figueiras, F.G., Lorenzo, L.M. and Arbones, B., 2003. Phytoplankton composition, photosynthesis and primary production during different hydrographic conditions at the Northwest Iberian upwelling system. Marine Ecology-Progress Series, 252: 89-104.

Tilstone, G. H., et al. 2004. *REVAMP Protocols; Regional Validation of MERIS chlorophyll products in North Sea coastal waters.*, 77 pp., Working meeting on MERIS and AATSR Calibration and Geophysical Validation (MAVT 2003). European Space Agency, ESRIN, Italy, 20-24 Oct 2004.

Tilstone, G.H., Smyth, T.J., Poulton, A, Hutson R. 2009. Measured and remotely sensed estimates of primary production in the Atlantic Ocean from 1998 to 2005. Deep-Sea Research, 56(15), 918-930.

Welschmeyer NA (1994) Fluorometric analysis of chlorophyll *a* in the presence of chlorophyll *b* and pheopigments. Limnol Oceanogr 39: 1985−1992

Investigation of Spatial Variation into the Cycling of Dimethylsulfoniopropionate (DMSP) and Related molecules in Different Oceanic Provinces of South-North Atlantic Ocean.

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Objectives

- To investigate the distribution, diversity and abundance of DMSP cycling microbial guilds along the Atlantic transect.
- To investigate the correlation between total and size fractionated particulate DMSP concentrations in seawater column, algal and bacterial DMSP synthesizing genes.
- To elucidate microbial genes that facilitate DMSP demethylation and cleavage pathways.

Methodology

Microbial Genomics: Fresh seawater samples were collected from the pre-dawn CTD cast. Water samples were collected into 20 L carboys from 3 depths (surface, DCM and 500 m). 20 L sea water were filtered immediately after collection following the AtlantECO protocol through a size fractionated 142 mm diameter polycarbonate filters of 3.0 µm (for single cell phytoplankton and particulate bacteria) and 0.2 µm (for free-living bacteria) filter pore size using peristaltic pump. Filtration ran for 15 minutes (prevented the filter from drying out) and filters were gentle folded, kept into 5 mL cryovials, flash frozen in liquid nitrogen and stored in freezer -80 °C on board for RNA and DNA preservation see figure 1 & 2. The filtrate was than spiked with 1 mL iron chloride and incubated for an hour for viral filtration through a 0.8 µm filter pore size and the filter was kept in 5 mL cryovial and stored in a refrigerator 4 °C on board. After the cruise these samples will be analysed for meta- genomics and -transcriptomics using advanced bioinformatics tools.

Figure 1: Meta- genomics and -transcriptomics targeting single cell eukaryotes and particulate prokaryotes.

Figure 2: Meta- genomics and -transcriptomics targeting free-living prokaryotes.

Sample collection for DMSP and DMSO: Seawater samples were collected from the CTD bottles in triplicates from 2 depths (surface and DCM) using pipe tubing into 250 mL amber glass bottles fitted with gas-tight stoppers. Samples were processed within 2 hours after collection. DMSP was fixed with the addition of 5 M H_2SO_4 in samples resulting in pH<2, stopping biological activity, preserving DMSP and causing oxidation of any pre-existing DMS in the water (after 24 h) (see Kiene and Slezak 2006).
Total DMSP/DMSO: Sample bottle was inverted 10 times to ensure all particles are fully suspended. Plastic syringe and tubing were used to draw up 20 mL of unfiltered seawater and transfer gently 16 mL into 20 mL vial with 144 µL of 5 M H_2SO_4 and screw on cap. The samples were stored in 4 °C.
Particulate DMSP/DMSO: Sample bottle was inverted 10 times to ensure all particles are fully suspended and small volumes of seawater were gently filtered to quantify particulate fractions of organic sulfur compounds. Plastic syringe and tubing were used to draw up 20 mL of unfiltered seawater and gently filtered 6 mL through 3.0 PC filter in Swinnex filtration unit. The filter was quickly, gentle folded and put in 20 mL glass vial with 8 ml MilliQ and 72 µL of 5 M H_2SO_4 and screw on cap. The same procedure was repeat using 0.2 µm filters. The samples were kept in 4 °C. These samples will be analysed post cruise using either gas purge trap or auto sampler of gas chromatography with flame photo metric detector.
For the eDNA project
Four litre of sea water samples were collected into carboys from the pre-dawn CTD niskin bottles from 2 depths (DCM and 500 m). Samples were kept in the fridge at 4 °C until they were processed within 4 hours after collection from the CTD. Seawater samples were filtered through Millipore Sterivex-GP, 0.45µm sterile vented filter units (SVGP01050) by using a Cole-Palmer MasterFlex L/S Multichannel Pump (Model 7535-08). After filtration sterivex cartridges were sealed from the ends and stored at -80 °C.

Table 1: Summary of where the samples were collected from.

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (-ve W)	Depths sampled (m)
23.02.2023	08:24	1	1	-46.098	-48.739	5, 30 & 500
24.02.2023	08:11	3	3	-44.032	-45.660	5, 25 & 500
25.02.2023	08:07	5	5	-41.247	-43.890	5, 60 & 500
27.02.2023	07:11	8	8	-37.425	-40.748	5, 75 & 500
28.02.2023	06:51	10	10	-35.532	-37.587	5, 80 & 500
01.03.2023	05:46	12	12	-33.935	-34.454	5, 95 & 500
02.03.2023	05:46	14	14	-31.872	-31.293	5, 130 & 500
03.03.2023	05:40	16	16	-30.155	-28.172	5, 125 & 500
04.03.2023	05:34	18	18	-28.384	-25.082	5, 115 & 500
05.03.2023	05:35	20	20	-25.158	-24.491	5, 130 & 500
06.03.2023	05:35	22	22	-21.961	-24.495	5, 145 & 500
08.03.2023	05:37	25	25	-16.015	-25.061	5, 145 & 500
09.03.2023	05:40	27	27	-12.805	-25.053	5, 135 & 500
10.03.2023	05:42	29	29	-9.864	-25.043	5, 125 & 500
11.03.2023	05:39	31	31	-6.683	-25.187	5, 98 & 500

Date	Time (UTC)	Station number	CTD number	Lat (+ve N)	Lon (-ve W)	Depths sampled (m)
12.03.2023	5.32	33	33	-3.640	-25.165	5, 65 & 500
13.03.2023	06:25	34	34	-0.001	-25.137	5, 65 & 500
14.03.2023	05:36	36	36	3.018	-25.418	5, 52 & 500
15.03.2023	05:33	38	38	6.177	-25.369	5, 58 & 500
16.03.2023	05:41	40	40	9.264	-25.312	5, 63 & 500
20.03.2023	04:58	43	43	22.615	-25.004	5, 90 & 500
21.03.2023	04:40	45	45	25.700	-25.001	5, 85 & 500
22.03.2023	04:46	47	47	28.348	-24.148	5, 100 & 500
23.03.2023	04:33	49	49	31.001	-22.771	5, 95 & 500
24.03.2023	04:37	51	51	34.065	-21.188	5, 73 & 500
25.03.2023	03:41	53	53	36.628	-19.461	5, 48 & 500
25.03.2023	12:02	54	54	37.797	-18.781	5 & 25
26.03.2023	10:19	55	55	39.661	-17.526	5, 35 & 500
26.03.2023	11:52	56	56	40.537	-16.918	5 & 20

Zooplankton biomass and metabolism

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Overview
A series of depth discrete net samples were taken in order to address the objectives of EU project Mission Atlantic WP3 Mapping Pelagic Ecosystems of the Atlantic (https://missionatlantic.eu). Towards this aim, we obtained samples to allow us to describe vertical profiles in the taxonomic composition, biomass and abundance of the pelagic mesozooplankton community through epipelagic and mesopelagic depth layers. In addition, samples were taken to determine the metabolic performance of the mesozooplankton community through measurement of the Electron Transport System (ETS) activity. Water samples were taken from the CTD at the deep chlorophyll maximum (DCM) and surface in order to describe the food environment for the epipelagic mesozooplankton community. All samples were taken at the pre-dawn stations.

Mammoth net
The Hydro-Bios Mammoth net has nine 300µm nets that open and close sequentially. These opening/closing preset depths were consistent across all deployments and divided the sampled water column into intervals: 500-438, 438-375, 375-313, 313-250, 250-188, 188-125, 125-63, 63-33 and 33-5m.

The Mammoth net was deployed from the mid-ships P-frame. The trawl warp was fed through the main winch. The side wires, which were combined to form a single bridle, were hauled using a Rexwroth winch. The trawl warp was inboard of the anti-pendulum roller attached to a swivel on the main net, whilst the side wires for the cod-ends were out-board. The anti-pendulum roller was bent inwards to create a gap between the cod-ends and the main net body. Steady lines were used on both the cod-ends and the net frame to control the system going outboard. Once over the side, the net was spun around so the safety bar could be disengaged prior to deployment. Retrieval was the reverse.

The Mammoth net was deployed to a depth of 540m wire out at a rate up to 0.5 m/s, usually 0.3 m/s, dependent on the swell and time constraints, and retrieved at up to 0.4m/s, usually 0.3 m/s. The Mammoth net was run in self-logging mode, with a trigger depth for the instrument to turn on set at 520m. On occasions when the wire angle was greater than usual, extra wire was paid out to ensure the Mammoth net reached the trigger depth.

Once onboard, the nets were washed down with seawater to ensure the whole sample was collected in the cod-end. The contents of each cod-end were concentrated onto a 63 µm mesh before being washed into a 250 mL Nalgene bottle with filtered seawater and preserved using 25 mL borax buffered formaldehyde (4% final concentration) for later analysis using a FlowCam Macro.

The following table gives a full list of deployments:

MAMMOTH NET DEPLOYMENTS

Mammoth No.	Event	Date	Time (UTC)	Time (local)	Latitude	Longitude	Depth (m)	Wire out speed (m/s)	Wire in speed (m/s)	Samples preserved?	Comments
1	3	22/02/23	16:31	13:31	-47.34	-50.64	540	0.3	0.2	Y	
2	5	23/02/23	06:18	03:18	-46.09	-48.73	540	0.3	0.2	Y	
3	15	24/02/23	06:11	03:11	-44.03	-45.66	540	0.3	0.2	Y	
4	24	25/02/23	06:02	03:02	-41.25	-43.90	540	0.3	0.2	Y	
5	38	27/02/23	05:43	02:42	-37.42	-40.75	540	0.5	0.4	Y	
6	108	28/02/23	05:00	02:00	-35.53	-37.58	540	0.3	0.3	Y	
7	118	01/03/23	03:54	01:54	-33.93	-34.44	540	0.3	0.3	Y	
8	151	02/03/23	04:11	02:11	-31.87	-31.29	540	0.4	0.3	Y	
9	160	03/03/23	03:56	01:56	-30.16	-28.17	540	0.3	0.3	Y	
10	170	04/03/23	03:52	01:52	-28.39	-25.09	540	0.3	0.3	Y	
11	184	05/03/23	03:53	01:53	-25.16	-24.49	540	0.3	0.3	Y	
12	196	06/03/23	03:53	01:53	-21.96	-24.50	540	0.3	0.3	Y	
13	210	08/03/23	03:57	01:57	-16.01	-25.06	540	0.3/ 0.4	0.3	Y	Deployed @ 0.3m/s until 320m, then 0.4 m/s
14	217	09/03/23	03:53	01:53	-12.80	-25.06	540	0.3	0.3	Y	
15	229	10/03/23	03:57	01:57	-9.86	-25.05	540	0.3	0.3	Y	
16	238	11/03/23	03:53	01:53	-6.68	-25.19	540	0.3	0.3	Y	
17	248	12/03/23	03:51	01:51	-3.64	-25.17	540	0.3	0.3	Y	
18	255	13/03/23	04:31	02:31	0.00	-25.16	540	0.3	0.3	N	Did not reach trigger depth
19	267	14/03/23	03:57	01:57	3.01	-25.42	540	0.3	0.3	Y	
20	278	15/03/23	03:55	01:55	6.18	-25.37	540	0.3	0.3	Y	
21	288	16/03/23	03:53	01:56	9.26	-25.31	540	0.3	0.3	Y	
22	301	20/03/23	02:53	01:53	22.61	-25.01	540	0.3	0.3	Y	
23	310	21/03/23	02:53	01:53	25.70	-25.00	560	0.3	0.3	Y	
24	320	22/03/23	02:57	01:57	28.35	-24.15	560	0.3	0.3	Y	
25	330	23/03/23	02:49	01:49	31.05	-22.77	540	0.3	0.3	Y	
26	339	24/03/23	02:52	01:52	34.06	-21.19	540	0.3	0.3	Y	
27	349	25/03/23	01:53	01:53	36.79	-19.46	560	0.3	0.3	Y	
28	359	26/03/23	01:54	01:54	39.66	-17.53	540	0.3	0.3	Y	Battery failed, net 9 did not close.

Bongo net
A triple WP2 net (57 cm diameter rings, 0-200m) was deployed to collect 2 x 200 µm and 1 x 120 µm mesh mesozooplankton samples. On occasions when the wind was at greater than force 4, a double WP2 net (57 cm diameter rings, 0-200m) was deployed to collect 2 x 200 µm.

The Bongo net was deployed from the aft starboard using the NMF winch and starboard aft crane, which held the block. The net was moved gradually from the deck to vertical by hauling on the winch. Once suspended and clear of the deck, the net was moved outboard by the crane and the wire paid out to start the deployment. The net was deployed and retrieved at 12 m/min.

One 200 µm mesh sample was preserved in 4% borax buffered formaldehyde for the AMT time series (See report by Tarran). The remaining samples were immediately transferred to the controlled temperature laboratory which was set to 4 °C. The second 200 µm mesh sample was immediately filtered onto a pre-combusted 47mm GF/F filter and frozen at -80 °C to determine the ETS activity. The 120 µm mesh sample was used to collect live *Oithona* spp. specimens for ETS activity measurements. Three replicates of 50 animals were filtered onto a pre-combusted 25mm GF/F filter and frozen at -80 °C.

The following table gives a full list of deployments:

BONGO NET DEPLOYMENTS

Bongo No.	Event	Date	Time (UTC)	Time (local)	Latitude	Longitude	Depth (m)	AMT time-series?	Community ETS?	*Oithona* spp. ETS?	Comments
1	8	23/02/23	08:19	05:19	-46.10	-48.74	200	Y	Y	N	CT lab not to 4°C
2	27	25/02/23	07:14	04:14	-41.25	-43.89	200	Y	Y	Y	
3	111	28/02/23	06:46	03:46	-35.53	-37.59	200	Y	Y	N	Few *Oithona*
4	124	01/03/23	05:41	03:41	-33.93	-34.45	200	Y	Y	Y	
5	156	02/03/23	05:46	03:46	-31.87	-31.29	200	Y	Y	Y	
6	164	03/03/23	05:36	03:36	-30.15	-28.17	200	Y	Y	Y	
7	175	04/03/23	05:34	03:34	-28.38	-25.08	200	Y	Y	Y	
8	189	05/03/23	05:31	03:31	-25.16	-24.49	200	Y	Y	Y	
9	200	06/03/23	05:31	03:31	-21.96	-24.49	200	Y	Y	Y	
10	222	09/03/23	07:04	05:04	-12.80	-25.05	200	Y	Y	N	Double Bongo
11	234	10/03/23	05:39	03:39	-9.86	-25.04	200	Y	Y	Y	
12	243	11/03/23	05:42	03:42	-6.68	-25.19	200	Y	Y	Y	
13	253	12/03/23	05:32	03:32	-3.64	-25.16	200	Y	Y	Y	
14	260	13/03/23	06:23	04:23	0.00	-25.14	65	N	N	Y	Aborted
15	272	14/03/23	05:39	03:39	3.02	-25.42	200	Y	Y	Y	
16	283	15/03/23	05:31	03:31	6.18	-25.37	200	Y	Y	Y	
17	292	16/03/23	05:35	03:35	9.26	-25.31	200	Y	Y	Y	
18	305	20/03/23	04:31	03:31	22.61	-25.00	200	Y	Y	N	Double Bongo
19	314	21/03/23	04:34	03:34	25.70	-25.00	200	Y	Y	N	Double Bongo
20	324	22/03/23	04:39	03:39	28.35	-24.15	200	Y	Y	N	Double Bongo
21	334	23/03/23	04:30	03:30	31.05	-22.77	200	Y	Y	Y	
22	344	24/04/23	04:36	03:36	34.07	-21.19	200	Y	Y	Y	
23	353	25/03/23	03:37	03:37	36.79	-19.46	200	Y	Y	Y	

24	363	26/03/23	03:36	03:36	39.66	-17.53	200	Y	Y	Y	

CTD water samples
A 200-500 mL water sample was taken from the CTD at the deep chlorophyll maximum (DCM) and preserved with 1% acidified Lugol's iodine solution. 15 mL water samples were taken from the CTD at 5m and the DCM and frozen at -20 °C.

The following table gives a full list of samples taken:

CTD WATER SAMPLES

Date	Event	Bottle number	Depth	Category	Lugol's sample (mL)	Frozen sample (mL)
24/02/23	19	14	25	DCM	200	15
		22	5	Surface		15
25/02/23	29	13	60	DCM	200	15
		21	5	Surface		15
27/02/23	41	13	75	DCM	200	15
		21	5	Surface		15
28/02/23	112	13	80	DCM	200	15
		21	5	Surface		15
01/03/23	125	12	95	DCM	200	15
		22	5	Surface		15
02/03/23	155	10	130	DCM	200	15
		21	5	Surface		15
03/03/23	165	11	125	DCM	200	15
		21	5	Surface		15
04/03/23	174	11	110	DCM	200	15
		21	5	Surface		15
05/03/23	188	11	125	DCM	200	15
		22	5	Surface		15
06/03/23	201	11	145	DCM	200	15
		21	5	Surface		15
08/03/23	213	11	140	DCM	200	15
		21	5	Surface		15
09/03/23	221	11	135	DCM	200	15
		21	5	Surface		15
10/03/23	233	11	125	DCM	200	15
		21	5	Surface		15
11/03/23	242	12	98	DCM	200	15
		21	5	Surface		15
12/03/23	252	14	60	DCM	200	15
		21	5	Surface		15
13/03/23	259	14	65	DCM	200	15
		21	5	Surface		15
14/03/23	271	15	52	DCM	200	15
		21	5	Surface		15
15/03/23	282	15	58	DCM	200	15
		21	5	Surface		15
16/03/23	293	15	63	DCM	200	15

		21	5	Surface		15

Date	**Event**	**Bottle number**	**Depth**	**Category**	**Lugol’s sample (mL)**	**Frozen sample (mL)**
20/03/23	306	13	90	DCM	200	15
		21	5	Surface		15
21/03/23	315	13	85	DCM	500	15
		21	5	Surface		15
22/03/23	235	12	100	DCM	500	15
		21	5	Surface		15
23/03/23	335	12	95	DCM	500	15
		21	5	Surface		15
24/03/2023	343	13	73	DCM	500	15
		21	5	Surface		15
25/03/2023	354	14	48	DCM	500	15
		21	5	Surface		15
26/03/2023	364	16	35	DCM	500	15
		21	5	Surface		15

Mesoplankton Community Size Structure and abundance

Eloïse Savineau and Kathryn Cook, University of Exeter/National Oceanography Centre, Southampton, Prima Anugerahanti, University of Liverpool (Glen Tarran, *Plymouth Marine Laboratory, Plymouth*)

Methods:

Vertical net hauls were conducted each day at the pre-dawn stations for the collection of mesozooplankton samples (Table 3). A bongo (triple) net frame was deployed from the Discovery's aft starboard quarter using one of the ship's cranes and a Lebus general purpose winch with 8 mm steel wire. The nets used had 0.57m diameter openings and carried 2 WP-2 nets with 200 µm nylon mesh and a 120 µm mesh net, fitted with cod ends with 200 µm mesh windows and a 120 µm window. Nets were deployed to a depth of 200 m and then hauled at a rate of approx. 12.5 m min^{-1}, providing duplicate 200 µm samples and a single 120 µm sample, integrated between 200m and the surface. Nets were washed with seawater whilst still outboard and then brought onboard where the cod ends containing the samples were collected into buckets. Nets were then washed down with fresh water before stowing. The 120 µm sample was used to pick live *Oithona* copepods for respiration studies (see zooplankton group report). One of the 200 µm samples was filtered onto a 47 mm diameter GF/F filter, also for respiration studies (see zooplankton group report). The remaining 200 µm sample was passed through a 200 µm sieve and the material retained on the sieve was then washed into a 100 mL plastic bottle using 20 µm filtered seawater. 10 mL of 37% borax-buffered formaldehyde (4% final concentration) was added and the sample was then made up to 100 mL using the filtered seawater. This sample was then stored at 4°C for analysis on return to the UK. Back in the UK, samples will be stored sa part of the AMT zooplankton time series archive.

Details of bongo WP-2 net vertical deployments and 200 µm sample preservation

DATE	Bongo cast	STATION	TIME on deck (GMT)	Duration (mins)	LAT +N, -S	LONG E	Preserved sample name
23-Feb	1	1	08:45	18:00	-46.10	-48.74	AMT30 Bongo 01
25-Feb	2	5	07:42	16:00	-41.25	-43.89	AMT30 Bongo 02
28-Feb	3	10	07:17	17:00	-35.53	-37.59	AMT30 Bongo 03
01-Mar	4	12	06:16	15:00	-33.94	-34.45	AMT30 Bongo 04
02-Mar	5	14	06:17	16:00	-31.87	-31.29	AMT30 Bongo 05
03-Mar	6	16	06:04	15:00	-30.15	-28.17	AMT30 Bongo 06
04-Mar	7	18	06:02	16:00	-28.38	-25.08	AMT30 Bongo 07
05-Mar	8	20	05:58	16:00	-25.16	-24.49	AMT30 Bongo 08
06-Mar	9	22	05:57	15:00	-21.96	-24.49	AMT30 Bongo 09
08-Mar	-	25	-	-	-16.01	-25.06	-
09-Mar	10	27	07:36	17:00	-12.80	-25.30	AMT30 Bongo 10
10-Mar	11	29	06:11	15:00	-9.86	-25.04	AMT30 Bongo 11
11-Mar	12	31	06:08	16:00	-6.68	-25.19	AMT30 Bongo 12
12-Mar	13	33	05:59	15:00	-3.64	-25.16	AMT30 Bongo 13
13-Mar	14	34	06:36	04:00	0.00	-25.14	AMT30 Bongo 14
14-Mar	15	36	05:58	12:00	3.02	-25.42	AMT30 Bongo 15
15-Mar	16	38	05:54	14:00	6.18	-25.37	AMT30 Bongo 16
16-Mar	17	40	05:56	13:00	9.26	-25.31	AMT30 Bongo 17

20-Mar	18	43	04:56	16:00	22.61	-25.00	AMT30 Bongo 18
21-Mar	19	45	04:58	15:00	25.70	-25.00	AMT30 Bongo 19
22-Mar	20	47	05:02	15:00	28.35	-24.15	AMT30 Bongo 20
23-Mar	21	49	04:54	16:00	31.00	-22.77	AMT30 Bongo 21
24-Mar	22	51	05:00	16:00	34.07	-21.19	AMT30 Bongo 22
25-Mar	23	53	04:00	15:00	36.79	-19.46	AMT30 Bongo 23
26-Mar	24	55	03:59	16:00	39.66	-17.53	AMT30 Bongo 24

Red Camera Frame : Particle size distribution

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Objectives

Particle size is one of the important factors that controls particle sinking speed (hence carbon transport from the surface to the deep ocean), we aim to investigate particle size distributions using the particle images. We conducted 27 deployments of the Red Camera Frame to a) capture images of particles and b) measure biological and physical parameters simultaneously.

Methods

Backscatter/ fluorescence sensor (ECO TRIPLET 3), three imaging devices with different pixel resolutions (LISST-HOLO2, CPICS and UVP5), and CTD (RBR concerto) are mounted on RCF. Each instrument detects particles in different size range (ECO TRIPLET 3 measures backscatter of particles in µm scale, LISST-HOLO2 and CPICS detect particles within µm and mm scale, and UVP5 detects particles within mm and cm scale), hence combining data from each instrument on RCF allow us to construct particle size distributions from µm scale to cm scale which are size range of natural particles in the water column. We also mounted a hub system which saves time stamp, data from RBR concerto and ECO TRIPLET3, image number of CPICS, so that synchronizing data between different instruments can be easier during post-cruise data processing. The hub system is also used to communicate ECO TRIPLET3 and RBR concerto for pre-deployment parameterization and post deployment data downloading.

<u>RCF setup</u>
Sampling volume of each imaging system differs (UVP5 and RBR concerto: downwards, LISST HOLO2, CPICS and ECO TRIPLET3: sideways), so that the position and orientation is important when we mount each system on the RCF. UVP5 and RBR concerto are vertically positioned in the middle of the frame (camera and sensors facing downwards), and LISST HOLO2, CPICS and ECO TRIPLET3 are horizontally mounted on the frame (camera and sensors facing sideway). It is important that there is no obstruction such as frames and battery packs under the sampling volume, so that particles (especially fragile marine snow) do not get destructed before passing through the sampling volume (Figure 1). To stabilize RCF, we applied a weight between RCF and the cable.

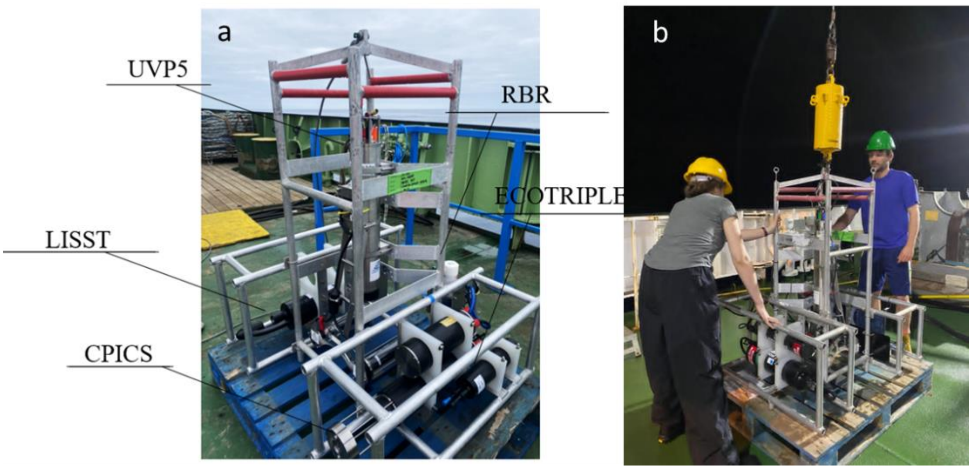

Figure 1 Red Camera Frame. a- Description of instrument position. b- deployment of RCF.

i) UVP5

Underwater Video Profiler 5 (UVP5, Hydroptics), pressure rated to 3000m, continuously record images in the sample volume (field view of 22 x 18 cm). All images are recorded in the internal memory that can store up to 100 profiles. Fully charged internal battery lasts up to 7 hours with recording mode. The system automatically detects particles in focus, crop the in-focus particles (vignettes) and save the vignettes.

ii) LISST HOLO2

LISST HOLO2 (Sequoia Scientific, Inc.) is a standalone instrument carries internal battery that lasts up to 20 hours. Although we had external battery, the brackets were too big and we could not mount the external battery on RCF. Holographic images of particles that go through its sample volume (1.86 cm^3, Figure) were taken at 10 Hz (maximum sampling rate) and saved in the internal memory. Each hologram is 1600 x 1200 pixel with 4.5 µm and we can resolve particles larger than 25 µm. Sampling started when LISST HOLO2 was below 5 m and sampling was manually stopped when RCF was recovered on the deck, so that images during both descending and ascending are obtained. Since we need to send RCF to 22m and bring back to the surface to activate UVP5 before sending RCF to the full target depth (600m), we decided not to use depth trigger to stop LISST HOLO2. We used the default setting for image names such as 000-0001, however, using time stamp may also be a good idea as matching with other instruments.

Data transfer and battery charge

Each deployment captured ~30,000 holograms, we transferred holograms after each deployment to clear the internal memory for next deployment. Internal battery was also charged after every deployment.

iii) CPICS

Continuous Plankton Imaging and Classification (Coastal Ocean Vision) continuously record images in the sample volume (330 mm^3 with filed view of 15 x 11 mm). It automatically detects particles in focus, crop the in-focus particles (region of interest, ROI) and save the cropped images. Saving full frames is available, however, it will consume memories a lot and we decided to save only ROIs. Start and end of recording was controlled by CPICS viewer that requires communication between CPICS and laptop via ethernet cable before and after deployment.

Data transfer and battery

Data transfer is carried out via Ethernet connection. Once RCF is recovered and secured at the hanger, plug 13 pins Ethernet cable to battery pack to communicate with CPICS. Open CPICS viewer to stop the software, then transfer ROIs using WinSCP. Although fully charged batteries lasts up to 6 hours, we charged the battery after every deployment.

iv) ECOTRIPLET3

The 1000-m rated standalone Wetlabs Environmental Characterization Optics (ECO) Triplet Fluorometer and Backscattering Sensor measures backscatter at 2 wavelengths (532nm and 700 nm) and chlorophyll fluorescence. This instrument does not have a pressure sensor, so it relies on the time variable that is then matched to the RBR).

Data transfer and battery

Data transfer was carried out via the hub system. Batteries were replaced with fresh packs before the cruise and no replacement was required during the cruise.

v) RBR concerto

RBR concerto measures multiple biological and physical variables (pressure, temperature, conductivity, turbidity and fluorescence). Since CPICS and ECOTRIPLET do not have pressure sensors, measurements of pressure by RBR concerto is fundamental.

Data transfer and battery

Data transfer was carried out via the hub system is used. Batteries were replaced with fresh batteries before the cruise and no replacement was required during the cruise.

Lab set up
RCF is kept at the hanger between the deployments, so that it is accessible for pre deployment parameterization and post deployment data downloading and charging battery packs. UVP5 deck unit and a laptop are set up at the nearest lab (the deck lab on Discovery), and all necessary cables (UVP5: external power supply and communication cables, CPICS: battery charge and communication cables, hub: communication cable).

Deployment
Deployments of RCF is operated by Romica winch wire through a block on the starboard aft crane over the starboard side. RCF was sent to 22 m at speed of 1.0 m s^{-1} and stopped at 22m for 90 s to activate UVP5. RCF is then brought back to the surface (~2m), so that we can collect particle images within 0 – 20 m with UVP5. Once we confirm that UVP5 is activated (*1) we send to the target depth (600 m) at speed of 0.5 m s^{-1}, and recovered at speed of 1 m s^{-1}.

*1: Red light should be observed from the surface when UVP5 is activated. If activation fails, repeat the activation process at faster sinking speed.

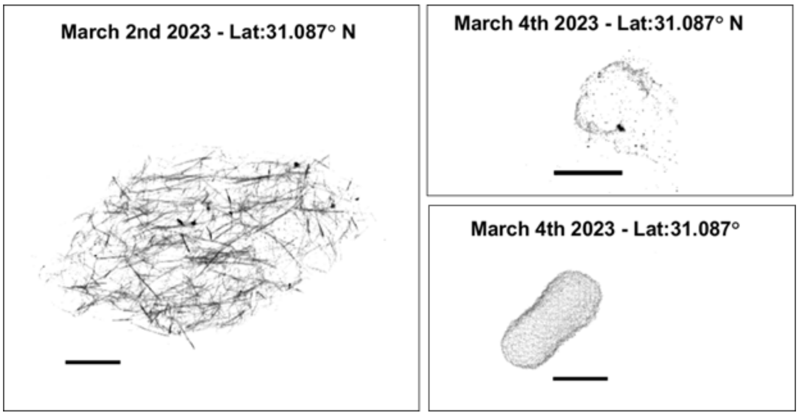

Figure 2 Example images obtained by UVP5. Scale is 1mm

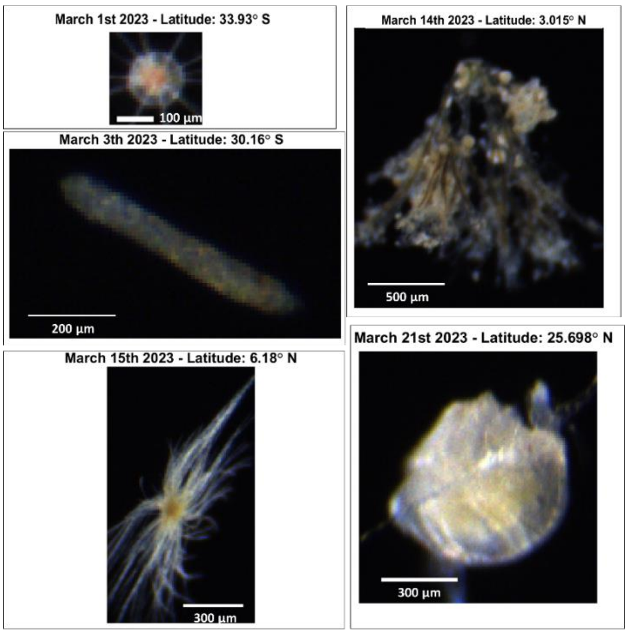

Figure 3 Example images obtained by CPICS.

Table 2 RCF deployment details of DY157 - date, number of profiles, echo depth, location, metrological information and data acquisition status are described (U: UVP5, C: CPICS, L: LISST HOLO2, E: ECO TRIPLET3, R: RBR Concerto. Y: Yes, N: No).

Date	Time	RCF #	Event #	Profile depth m	Echo depth m	Latitude			Longitude			Wind speed Knots	Sea stat	Air temp. degC	SST degC	Data acquisition status					
						Deg.	Min		Deg.	Min						U	C	L	E	R	Note
23/02/2023	06:51	1	6	600	5666	46	5.74	S	48	44.02	W	16	5	15.5	15.1	Y	N	Y	Y	Y	
24/02/2023	06:50	2	16	600	4979	44	1.86	S	45	39.48	W	6	3	16.30	16.3	Y	Y	Y	Y	Y	
25/02/2023	06:20	3	26	600	5170	41	14.92	S	43	53.76	W	9	3	17.65	19.67	Y	Y	Y	Y	Y	
27/02/2023	05:20	4	39	600	5029	35	31.86	S	37	25.47	W	15.6	4	19.7	22.1	Y	Y	Y	Y	Y	
28/02/2023	05:18	5	109	600	4767	35	31.86	S	37	35.06	W	10	4	20	22.4	Y	Y	Y	Y	Y	
01/03/2023	04:26	6	121	600	4262	33	55.7278	S	34	26.44	W	5	2	20.9	24.1	Y	Y	Y	Y	Y	
02/03/2023	04:12	7	153	600	4113	31	52.24	S	31	17.43	W	4	2	22.5	25	Y	Y	Y	Y	Y	
03/03/2023	04:20	8	162	600	3950	30	9.38	S	28	10.39	W	10	3	24.1	26.4	Y	Y	Y	Y	Y	
04/03/2023	04:12	9	172	600	4530	28	23.15	S	25	5.12	W	1.5	1	24.4	26.6	Y	Y	Y	Y	Y	
05/03/2023	04:19	10	186	600	4480	25	9.54	S	24	29.64	W	12.9	4	25.6	27.2	Y	Y	Y	Y	Y	
06/03/2023	04:05	11	198	600	5595	21	57.72	S	24	29.83	W	10.5	3	25.6	27	Y	Y	Y	Y	Y	
08/03/2023	04:10	12	211	600	5574	16	0.83	S	25	3.834	W	18.7	5	25	27.2	Y	Y	Y	Y	Y	
09/03/2023	04:10	13	219	570	4984	12	48.25	S	25	3.31	W	14	4	25.9	27.4	Y	Y	Y	Y	Y	1
10/03/2023	04:17	14	231	600	5598	9	51.73	S	25	2.7	W	13	4	26.3	27	Y	Y	Y	Y	Y	
11/03/2023	04:17	15	240	600	5637	6	40.88	S	25	11.58	W	15.27	4	26.86	28.48	Y	Y	Y	Y	Y	
12/03/2023	04:06	16	250	600	5585	3	58.34	S	25	9.98	W	10	3	26.9	28.5	Y	Y	Y	Y	Y	
13/03/2023	04:48	17	257	600	2812	0	0	S	25	8.54	W	5.74	2	26.74	28.28	Y	Y	Y	Y	Y	2
14/03/2023	04:17	18	269	600	4459	3	0.89	N	25	25.05	W	2.78	2	27.38	28.99	Y	Y	Y	Y	Y	
15/03/2023	04:10	19	280	600	4169	6	10.55	N	25	22.04	W	9.4	2	25.9	28.3	Y	Y	Y	Y	Y	
16/03/2023	04:05	20	290	600	4667	9	15.644	N	25	18.74	W	2.72	1	24.7	27.13	Y	Y	Y	Y	Y	
20/03/2023	04:10	21	303	600	5153	22	36.8	N	25	0.3	W	16.5	4	21.02	22.44	Y	N	Y	Y	Y	3
21/03/2023	03:10	22	311	600	5156	25	41.91	N	25	0.13	W	14.93	4	19.37	22.14	Y	Y	Y	Y	Y	
22/03/2023	03:13	23	322	600	5127	28	20.772	N	24	8.9	W	18	5	19.4	21.2	Y	Y	Y	Y	Y	4
23/03/2023	03:10	24	332	600	5204	31	2.8891	N	22	46.3755	W	8	3	17.39	20.4	Y	N	Y	Y	Y	
24/03/2023	03:12	25	341	600	5202	34	3.74	N	21	11.27	W	3	1	18.2	19.1	Y	N	Y	Y	Y	
25/03/2023	02:10	26	351	600	4691	36	47.56	N	19	27.62	W	4.1	2	16.84	17.11	Y	N	Y	Y	Y	

<Notes>

1: Winch trouble (no power supply to the monitor). Recovered RCF at 570m.
2: CPICS time was incorrectly set. 23/03/2023 instead of 13/03/2023
3: CPICS battery was drained and unbale to collect images
4: CPICS battery got flooded. No data collection from following deployment.

General problems during deployments

Most deployments were smoothly operated throughout the cruise, however, the data quality of CPICS was not satisfying. No particle was detected for first 5 deployments possibly because most particles were out of focus or not clear enough to pass the detection algorithm. Since the light from UVP5 might have contaminated sampling volume of CPICS and caused lower quality of images, we applied a black plastic panel between CPICS and UVP5 to reduce light contamination. CPICS started detecting particles after applying the modification, however, number of images was approximately 1- 2 for every 1 m.

CPICS started failing with charging the battery pack after 10^{th} deployment, as the battery charger displayed false message of fully charged when the battery was not charged. After 22^{nd} deployment which the battery was completely drained, we tested cables for battery charger and no major concern was found. Small damage on o-ring was observed when we serviced the battery pack, however, replacement was unavailable because of no spare supply. We continued deployments and the battery pack was flooded on 24^{th} deployment.

MSS90 : Microstructure (turbulence) measurements

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Objectives

Turbulence is one of the major physical mechanisms that drives formation and destruction of marine snow aggregates, so that our objective of turbulence measurements is comparing turbulence with particle size distributions obtained from RCF. We conducted 51 deployments of microstructure profiler (MSS 90, Sea & Sun Technology) to make turbulence and biological measurements simultaneously up to 200m.

Methods

MSS90 carries sensors of conductivity, temperature (slow and fast response), pressure, fluorescence, and shear (x-axis and y-axis). Shear probe numbers are 098 and 099 respectively and calibrated in 2019. Deployments of MSS90 was operated by a winch with cable drum which supplies power to MSS90 and transmit real time data from MSS90 to the lab, and the winch was fixed on aft port throughout the cruise (Figure 1). MSS90 was connected to the winch before deployment and after the deployment and stored in the box at hanger between daily deployments. We set up the deck unit and laptop at the deck lab and run the cable between the winch and the deck unit, so that we can monitor the data from MSS90 during the deployment.

Figure 1 Deployment of MSS 90. a- winch operation b- deployment of MSS90. c – sensors of MSS90

Deployments

Sinking in free fall mode of MSS90 is strictly required for good quality of microstructure data that excludes the movements of ship. Providing a slack in the cable, observing 2 loops of cable near the surface is typically sufficient but not excess length, allows the free fall mode sinking. Monitoring the depth and sinking velocity of MSS90 is not available with the winch, hence monitoring the transmitted data using the software (SSDA 228, supplied by SST) at the lab and communicate with the winchman was required. Profile depth was between 200 m and 250 m, and sinking velocity of MSS90 during this cruise was typically 0.6 m s^{-1} which provides a good quality of microstructure data. Sinking velocity was estimated by the duration MSS90 travels for 10m. Details of deployments are provided in table 1.

Table 1 Observation details of MSS90. We conducted single deployments for first 3 stations and 2 deployments from 4th station and onwards.

MSS #	Event#	Filename	Date	Time	Latitude			Longitude			Echo depth	Depth	Temp	SST	Sea state	Wind	Max out
					Deg	Min		Deg	Min		m						
1	7	MSS90_1	23/02/2023	07:57	46	5.90	S	48	44.22	W	5670	200	15.3	15.2	4	11	254
2	17	MSS90_2	24/02/2023	07:37	44	1.89	S	45	39.5	W	4980	200	NA	NA	3	7	256
3	28	MSS90_3	25/02/2023	07:48	41	14.91	S	43	53.57	W	5172	200	18.23	19.68	2	7	237
4	NaN	MSS90_4	27/02/2023	06:38	37	25.49	S	40	44.78	W	5011	200	19.6	22.1	5	10	245
5	NaN	MSS90_5	27/02/2023	06:52	37	25.49	S	40	44.78	W	5011	200	19.6	22.1	5	10	245
6	110	MSS90_6	28/02/2023	06:14	35	31.89	S	37	35.11	W	4764	200	19.9	22.4	3	12	246
7	110	MSS90_7	28/02/2023	06:23	35	31.89	S	37	35.11	W	4764	200	19.9	22.4	3	12	260
8	123	MSS90_8	01/03/2023	05:09	33	55.8	S	34	26.62	W	4242	200	21.1	24.1	2	7	233
9	123	MSS90_9	01/03/2023	NaN	33	55.8	S	34	26.62	W	4242	200	21.1	24.1	2	7	233
10	154	MSS90_10	02/03/2023	05:18	31	52.24	S	31	17.44	W	4112	200	22.4	25	2	5.4	228
11	154	MSS90_11	02/03/2023	05:28	31	52.24	S	31	17.44	W	4112	200	22.4	25	2	5.4	228
12	163	MSS90_12	03/03/2023	05:12	30	9.38	S	28	10.39	W	3950	200	24	26.4	3	10	230
13	163	MSS90_13	03/03/2023	05:22	30	9.38	S	28	10.39	W	3950	200	24	26.4	3	10	223
14	173	MSS90_14	04/03/2023	05:03	28	23.14	S	25	5.11	W	4666	200	24.4	26.6	1	2.4	229
15	173	MSS90_15	04/03/2023	05:14	28	23.14	S	25	5.11	W	4666	200	24.4	26.6	1	2.4	226
16	187	MSS90_16	05/03/2023	05:06	25	9.5	S	24	29.57	W	4507	200	24.7	27.2	3	7.5	220
17	187	MSS90_17	05/03/2023	05:16	25	9.5	S	24	29.57	W	4507	200	24.7	27.2	3	7.5	209
18	199	MSS90_18	06/03/2023	NaN	21	57.67	S	24	29.7	W	5499	200	25.6	27	3	10.2	233
19	199	MSS90_19	06/03/2023	NaN	21	57.67	S	24	29.7	W	5499	200	25.6	27	3	10.2	230
20	212	MSS90_20	08/03/2023	05:08	16	0.86	S	25	3.72	W	5559	200	26	27.2	5	15.9	225
21	212	MSS90_21	08/03/2023	05:17	16	0.86	S	25	3.72	W	5559	200	26	27.2	5	15.9	215
22	220	MSS90_22	09/03/2023	05:08	12	48.27	S	25	3.23	W	4899	200	25.6	27.4	5	18	215
23	220	MSS90_23	09/03/2023	05:18	12	48.27	S	25	3.23	W	4899	200	25.6	27.4	5	18	219
24	232	MSS90_24	10/03/2023	05:08	9	51.73	S	25	2.71	W	5598	200	26.2	27.2	4	16.8	218
25	232	MSS90_25	10/03/2023	05:20	9	51.73	S	25	2.71	W	5598	200	26.2	27.2	4	16.8	205
26	241	MSS90_26	11/03/2023	05:08	6	40.95	S	25	11.47	W	5650	200	27	28.5	4	15	241

27	241	MSS90_27	11/03/2023	05:18	6	40.95	S	25	11.47	W	5650	200	27	28.5	4	15	238
28	251	MSS90_28	12/03/2023	05:03	3	38.4	S	25	9.87	W	5575	200	26.9	28.5	4	11	233
29	251	MSS90_29	12/03/2023	05:15	3	38.4	S	25	9.87	W	5575	200	26.9	28.5	4	11	228
30	258	MSS90_30	13/03/2023	05:48	0	0	S	25	8.4	W	NaN	NaN	NaN	NaN	NaN	NaN	NaN
31	258	MSS90_31	13/03/2023	06:00	0	0	S	25	8.4	W	NaN	NaN	NaN	NaN	NaN	NaN	NaN
32	270	MSS90_32	14/03/2023	05:00	3	0.9	N	24	25.02	W	NaN	200	NaN	NaN	NaN	NaN	213
33	270	MSS90_33	14/03/2023	05:26	3	0.9	N	24	25.02	W	NaN	200	NaN	NaN	NaN	NaN	200
34	281	MSS90_34	15/03/2023	05:06	6	10.54	N	25	22.04	W	4168	200	25.9	28.3	3	7.3	228
35	281	MSS90_35	15/03/2023	05:06	6	10.54	N	25	22.04	W	4168	200	25.9	28.3	3	7.3	201
36	291	MSS90_36	16/03/2023	05:30	9	15.65	N	25	18.74	W	4726	200	24.7	27.1	1	5.4	256
37	291	MSS90_37	16/03/2023	05:30	9	15.65	N	25	18.74	W	4726	200	24.7	27.1	1	5.4	243
38	304	MSS90_38	20/03/2023	05:03	22	36.84	N	25	0.3	W	5154	200	20.9	22.4	5	19	242
39	304	MSS90_39	20/03/2023	05:15	22	36.84	N	25	0.3	W	5154	200	20.9	22.4	5	19	231
40	313	MSS90_40	21/03/2023	05:05	25	41.9	N	25	0.13	W	5156	200	19.37	22.14	4	15	NaN
41	313	MSS90_41	21/03/2023	05:30	25	41.9	N	25	0.13	W	5156	200	19.37	22.14	4	15	NaN
42	323	MSS90_42	22/03/2023	04:10	28	20.7	N	24	9.01	W	5143	200	19.4	20.4	5	19	242
43	323	MSS90_43	22/03/2023	05:20	28	20.7	N	24	9.01	W	5143	200	19.4	20.4	5	19	201
44	333	MSS90_44	23/03/2023	04:03	31	2.89	N	22	46.35	W	5187	200	17.4	20.4	3	8	243
45	333	MSS90_45	23/03/2023	04:15	31	2.89	N	22	46.35	W	5187	200	17.4	20.4	3	8	212
46	342	MSS90_46	24/03/2023	04:06	34	3.74	N	21	11.27	W	5202	200	18.2	19.1	2	6	243
47	342	MSS90_47	24/03/2023	04:15	34	3.74	N	21	11.27	W	5202	200	18.2	19.1	2	6	212
48	352	MSS90_48	25/03/2023	03:07	36	47.56	N	19	27.64	W	4715	200	16.7	17	4	15.3	242
49	352	MSS90_49	25/03/2023	03:20	36	47.56	N	19	27.64	W	4715	200	16.7	17	4	15.3	250
50	362	MSS90_50	26/03/2023	03:11	39	39.81	N	17	31.68	W	4022	200	14.41	15.4	2	6	256
51	362	MSS90_51	26/03/2023	03:22	39	39.81	N	17	31.68	W	4022	200	14.41	15.4	2	6	266

Post deployment data processing

Recorded raw data (MDR files) was converted to ascii format (TOB files) using SSDA 228 (options > export datafile), then TOB files were converted to mat files. Microstructure velocity shear for x-axis and y-axis ($\frac{\partial u}{\partial z}, \frac{\partial v}{\partial z}$, s^{-1}) were calculated from the shear sensor output (note: sensitivity of shear probe was provided in the calibration file). Sinking velocity at 1024 Hz was calculated, and data with sinking velocity slower than 0.4 m s^{-1} was discarded. Slow sinking velocity was often found at near the surface. Using the velocity shear, turbulent kinetic dissipation rate (TKE dissipation rate, ε, W kg^{-1}) as a proxy of strength of turbulence was estimated.

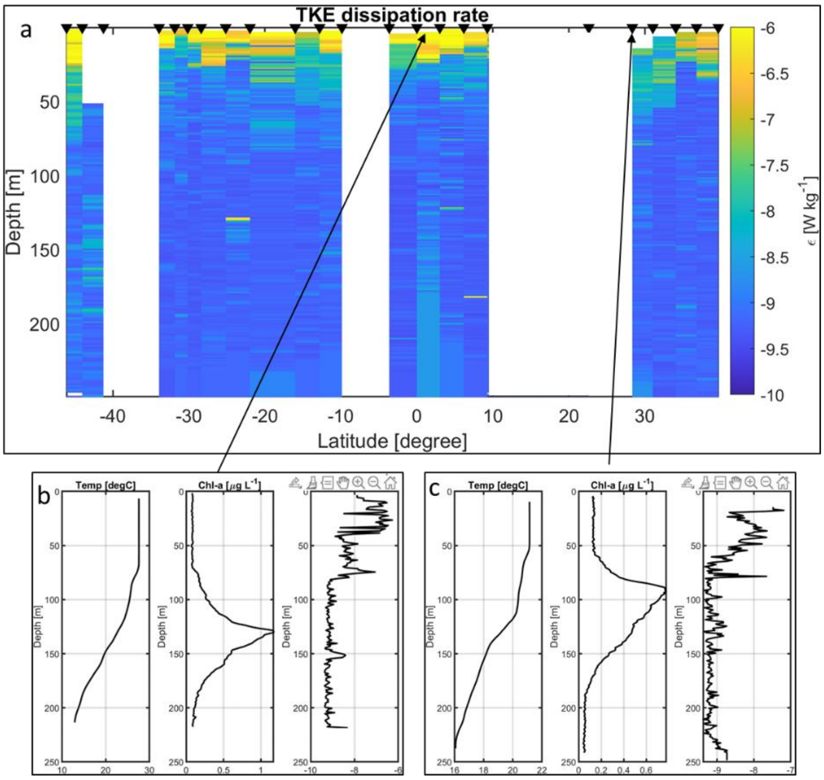

Figure 2 Example of turbulent kinetic energy dissipation rate measured by MSS90 during DY157 cruise. a- distribution across the transect. b. profile (temperature, chl-a, and TKE dissipation rate) of 14th deployment. c. profile of 24th deployment.

Sinking particulate fluxes

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Objectives

Directly measure particulate fluxes of Chlorophyll, Biogenic Silica (BSi), and Particulate Organic Carbon (POC), to enable calibration of high-resolution optical flux estimates from in-situ particle imaging.

Methods

MSCs were typically deployed to sample two depths below the mixed layer depth (MLD), typically around MLD+10 m and MLD+110 m. On occasion this protocol was adjusted to sample the DCM and capture this region of high particle concentrations.

A full description of the assumptions and established protocols followed in sampling the MSC are described in Riley et al. (2012), Giering et al. (2016), and Baker et al. (2017). However, the MSC deployed on this cruise was a new prototype model (“Yuki”) developed at the NOC. The Yuki model is principally the same as the MSCs described in the above studies, but differs slightly from the previous MSC in order to improve scientific quality (minimize disturbance to particles through turbulence) in ease of set up and. Briefly, the MSC is a large volume (95L) water sampler with a removable base section and a removable tray at the bottom of the base section. Once returned to deck, 5 L is decanted from the top of the MSC to provide a “time-zero” (Tzero) measurement. After a 2 h settling period, suspended material is sampled by draining another 5 L from the top of the MSC (MSC “top” measurement”). After sampling of suspended material, the MSC may be drained down to the base section by a tap halfway down the top section of the MSC, and then a tap in the base section of the MSC. When the water level reaches the top of the base section, a 5 L MSC “base” measurement may be taken from the base tap. Draining the MSC typically took ~20-25 minutes. The base section of the MSC is then removed from the top section of the MSC, and remaining water above the lip of the MSC tray siphoned off. Fast sinking material is assumed to have settled into the tray at the bottom of the MSC base section; a lid is placed on this tray which can now be removed (MSC “tray” measurement).

A full list of all MSC deployments with parameters measured is shown in Table 1; filtration volumes used in each analysis are shown in Table 2.

Sample filtration, preservation, analysis

Particular Organic Carbon (POC) and Nitrogen (PON)

Samples were filtered through precombusted (24 hours, 450 °C) glass fibre filters (GF/F, 0.7 μm, 25 mm diameter, Whatman) and rinsed with filtered seawater. Typically for Tzero, top, and base sections of MSC, 1000 mL were typically filtered in duplicates, with 250 – 350 mL typically filtered in duplicate for the smaller tray samples. Filters were then placed into Petrislides, and dried in an oven (at least 24 hours, 40 °C) before being stored at room temperature for analysis back on land. Blank corrections were prepared by filtering duplicates of 1800 mL, 600 mL, and 200 mL of raw seawater and following the protocol as described above.

Biogenic Silica (BSi)

Samples were filtered onto polycarbonate filters (0.8 μm, 25 mm diameter, Whatman) and rinsed with filtered seawater. For each of the time-zero, top and base sections of MSC, 500 mL of sample were filtered and for the tray section, 200 mL was typically filtered. Filters were placed into 15 mL corning tubes, dried (at least 24 hours, 40°C) before being stored at room temperature for analysis back on land.

Total Chlorophyll

Samples were filtered onto GF/F filters (nominal pore-size 0.7 µm, 47 mm diameter, Whatman) rinsed with filtered seawater, and placed into glass vials containing 6 mL acetone (90%, HPLC) and stored at -20°C for 24 hours, for analysis on board. Fluorescence was analysed on board using a Turner Designs Trilogy fluorometer calibrated with a blank and solid standard.

Issues to be noted with Yuki deployment

As a new model, the ANTICS team discovered several useful tips to avoid misfires of the new MSC, which largely arise from friction around the internal pole of the release mechanism. All points are essential; bold points are tips and tricks that seem to decrease likelihood of misfires.

General maintenance:
Rinse Yuki with fresh water **daily,** after deployments are finished with the day. As well as the inside of the MSc top and base, particular care should be taken **to thoroughly wash the pulleys of the release mechanism, as well as the internal pole which raises the MSC lid**. We recommend pulling on the release wire to **raise the internal pole up and down whilst rinsing, to expose the entire pole**. This will minimize friction between the pole which can prevent the lid from closing. After work is done for the day, <u>check all taps and top valve are closed.</u>

We recommend a **heavy messenger** when firing MSC and to throw the messenger down the wire with **plenty of force**.- if experiencing misfires, perhaps add some weight to messenger, and ensure all tips outlined in pre-deployment set up (below) are followed**. Lubricating central pole, and set up of catch into the groove on central pole are the key points.**

On one occasion, and on previous prototype, the MSC failed because the release wire became caught on the handle of a clip which fastens base section to main MSC body. We believe this occurs when the MSC fires, allowing the base plate to close, but the then slackened wire becomes caught. This prevents the lid from fully closing. **Use cable ties to prevent lateral movement of wire in the vicinity of the red clip handle.**

Pre-deployment set up:
Check all taps and valve are closed. We mention this both at the end of the start and start of a new day as a double failsafe, as the **MSC will leak if these are not fastened.** Insert white tray into base section, secure with white conical screw. Lift cocking arm (it is easiest to hold this up with your thigh, giving you to hands to...) slide the base plate up and into position. Lower the cocking arm to secure primed base plate in open position. From this point on, the cocking arm should not be moved. You may notice a slight amount (a few mm) of lateral movement of the base plate within the base when it is secured upright within the base. I like to ensure the base is positioned centrally, not touching either side of the base walls. I am not sure this makes any difference, but I am aiming to avoid the base plate or tray catching on the walls of the base (this happened on an earlier cruise with an earlier prototype but has not been seen to happen with the latest prototype).

Place metal support under MSC frame and place the base on the metal support. **Check O ring is seated correctly** before sliding base section in. (This can be a tight squeeze past the clips. It is easiest to rotate the base clockwise slightly and slide the nodule on the LHS of the base in past the metal frame. Then, the nodule on the RHS can be slid past the metal frame, and the base can then be positioned underneath the main section of the MSC.)

Ensure the pins which will hold the MSC base to the main body of the MSC are **all aligned prior to fastening.** It is easiest to **attach opposite pins simultaneously**, either by one individual, or with two persons communicating clearly to ensure this is simultaneous. If one clip is excessively stiff to close, check all clips are correctly aligned, the O-ring is seated correctly, and try again.

The following paragraph is important as there is a knack to setting up the MSC in such a way that friction is minimized. Before securing the lid, pull on the release wire to repeatedly raise and lower the

central tube attached to the lid **whilst rinsing the central tube with fresh/MQ water from a squeezy bottle**. Make sure **to dampen all around the surface of the central tube.** The idea is to **lubricate the pole as it slides in and out of the sheath.** When dry at the start you may notice some friction; you will probably notice this decreasing as you wetten the tube. If in doubt, keep rinsing!
Once satisfied the pole is damp, pull down on the wire to raise the lid as high as it will go- higher slightly than the position in which the release mechanism will secure lid in place. Whilst pressing the release catch against the central tube, slowly lower down the central tube to the point where the groove on the central tube is at the same height as the catch; the catch will slot into the groove. **We have found lowering the groove down to the catch from the very top seems to create less friction than raising the lid up until the groove reaches the catch.** We also recommend ensuring **the catch is not wedged too hard or too far into the groove** as this creates more friction: support the base or put a wedge beneath it, and ensure catch is only about ¾ of the way into the groove. **A good test** once catch is secure is to wiggle the lid up and down slightly. If no movement whatsoever, catch is too far into groove and friction may be excessive. If lid wiggles slightly (mm or two) up and down, **there is a little bit of play** and the catch is probably a good distance into the groove.

Finally, attach release wire to cocking arm using R-pin. You may have to **(by no more than a cm or so)** slightly raise the cocking arm to align the pin with the hole on the cocking arm. If you have to raise the arm by any more than this, **do not!**- it may cause base to fall, and you will have to start set up again. In this instance, check the wire isn't caught on anything. Once fastened, you're ready to go. **Either use a wedge or support the lid whilst shackle is being attached by crew** in case they accidentally trigger the release mechanism. Recheck taps and valve are closed.

Deploy. **Plenty of welly when throwing messenger down wire!** Recover. Undo valve to take samples but do back up in between to seal MSc in case of leaks.

References

Baker, C. A., Henson, S. A., Cavan, E. L., Giering, S. L., Yool, A., Gehlen, M., Belcher, A., Riley, J. S., Smith, H. E. & Sanders, R., 2017. Slow-sinking particulate organic carbon in the Atlantic Ocean: Magnitude, flux, and potential controls. *Global Biogeochemical Cycles*, **31**(7), pp.1051-1065.

Giering, S. L. C., Sanders, R., Martin, A. P., Lindemann, C., Möller, K. O., Daniels, C. J., Mayor, D. J. & St. John, M. A., 2016. High export via small particles before the onset of the North Atlantic spring bloom. *Journal of Geophysical Research: Oceans,* **121**(9), pp.6929-6945.

Riley, J. S., Sanders, R., Marsay, C., Le Moigne, F. A., Achterberg, E. P. & Poulton, A. J., 2012. The relative contribution of fast and slow sinking particles to ocean carbon export. *Global Biogeochemical Cycles*, **26**(1).
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Table 1: Details of MSC deployments from DY157 cruise along with parameters sampled from each. X indicates parameter sampled.

Date	Event	MSC #	MSC ID	Depth (m)	Lat (N)		Lon (W)		Time triggered (GMT)	Purpose	POC	BSi	PIC	Chl	Sinking vel.	Comments
23/02/23	004	1	Yuki	50	-46	5.65'	48	43.93'	06:11	Fluxes, SV	x	x	x	x	x	
23/02/23	010	2	Yuki	150	-46	5.86'	48	44.32'	09:13	Fluxes	-	-	-	-	-	Misfire.
24/02/23	014	3	Yuki	50	-44	1.86'	45	39.48'	06:30	Fluxes	-	-	-	-	-	Misfire.
24/02/23	018	4	Yuki	50	-44	1.939'	44	39.60'	08:10	Fluxes	-	-	-	-	-	Misfire.
24/02/23	023	5 (3)	Yuki	40	-43	21.93'	44	40.20'	15:46	Fluxes, SV	x	x	x	x	x	Labelled as MSC3.
25/02/23	025	6	Yuki	50	-41	14.93'	43	53.86'	06:08	Fluxes	x	x	x	x	-	
25/02/23	030	7	Yuki	150	-41	14.76'	43	53.36'	08:52	Fluxes, SV	x	x	x	x	x	
26/02/23	035	8	Yuki	50	-38	27.11'	42	45.51'	15:04	Fluxes	x	x	x	x	-	
27/02/23	037	9	Yuki	50	-37	25.48'	40	44.75'	05:03	Fluxes, SV	x	x	x	x	x	
27/02/23	041	10	Yuki	150	-37	25.51'	40	44.86'	07:57	Fluxes, SV	x	x	x	x	x	
28/02/23	107	11	Yuki	150	-35	31.86'	37	35.06'	05:01	Fluxes, SV	x	x	x	x	x	
28/02/23	113	12	Yuki	80	-35	31.92'	37	35.19'	07:48	Fluxes	x	x	x	x	-	
01/03/23	120	13	Yuki	150	-33	55.69'	34	26.36'	04:10	Fluxes	x	x	x	x	-	Event 119 misfire; 120 success
01/03/23	127	14	Yuki	50	-33	56.15	34	27.32'	06:59	Fluxes	x	x	x	x	-	
02/03/23	152	15	Yuki	150	-31	52.24'	31	17.44'	04:01	Fluxes	x	x	x	x	-	
02/03/23	157	16	Yuki	50	-31	52.30'	31	17.55'	06:39	Fluxes	x	x	x	x	-	
03/03/23	161	17	Yuki	50	-30	9.42'	28	10.41'	04:15	Fluxes	x	x	x	x	-	
03/03/23	166	18	Yuki	150	-30	9.27'	28	10.32'	07:01	Fluxes	x	x	x	x	-	
04/03/23	171	19	Yuki	150	-28	23.15'	25	5.13'	03:59	Fluxes	x	x	x	x	-	
04/03/23	177	20	Yuki	40	-28	23.07'	25	4.94'	06:40	Fluxes, SV	x	x	x	x	x	Event 176 misfire; 177 success
05/03/23	186	21	Yuki	150	-25	9.54'	24	29.64'	03:58	Fluxes	x	x	x	x	-	Event 185 misfire; 186 success.
05/03/23	190	22	Yuki	50	-25	9.46'	24	29.49'	06:45	Fluxes	x	x	x	x	-	
06/03/23	197	23	Yuki	40	-21	57.72'	24	29.83'	03:57	Fluxes	x	x	x	x	-	
06/03/23	202	24	Yuki	150	-21	57.67'	24	29.70'	06:43	Fluxes	x	x	x	x	-	
08/03/23	209	25	Yuki	50	-16	0.80'	25	3.84'	04:00	Fluxes	x	x	x	x	-	
08/03/23	214	26	Yuki	150	-16	0.90'	25	3.60'	06:44	Fluxes, SV	x	x	x	x	x	

09/03/23	218	27	Yuki	60	-12	48.26'	25	3.31'	03:57	Fluxes	x	x	x	x	-	
09/03/23	224	28	Yuki	140	-12	48.13'	25	3.31'	08:00	Fluxes	x	x	x	x	-	
10/03/23	230	29	Yuki	60	-9	51.73'	25	2.71'	04:07	Fluxes	x	x	x	x	-	
10/03/23	235	30	Yuki	130	-9	51.84'	25	2.56'	06:47	Fluxes	x	x	x	x	-	
11/03/23	239	31	Yuki	60	-6	41.89'	25	11.59'	04:05	Fluxes, SV	x	x	x	x	x	
11/03/23	244	32	Yuki	150	-6	41.01'	25	11.38'	06:57	Fluxes, SV	x	x	x	x	x	
12/03/23	249	33	Yuki	50	-3	38.33'	25	9.99'	03:58	Fluxes, SV	x	x	x	x	x	
12/03/23	254	34	Yuki	150	-3	38.40'	25	9.87'	06:48	Fluxes	x	x	x	x	-	
13/03/23	256	35	Yuki	50	0	0'	25	9.63'	04:39	Fluxes, SV	x	x	x	x	x	
13/03/23	261	36	Yuki	150	0	0'	25	7.67'	07:31	Fluxes	x	x	x	x	-	
14/03/23	268	37	Yuki	50	3	0.88'	25	25.06'	04:04	Fluxes, SV	x	x	x	x	x	
14/03/23	273	38	Yuki	150	3	1.11'	25	25.06'	06:46	Fluxes, SV	x	x	x	x	x	
15/03/23	279	39	Yuki	50	6	10.55'	25	22.04'	03:58	Fluxes, SV	x	x	x	x	x	
15/03/23	284	40	Yuki	150	6	10.86'	25	22.13'	06:52	Fluxes, SV	x	x	x	x	x	
16/03/23	289	41	Yuki	50	9	15.59'	25	18.74'	04:02	Fluxes, SV	x	x	x	x	x	
16/03/23	294	42	Yuki	150	9	15.86'	25	18.73'	06:46	Fluxes, SV	x	x	x	x	x	
20/03/23	302	43	Yuki	160	22	36.80'	25	0.35'	02:59	Fluxes, SV	x	x	x	x	x	
20/03/23	307	44	Yuki	60	22	36.90'	25	0.24'	05:09	Fluxes, SV	x	x	x	x	x	
21/03/23	311	45	Yuki	160	25	41.91'	25	0.14'	03:00	Fluxes, SV	x	x	x	x	x	
21/03/23	316	46	Yuki	60	25	42	25	0	06:05	SV	-	-	-	-	-	Misfire.
22/03/23	321	47	Yuki	60	28	19.22'	24	9.70'	03:01	Fluxes, SV	x	x	x	x	x	
22/03/23	326	48	Yuki	160	28	20.90'	24	8.83'	05:49	Fluxes	x	x	x	x	-	
23/03/23	331	49	Yuki	160	31	2.89'	22	46.38'	02:59	Fluxes	x	x	x	x	-	
23/03/23	336	50	Yuki	60	31	3.05'	22	46.27'	05:45	Fluxes	x	x	x	x	-	
24/03/23	340	51	Yuki	160	34	3.74'	21	11.27'	02:58	Fluxes, SV	x	x	x	x	x	
24/03/23	345	52	Yuki	60	34	3.9'	21	11.2'	05:48	Fluxes, SV	x	x	x	x	x	
25/03/23	350	53	Yuki	160	36	47.53'	19	27.62'	02:03	Fluxes, SV	x	x	x	x	x	
25/03/23	355	54	Yuki	60	36	47.53'	19	27.62'	04:49	Fluxes, SV	x	x	x	x	x	
26/03/23	360	55	Yuki	160	39	39.80'	17	31.70'	02:06	Fluxes, SV	x	x	x	x	x	
26/03/23	366	56	Yuki	60	39	39.67'	17	31.56'	05:00	Fluxes, SV	x	x	x	x	x	Event 365 misfire; 366 success.

Table 2: Details of volumes filtered for each parameter (POC, BSi, PIC, Chl) from each MSC. Volumes of water within each tray sample are also presented.

Date	MSC	MSC ID	Fraction	Tray volume (mL)	POC-1	POC-2	BSi	PIC	Chl
23/02/23	1	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1410	400	400	250	250	110
23/02/23	2	Yuki	Tzero	NA					
			Top						
			Base						
			Tray						
24/02/23	3	Yuki	Tzero	NA					
			Top						
			Base						
			Tray						
24/02/23	4	Yuki	Tzero	NA					
			Top						
			Base						
			Tray						
24/02/23	5	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1420	400	400	250	250	100
25/02/23	6	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1730	500	500	300	300	100
25/02/23	7	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1820	500	500	300	300	200
26/02/23	8	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1580	500	500	200	200	100
27/02/23	9	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1180	350	350	150	150	100
27/02/23	10	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1160	350	350	150	150	100

28/02/23	11	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1630	500	500	250	250	100
28/02/23	12	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	930	250	250	150	150	100
01/03/23	13	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1730	500	500	250	250	200
01/03/23	14	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1920	500	500	300	300	200
02/03/23	15	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2020	600	600	300	300	200
02/03/23	16	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1960	600	600	300	300	160
03/03/23	17	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1980	600	600	300	300	100
03/03/23	18	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2030	600	600	300	300	200
04/03/23	19	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1540	500	500	200	200	100
04/03/23	20	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1940	500	500	300	300	200
05/03/23	21	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1700	500	500	250	250	150

05/03/23	22	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1870	500	500	350	350	150
06/03/23	23	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1990	600	600	300	300	150
06/03/23	24	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1950	600	600	300	300	150
08/03/23	25	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1830	600	600	250	250	100
08/03/23	26	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1880	600	600	250	250	150
09/03/23	27	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1980	600	600	300	300	150
09/03/23	28	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1970	600	600	300	300	150
10/03/23	29	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2030	600	600	300	300	200
10/03/23	30	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2000	600	600	300	300	200
11/03/23	31	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1980	600	600	300	300	150
11/03/23	32	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1440	500	500	150	150	100

12/03/23	33	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray		600	600	300	300	200
12/03/23	34	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1850	600	600	250	250	150
13/03/23	35	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1900	600	600	250	250	200
13/03/23	36	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1900	600	600	300	300	150
14/03/23	37	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1880	600	600	250	250	150
14/03/23	38	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2000	600	600	300	300	200
15/03/23	39	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1980	600	600	300	300	150
15/03/23	40	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1850	600	600	300	300	150
16/03/23	41	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1970	600	600	300	300	150
16/03/23	42	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray		600	600	300	300	200
21/03/23	43	Yuki	Tzero		1000	1000	500	500	200
			Top		NA	NA	NA	NA	NA
			Base		1000	1000	500	500	200
			Tray	1800	500	500	300	300	150

21/03/23	44	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1995	600	600	300	300	150
22/03/23	45	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2020	600	600	300	300	200
22/03/23	46	Yuki	Tzero	NA					
			Top						
			Base						
			Tray						
24/03/23	47	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1930	600	600	300	300	100
24/03/23	48	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2000	600	600	300	300	200
24/03/23	49	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2030	600	600	300	300	200
24/03/23	50	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1980	600	600	300	300	150
25/03/23	51	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2030	600	600	300	300	200
25/03/23	52	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray		600	600	300	300	200
26/03/23	53	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2000	600	600	300	300	200
26/03/23	54	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2050	600	600	300	300	200

27/03/23	55	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	2050	600	600	300	300	200
27/03/23	56	Yuki	Tzero		1000	1000	500	500	200
			Top		1000	1000	500	500	200
			Base		1000	1000	500	500	200
			Tray	1960	600	600	300	300	150

DY157 – CTD & Mooring Cruise Report

Thomas Ballinger
Sensors and Moorings – National Oceanography Centre

Contents

CTD Summary

The Atlantic Meridional Transect is a long standing project that undertakes biological, chemical and physical oceanographic research. DY157 is utilising the voyage between the Falkland Islands and the UK.

56 CTD casts were undertaken with an NMF 24-way Stainless Steel CTD frame with 24 off 20l Niskin water samplers. Dual SBE 43 dissolved oxygen sensors were used. The primary temperature, conductivity and dissolved oxygen sensors were fitted to the 9 plus with the secondary sensors mounted on the vane. There were no casts deeper than 500m.

The CTD was operated out of the hangar using the overhead gantry to position the CTD for deployment. The preferred method for this is to disconnect the CTD wire from the swivel and use a master link to connect the gantry hook to the swivel, this prevents subjecting the swivel to any lateral load. The CTD was deployed using CTD wire storage drum 2.

The winch system Active Heave Compensation was used on all casts showing improvements in package stability and an improvement in stabilising winch tension.

There was a fouling event at 78m on the up cast of CTD016 during which the secondary sensors became noisy. Upon recovery both the primary and secondary sensors were flushed with bleach and triton-x solutions and then thoroughly flushed with MilliQ. The frame and optical sensors were also all cleaned as there were visible signs of fouling.

Between casts the whole CTD package was rinsed with fresh water with particular attention paid to the SBE 32 latch assembly. After each cast the primary and secondary sensors were flushed three times with MilliQ. Periodically the optical sensors were cleaned with MilliQ and Optic Prep wipes.

There were no major technical issues with the Stainless Steel CTD suite during the cruise with only one sensor requiring changing. DWIRR was unstable during cast 19, PAR2 was replaced with PAR4 for cast 21. The issue persisted so for cast 23 PAR2 was installed with a new cable, after which no more issues occurred. The suspect cable was checked and no faults were found, possibly a little water made its way into the connector.

Before cast CTD004 bottles 4 and 24 were changed as chips were found around the bottom cap seal, the same was noticed with bottle 4 which was replaced prior to cast CTD020. During cast 021 bottle 23 failed to fire, after this all lanyards were checked and the SBE32 was washed thoroughly. There were no other failed water collections throughout the cruise. All bottles were leak tested before the start of science with no issues noticed.

During cast 24 10 modulo errors occurred, this did not affect the data and the cast completed successfully. After the completion of sampling all connections on the CTD were cleaned and inspected for water ingress, there were no further errors throughout the cruise.

CTD Configuration

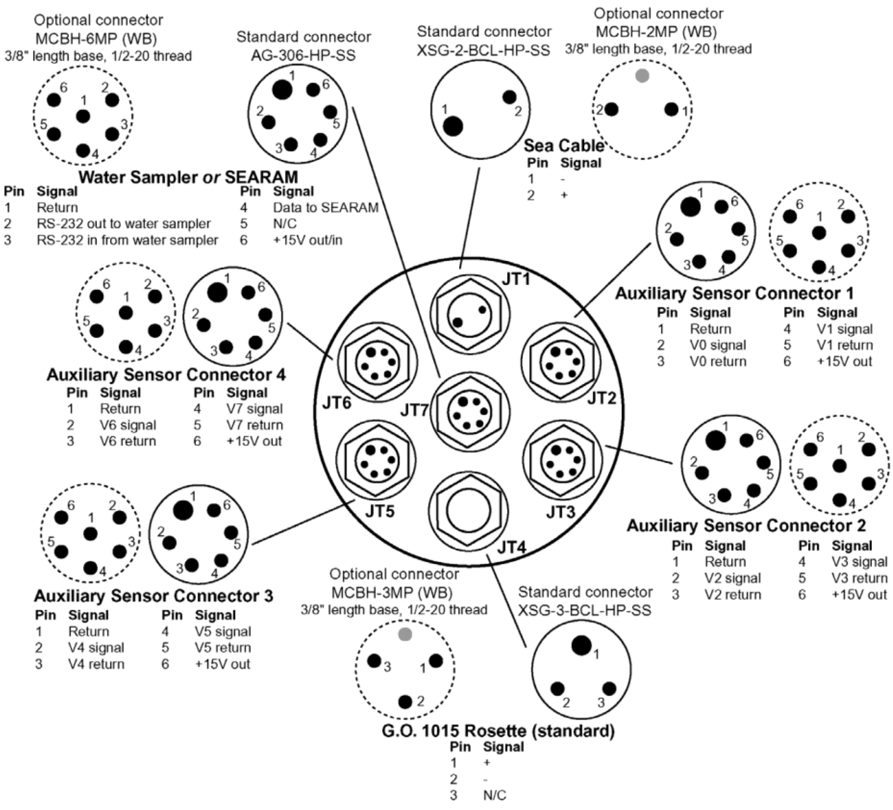
Stainless Steel CTD Instrument Package

The following sensors were fitted to the Stainless Steel CTD frame.

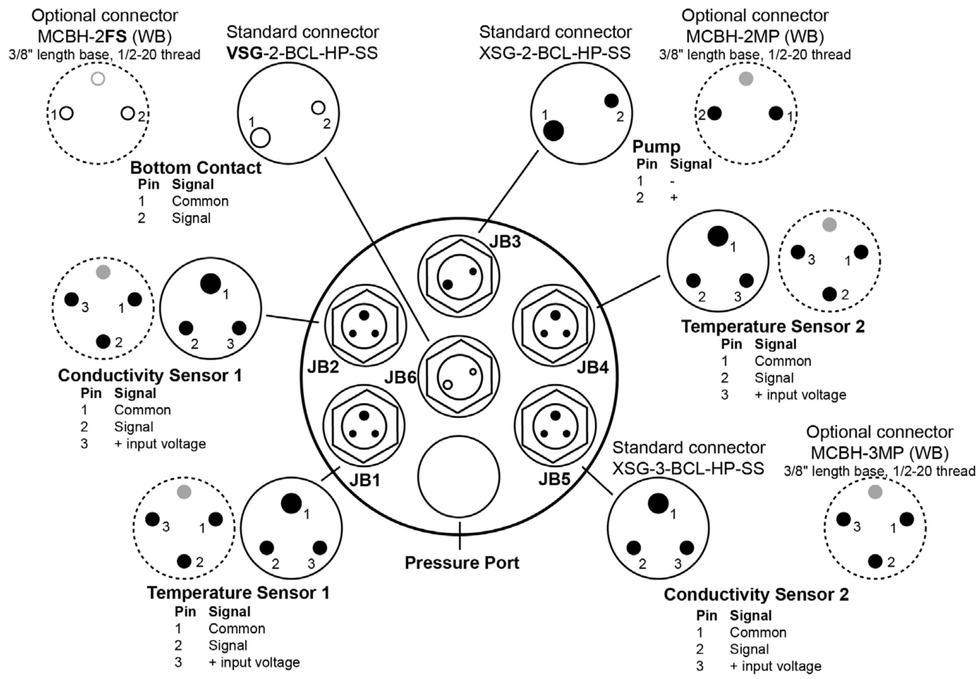
Instrument / Sensor	Manufacturer/ Model	Serial Number	Channel	Casts Used
Primary CTD deck unit	SBE 11plus	11P-24680-0588	n/a	All casts

CTD Underwater Unit	SBE 9plus	09P-34173-0758	n/a	All stainless casts
Stainless steel 24-way frame	NOCS	CTD 6	n/a	All stainless casts
MDS Titanium CTD Swivel	MDS	1246-2	n/a	All stainless casts
Primary Temperature Sensor	SBE 3P	03P-4380	F0	All stainless casts
Primary Conductivity Sensor	SBE 4C	04C-2165	F1	All stainless casts
Digiquartz Pressure sensor	Paroscientific	90074	F2	All stainless casts
Secondary Temperature Sensor	SBE 3P	03P-4782	F3	All stainless casts
Secondary Conductivity Sensor	SBE 4C	04C-3874	F4	All stainless casts
Primary Pump	SBE 5T	05T-3085	n/a	All stainless casts
Secondary Pump	SBE 5T	05T-3607	n/a	All stainless casts
24-way Carousel	SBE 32	32-1376	n/a	All stainless casts
DOST	SBE 35	Not fitted	n/a	All stainless casts
Primary Dissolved Oxygen Sensor	SBE 43	43-2831	V0	All stainless casts
Secondary Dissolved Oxygen Sensor	SBE 43	43-0862	V1	All stainless casts
Fluorometer	CTG Aquatracka MKIII	88-2960-163	V2	All stainless casts
Transmissometer	WETLabs C-Star	1719Tr	V3	All stainless casts
Altimeter	Valeport VA500	81629	V4	All stainless casts
Light Scattering Sensor	WETLabs BBRTD	168	V5	All stainless casts
PAR Up-looking DWIRR	CTG/PML par	02	V6	1-21 / 23-56
PAR Up-looking DWIRR	CTG/PML par	04	V6	Cast 22
PAR Down-looking UWIRR	CTG/PML par	05	V7	All stainless casts
20L Water Samplers	OTE		n/a	All stainless casts

SBE 9plus CTD Top End Cap Configuration



SBE 9plus CTD Bottom End Cap Configuration



Seasave Configurations & Instrument Calibrations

Date: 03/29/2023

Instrument configuration file: C:\Users\sandm\Documents\Cruises\DY157\Data\Seasave Setup Files\DY157_SS_0758_nmea_.xmlcon

Configuration report for SBE 911plus/917plus CTD

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

1) Frequency 0, Temperature

Serial number : 03P-4380
Calibrated on : 27-May-2022
G : 4.37193352e-003
H : 6.54672313e-004
I : 2.35221830e-005
J : 1.81401914e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency 1, Conductivity

Serial number : 04C-2165
Calibrated on : 21-Dec-21
G : -9.76374944e+000
H : 1.34220948e+000
I : -2.04030878e-003
J : 2.02334186e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

Serial number : 90074
Calibrated on : 23-Sep-2022
C1 : -6.571123e+004
C2 : 2.050504e-001
C3 : 1.612220e-002
D1 : 2.883800e-002
D2 : 0.000000e+000
T1 : 2.986693e+001
T2 : -2.678465e-004
T3 : 3.986390e-006
T4 : 7.472100e-010
T5 : 0.000000e+000
Slope : 1.00012000
Offset : 0.01710
AD590M : 1.283700e-002
AD590B : -8.642460e+000

4) Frequency 3, Temperature, 2

Serial number : 03P-4782
Calibrated on : 19-May-22
G : 4.34998447e-003
H : 6.36597811e-004
I : 2.09354221e-005
J : 1.77014255e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency 4, Conductivity, 2

Serial number : 04C-3874
Calibrated on : 14-Sep-21
G : -1.01595797e+001
H : 1.39651915e+000
I : -1.48456995e-004
J : 7.14671821e-005
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

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

Serial number : 43-2831
Calibrated on : 30-Jul-2022
Equation : Sea-Bird
Soc : 5.45600e-001
Offset : -4.87500e-001
A : -5.25530e-003
B : 1.79150e-004
C : -2.30920e-006
E : 3.60000e-002
Tau20 : 1.48000e+000
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

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

Serial number : 43-0862
Calibrated on : 18-Oct-22
Equation : Sea-Bird
Soc : 4.93900e-001
Offset : -4.94900e-001
A : -3.54540e-003
B : 1.19980e-004
C : -1.87350e-006
E : 3.60000e-002
Tau20 : 9.90000e-001
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

8) A/D voltage 2, Fluorometer, Chelsea Aqua 3

Serial number : 88-2960-163
Calibrated on : 20-April-2022
VB : 0.099110
V1 : 1.905480
Vacetone : 0.471530
Scale factor : 1.000000
Slope : 1.000000
Offset : 0.000000

9) A/D voltage 3, Transmissometer, WET Labs C-Star

Serial number : 1719TR
Calibrated on : 02-Feb-2021
M : 21.3312
B : -0.0789
Path length : 0.250

10) A/D voltage 4, Altimeter

Serial number : 81629
Calibrated on : 09-Jun-2022
Scale factor : 15.000
Offset : 0.000

11) A/D voltage 5, OBS, WET Labs, ECO-BB

Serial number : BBRTD-168
Calibrated on : 14-April-2020
ScaleFactor : 0.003243
Dark output : 0.043000

12) A/D voltage 6, PAR/Irradiance, Biospherical/Licor

Serial number : 02
Calibrated on : 27-Jun-2019
M : 0.45712515
B : 1.08610808
Calibration constant : 21740000000.00000000
Conversion units : umol photons/m^2/sec
Multiplier : 1.00000000
Offset : 0.00000000

13) A/D voltage 7, PAR/Irradiance, Biospherical/Licor, 2

Serial number : 05
Calibrated on : 2-Oct-2019
M : 0.47352961
B : 1.11774462
Calibration constant : 21740000000.00000000
Conversion units : umol photons/m^2/sec
Multiplier : 1.00000000
Offset : 0.00000000

Scan length : 45

Pump Control
This setting is only applicable to a custom build of the SBE 9plus.
Enable pump on / pump off commands: NO

Data Acquisition:
Archive data: YES
Delay archiving: NO
Data archive: C:\Users\sandm\Documents\Cruises\DY157\Data\CTD Raw Data\DY157_CTD056.hex
Timeout (seconds) at startup: 60
Timeout (seconds) between scans: 20

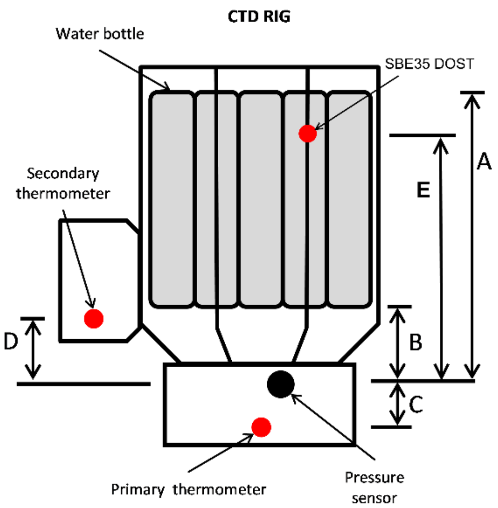
Instrument port configuration:
Port = COM4
Baud rate = 19200
Parity = N
Data bits = 8
Stop bits = 1

Water Sampler Data:
Water Sampler Type: SBE Carousel
Number of bottles: 36
Port: COM5
Enable remote firing: NO
Firing sequence: User input
Tone for bottle fire confirmation uses PC sound card.

Header information:
Header Choice = Prompt for Header Information

```
    prompt 0 = Ship: RRS Discovery
    prompt 1 = Cruise: DY157
    prompt 2 = Cast:
    prompt 3 = Station:
    prompt 4 = Julian Day:
    prompt 5 = Date:
    prompt 6 = Time (GMT):
    prompt 7 = Latitude:
    prompt 8 = Longitude:
    prompt 9 = Depth (uncorrected m):
    prompt 10 = Principal Scientist: Dr Andy Rees
    prompt 11 = Tom Ballinger
---------------------------------------------
TCP/IP - port numbers:
  Data acquisition:
    Data port:          49163
    Status port:        49165
    Command port:       49164
  Remote bottle firing:
    Command port:       49167
    Status port:        49168
  Remote data publishing:
    Converted data port:  49161
    Raw data port:      49160
---------------------------------------------
Miscellaneous data for calculations
  Depth, Average Sound Velocity, and TEOS-10
    Latitude when NMEA is not available:  48.00000000
    Longitude when NMEA is not available: 0.00000000
  Average Sound Velocity
    Minimum pressure [db]:          20.00000000
    Minimum salinity [psu]:         20.00000000
    Pressure window size [db]:      20.00000000
    Time window size [s]:           60.00000000
  Descent and Acceleration
    Window size [s]:                2.00000000
  Plume Anomaly
    Theta-B:                        0.00000000
    Salinity-B                      0.00000000
    Theta-Z / Salinity-Z            0.00000000
    Reference pressure [db]         0.00000000
  Oxygen
    Window size [s]:                2.00000000
    Apply hysteresis correction:    0
    Apply Tau correction:           1
  Potential Temperature Anomaly
    A0:                             0.00000000
    A1:                             0.00000000
    A1 Multiplier:                  Salinity
```

Stainless Steel CTD Frame Geometry



ID	Vertical distance from pressure sensor (m positive-up)
A	1.3 (Top of water samplers)
B	0.2 (Bottom of water samplers)
C	-0.075 (Primary T mounted on 9p)
D	0.085 (Secondary T mounted on Vane)
E	Not fitted

Technical Report

Stainless Steel CTD Wire CTD2

All stainless steel casts were carried out using wire CTD2, which was terminated using the potting method during the mobilisation for DY157. The CTD wire was electrically tested after terminating and had an insulation resistance of > 999 MΩ at 250V.

The mechanical termination was load tested as per the standard CTD load test of 5 minutes at 0.5T, 1.0T, 1.5T and 10 minutes at 2.0T. The mechanical termination did not slip under load. The mechanical termination was checked periodically throughout the cruise with no movement observed.

AUTOSAL

A Guildline 8400B, s/n 68958 was installed in the Salinometer Room as the main Autosal for salinity analysis. The bath temperature was set to 21ºC with the lab ambient temperature ranging between 18ºC – 19ºC. The salinometer was standardised prior to the start of analysis.
The Autosal was standardised using IAPSO Standard Seawater batch P164 (K15 = 0.9985, 2 x K15 = 1.99970). Crate 31 was analysed first, the standard read high at 1.99976 at the start of the run and increased to 1.99989 by the end of the crate. The Autosal was standardised again before any further analysis, the pot was adjusted to give a reading of 1.99969. The final standard of the cruise read 1.99978 showing a slight increase.
In total 9 crates were analysed throughout DT157.

MSS90L Turbulence Profiler

In total 51 profiles were conducted with a target depth of 200m, the profiler would overshoot this depth in order to maintain freefall. The maximum depth the profiler reached was 250M. Deployment was conducted from the port aft with the vessel moving 0.5 knots thorough the water to allow the wire to stream away. Sn 050 was used for all casts with no issues observed, after each deployment the profiler was rinsed with fresh water and stowed in the hangar.

Sea-Bird Data Processing

The table below lists the Sea-Bird processing routines run by Sensors and Moorings Technicians. Note this is only the modules that were run by NMF, not by scientific staff.

Module	Run?	Comments
Configure	N	

Data Conversion	Y	**As per BODC guidelines Version1.0 October 2010 (Oxygen Concentration umol/l and umol/kg, Latitude and Longitude (degrees), Scan Count, Time and Pressure Temperature)**
Bottle Summary	Y	**As per BODC guidelines Version1.0 October 2010, with above variables added (except not averaging Scan Count and Time)**
Mark Scan	N	
Align CTD	Y	As per BODC guidelines Version1.0 October 2010 **(dissolved oxygen advanced 6 seconds)** (appended file name)
Buoyancy	N	
Cell Thermal Mass	Y	As per BODC guidelines Version1.0 October 2010 (appended file name)
Derive	Y	As per BODC guidelines Version1.0 October 2010 (appended file name)
Bin Average	Y	As per BODC guidelines Version1.0 October 2010 **(1 metre depth bins)** (appended file name)
Filter	N	As per BODC guidelines Version1.0 October 2010 (appended file name)
Loop Edit	N	As per BODC guidelines Version1.0 October 2010 (appended file name)
Wild Edit	N	**Not applicable.**
Window Filter	N	
ASCII In	N	
ASCII Out	N	
Section	N	
Split	N	
Strip	Y	As per BODC guidelines Version1.0 October 2010 (appended file name)
Translate	N	
Sea Plot	N	
SeaCalc II	N	

Software Used

- SeaBird SeaTerm 1.59
- SeaBird SeaSave 7.26.7.121
- SeaBird SBE Data Processing 7.26.6.28

SOG Mooring Recovery

The mooring objective for AMT was to recover the Southern Gyre sediment trap mooring deployed in 2019.

As there was only a drop position and not a triangulated mooring position it was decided to range the mooring from 3 locations before sending the release command.

At 0400 on the 07th March 2023 the vessel arrived 500m off from the drop location. The acoustic release 1499 was interrogated using deck unit 010 but no response was received. Communication was attempted with the keel mounted transducer and the hand deployed dunker. Passive mode was selected for the ships echo sounders and the ships thrusters were disables and still no response was received.

The ship then repositioned to a safe location for a release command to be sent. The release command was sent with no response received from the acoustic release, subsequent ranges were also unsuccessful. Deck unit 178 was then set up and the range command sent, this gave a response 1280m which meant the first release command had been successful. 15 minutes later the mooring was on the surface and the ship began the approach for the recovery.

The billings float was tangled below the first set of buoyancy glass which meant it was not possible to grapple the recovery line, the glass had to be the first point of connection. The lines above the deep water buoyance were also tangled however this did not hinder the recovery.

The sediment trap samples were removed with the aid of the science party and refrigerated until demobilisation. Trap B had a full set of samples however the trap had not completed a full cycle, bottle 21 was in the open position upon recovery.

DY157 – Ocean Engineering Group

Andy Cotmore

Sensors and Moorings – National Oceanography Centre

Equipment?	Double Barrel Winch: Winch worked as expected and was used for the recovery of SOG mooring. Small oil spill found when joining the vessel but was found to be a leaking hose while the hoses were stored around the winch drums.

Equipment?	Reeler winch: Working alongside the DB winch for recovery of SOG mooring. The winch worked as expected and there were no issues with the new motor fitted on the previous cruise. I decided not to fit the new coupling as the current one was working fine. There was a small issue with the disengagement of the drive to the drum, this was found to be corroded but after being removed, cleaned and reassembled it was operating without any issues.
Equipment	2.5t Lebus Winch: Used for the deployment and recovery of bongo nets, red camera frame and the snow catcher. The new sheave (STR) was used to prevent any damage to the winch wire and worked well for the cruise duration. During the first few deployments I experienced power issues, the 110V supply would trip causing me to lose the winch display screen. Due to the tight schedule I used the STR counter sheave until I had time to investigate the issue. After investigating the issue with the help of the ETO (Charles Fisher) we found that the fuses fitted were incorrect to the drawings supplied by lebus. The correct fuses were fitted and the winch has experienced no power issues for the rest of the cruise. During deployment it was found that the hydraulic oil was getting excessively hot, after deck test with the crew we found there to be issues with the hydraulic cooling onboard. For future use an inline cooler may be advised so that we are not reliant on the ships cooling during prolonged use. The cooling onboard the RRS Discovery seems to be inadequate in hotter climates and ideally an upgrade to this system would be highly beneficial for all deck operated hydraulics. It would be ideal to have a spare set of 1AMP fuses in the spares box.
Equipment	RN lab containers: Both lab containers were used for the cruise. The newer container has had no issues and worked extremely well, especially the air con units in the tropical heat. The older container experienced some air con issues while struggling in the tropical heat. The refrigeration unit was periodically tripping and had to be reset continuously during the cruise. The source of the fault is still unknown but the reset allowed the AC unit to continue to work.

Equipment?	LN2 (liquid nitrogen units): New LN20 AC Compact unit was originally located in the AFT hold, after running this unit up it was found that the ventilation and power supply was not adequate to produce liquid nitrogen. The unit was moved to the hangar and has worked as it should since. It should be noted that the production rate is much slower than OEG's older units. Yellow frame LN2 had been working well and producing LN2 very well. The unit suddenly started experiencing issues that still have not been fully resolved. Several faults were found during my investigations, damaged supply hose to the dewar (replaced), blocked N2 filter (replaced). After discussions with Richie Phipps I also found that the feeder pipe was frozen and on removal I have cracked the clamp that holds this in place (now has a jubilee clip around this clamp). The unit appears to be working as it should but still will not deliver LN2 from the dewar but seems to be producing liquid nitrogen. That level gauge needs to be calibrated correctly as I only had a small amount of LN2 to attempt this calibration onboard. Due to the corrosion on removal of the level gauge I damaged the serial connector, this has been replaced with a serial lead from the electronics lab.
Equipment	Liquid scintillation: This unit has worked well all cruise with no issues, it should be noted that due to its location near the deck lab door the unit has some corrosion starting to appear new the cooling vents, this does not affect the use of the unit but something we need to keep an eye on for future use during scientific cruises.
Equipment	Fume hoods and laminar flow: All of the fume hoods onboard were in used this cruise, the one located in the RN lab had a continuous low flow alarm that I could not resolve but did not affect the use of this unit. All other unit have worked well and any chemicals used within has been recorded and will be submitted as a hard copy for OEG's records. Laminar flow units have worked well with no issues.
Workshop Spares Required	19mm spanners 19mm sockets Emery paper Cleaning brush for machine cleaning Dust pan and brush M5 taps Impact screwdriver Cable ties Dremel spares Plus gas (release spray) Super glue On arrival to the vessel I found that the Pneumatic tool chuck on the mill was not working, after investigation I found that the air supply is fine but the valve behind the machine may be broken. I have not resolved this fault as I feel it needs to be looked at properly once the vessel is alongside in Southampton.

Welding equipment & Consumables Required	One welding mask found to be broken and will be disposed of. Two masks still onboard.

Summary of Equipment Spares Required	Milli Q systems: on arrival to the vessel all of the four milli q systems had a number of faults. Most were new filters required and these were all fitted with spares OEG store onboard, these spares will need to be replenished before the next science cruise. All four units are still displaying a TOC measurement at risk alarm that can not be cleared and requires a service engineer. I believe this was mentioned in Steve Corless's report previously and will be fixed while the vessel is alongside in Southampton. The deck lab unit is displaying a pod pack alarm that after investigation I found that the millipak and trigger had been damaged, no one has owned up to this but as it has not affected the water quality or production I have not replaced the pod pak and trigger assembly so that OEG can make the decision upon my return. Milli Q spares used: • 4 x IPAK guard filters (set of 2) • 4 x IPAK quantra filters • 2 x vent filters • 3 x milli pak filters The mill q units will all be left in lab closed mode on my departure from the vessel. This trip it was found that when freshwater is being transferred but the chief mate the deck lab unit would leak, to solve this the chief mate notified me when they were doing so and I isolated the feed water supply to this unit. This has also been mentioned in their handover notes to notify the joining crew.

DY157 – Ship Scientific Systems

Nick Harker

National Marine Facilities, National Oceanography Centre

CONTENTS

1. Cruise Overview

Cruise	Departure	Arrival	Technician(s)
DY157	22/12/22 14:00	29/01/23	Nick Harker

Ship Scientific Systems (SSS) is responsible for operating and managing the Ship's scientific information technology infrastructure, data acquisition, compilation and delivery, and the suite of ship-fitted scientific instruments and sensors in support of the Marine Facilities Programme (MFP).

The work site was the AMT line transiting from Falklands to Southampton.

The main objectives for SSS in the service of the science party on this cruise were:

1. Acquire underway data and metadata, including sea-surface, meteorological, position and attitude, depth and multibeam swath.
2. Provide services for recording metadata and events and monitoring data streams.
3. Provide basic IT support.

All times in this report are in UTC.

1.1. Summary

A summary of the progress made against objectives is shown below.

[X] Objectives, [X] completed, [X] partially completed, [X] not completed.

Target	Outcomes	Objective met?
Acquire underway data and metadata, including sea-surface, meteorological, position and attitude, depth and multibeam swath.	Data collected and given to PI and data manager.	Yes.
Provide basic IT support.	Provided.	Yes.

2. Scientific Computer Systems

2.1. Underway Data Acquisition

Data from the suite of ship-fitted scientific instrumentation was aggregated onto a network drive on the ship's file server. This was available throughout the voyage in read-only mode to permit scientists to work with the data as it was acquired. A Public network folder was also available for scientists to share files. This directory can be found:

/Read_Only_Public

A copy of these two drives are written to the end-of-cruise disks that are provided to the Principal Scientist and the British Oceanographic Data Centre (BODC).

List of logged ship-fitted scientific systems:
/Cruise_Reports/DY157_Ship_fitted_information_sheet.docx

The data acquisition systems used on this cruise are detailed in the table below. The data and data description documents are filed per system in the *Data* and *Documentation* directories respectively within Ship Systems folder on the cruise data disk.

Table 3: Data acquisition systems used on this cruise.

Data acquisition system	Usage	Data products	Directory system name
Ifremer TechSAS	Continuous.	NetCDF ASCII pseudo-NMEA	/TechSAS/
NMF RVDAS	Continuous.	ASCII Raw NMEA	/RVDAS/
Kongsberg SIS	Continuous.	Kongsberg .all	/Acoustics/EM-***/
Kongsberg EA640	Continuous.	None, redirected to Techsas/RVDAS RAM	/Acoustics/EA-640/
Kongsberg EK80	Continuous.		/Acoustics/EK-80/
UHDAS (ADCPs)	Continuous.	ASCII raw, RBIN, GBIN, CODAS files	/Acoustics/ADCP/

Data description documents per system:
/Ship_Systems/Documentation/TechSAS/Data_Description/

Data directories per system:
/Ship_Systems/Data/

2.1.1. SIGNIFICANT ACQUISITION EVENTS AND GAPS

On this cruise, the NMF Event Logger/BAS Event Logger was used with CSV records of events saved to the cruise data directory.

Path and pattern to event log CSV files:
/Ship_Systems/Data/EventLogs/current_csv_logs/[logName]/*.csv

Summary of main events

Date	Time start*	Event
20/02/23	14:30	Start of DY157 data acquisition (Techsas,RAM)
20/02/23	22:20	Vessel departure from Stanley, Falklands (Echosounders on)
16/03/23	20:35	Entered EEZ Cape Verde, data logging stopped
19/03/2023	12:00	Left EEZ, data logging started
28/03/2023	12:30	Underway off
28/03/2023	15:30	Entered EEZ echosounders off
30/03/2023		End of DY157 acquisition (Techsas/RAM)

Summary of data gaps

Event log entries contain information for any data gaps.

2.2. INTERNET PROVISION

Satellite communications were provided with both the VSat and Fleet Broadband systems.

The ship operated with bandwidth controls to prioritise business use.

3. INSTRUMENTATION

3.1. COORDINATE REFERENCE

Path to ship survey files:

/Ship_Systems/Documentation/Vessel_Survey

3.1.1. ORIGIN (RRS DISCOVERY)

The ship's survey (Parker Maritime, 2013) defines two systems of reference point using two different central reference points (CRPs):

1. (0,0,0) at Frame 0 (aft-most frame, 6m forward from stern), centreline (centre of keel), baseline (ship's bottom-most longitudinal).
2. (0,0,0) at ship's centre of gravity (CG), Frame 44 (26.4m forward from Frame 0 at 0.6m framespacing), centreline (centre of keel), main deck (7.4m up from baseline).

The survey coordinate sense is X is positive forward, Y positive starboard, and Z positive down. The coordinate order in the survey is (Y,X,Z), but unless otherwise noted, all coordinates are given elsewhere as (X,Y,Z).

For all scientific purposes, unless otherwise stated, the coordinate system is referenced using the second system, with the CRP at the CG.

3.1.2. MULTIBEAM

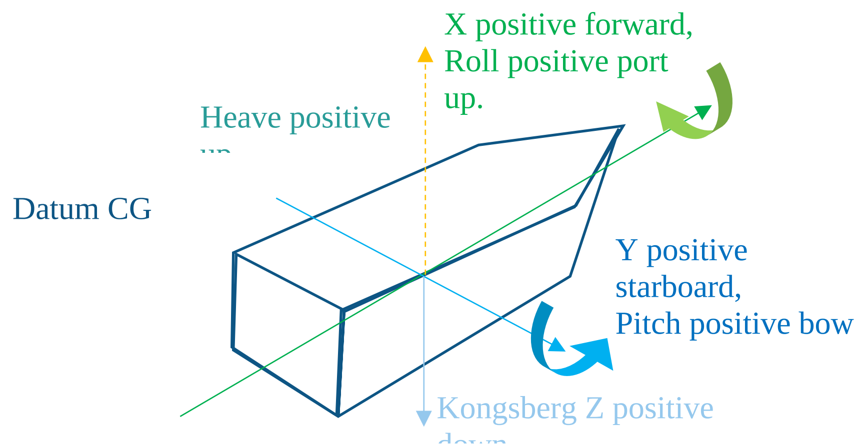


Figure 4: Conventions used for position and attitude. On the Discovery, the Datum is the CRP at the CG.

The Kongsberg axes reference conventions are (see Figure 4) as follows:

1. X positive forward,
2. Y positive starboard,
3. Z positive downward.

The rotational sense for the multibeam systems and Seapath is set to follow the convention of Applanix PosMV (the primary scientific position and attitude system), as per Figure 4.

3.1.3. PRIMARY SCIENTIFIC POSITION AND ATTITUDE SYSTEM

The translations and rotations provided by this system (Applanix PosMV) have the following convention:

1. Roll positive port up;
2. Pitch positive bow up;
3. Heading true positive to starboard;
4. Heave positive up.

3.2. POSITION, ATTITUDE AND TIME

System	Navigation (Position, attitude, time)
Statement of Capability	/Ship_Systems/Documentation/GPS_and_Attitude
Data product(s)	NetCDF: /Ship_Systems/Data/TechSAS/NetCDF/

	Raw NMEA: /Ship_Systems/Data/RAM/		
Data description	/Ship_Systems/Documentation/TechSAS /Ship_Systems/Documentation/RVDAS		
Other documentation	/Ship_Systems/Documentation/GPS_and_Attitude		
Component	**Purpose**	**Outputs**	**Headline Specifications**
Applanix PosMV	Primary GPS and attitude.	Serial NMEA to acquisition systems and multibeam	Positional accuracy within 2 m.
Kongsberg Seapath 330	Secondary GPS and attitude.	Serial and UDP NMEA to acquisition systems and multibeam	Positional accuracy within 1 m.
Oceaneering CNav 3050	Correction service for primary and secondary GPS and dynamic positioning.	RTCM to primary and secondary GPS	Positional accuracy within 0.15 m.
Fugro Seastar / MarineStar	Correction service for primary and secondary GPS and dynamic positioning.	Corrections to primary and secondary GPS	Positional accuracy within 0.15 m.
Meinberg NTP Clock	Provide network time	NTP protocol over the local network.	

3.3. Ocean and Atmosphere Monitoring Systems

3.3.1. SURFMET

Fitted Sensors Configuration sheet (Instrument serial numbers & calibration dates):

/Ship_Systems/Documentation/Surfmet/DY157_Surfmet_sensor_information_sheet.pdf

Sensor Calibration Certificates Location:

/Ship_Systems/Documentation/Surfmet/Calibration_Files/Fitted/

System	SURFMET (Surface water and atmospheric monitoring)
Statement of Capability	/Ship_Systems/Documentation/Surfmet
Data product(s)	NetCDF: /Ship_Systems/Data/TechSAS/NetCDF/ Raw NMEA: /Ship_Systems/Data/RAM/ CSV: /Ship_Systems/Data/RAM/CSV
Data description	/Ship_Systems/Documentation/TechSAS

	/Ship_Systems/Documentation/RVDAS	
Other documentation	/Ship_Systems/Documentation/Surfmet	
Calibration information	See Ship Fitted Sensor sheet for calibration information for each sensor.	
Component	**Purpose**	**Outputs**
Inlet temperature probe (SBE38)	Measure temperature of water at hull inlet.	Serial to Interface Box.
Drop keel temperature probe (SBE38)	Measure temperature of water in drop keel space.	Serial to Interface Box.
Thermosalinograph (SBE45)	Measure temp. and conductivity at sampling board. Salinity is calculated.	Serial to Interface Box.
Interface Box (SBE90402)	Signals management.	Serial to Moxa.
Debubbler	Reduces bubbles through instruments.	None.
Transmissometer (CST)	Measure of transmittance.	Analogue to NUDAM.
Fluorometer (WS3S)	Measure of fluorescence.	Analogue to NUDAM.
Air temperature and humidity probe (HMP155)	Temperature and humidity at met. platform.	Analogue to NUDAM.
Ambient light sensors (PAR, SKE510; TIR, CMP6)	Ambient light at met. platform.	Analogue to NUDAM.
Barometer (PTB210)	Atmospheric pressure at met. platform.	Analogue to NUDAM.
Anemometer (Windsonic)	Wind speed and direction at met. platform.	Serial to Moxa.
NUDAM	A/D converter.	Serial NMEA to Moxa.
Moxa	Serial to UDP converter.	UDP NMEA to Surfmet VM.
Surfmet Virtual Machine	Data management.	UDP NMEA to TechSAS, RVDAS.

Component	**Calibrated product steps**
SBE38: Temperature (°C)	No calibration to apply, residuals below uncertainty.
SBE45: Temperature (°C)	No calibration to apply, residuals below uncertainty.
SBE45: Conductivity ($S\ m^{-1}$)	No calibration to apply, residuals below uncertainty.

CST: Transmission (%)	1. Product = (Data − V_{dark})/($V_{\text{ref}} - V_{\text{dark}}$). Here product has units % and data, V_{dark} and V_{ref} have units V.
WS3S: Fluorescence (µg L^{-1})	1. Product = Coefficient × (Data − Offset). Here product has units µg L^{-1}, coefficient has units µg L^{-1} V^{-1}, and data and offset have units V.
HMP45A / HMP155: Temperature (°C)	No calibration to apply, residuals below uncertainty.
HMP45A / HMP155: Relative humidity (%)	No calibration to apply, residuals below uncertainty.
PTB110 / PTB210: Pressure (hPa)	No calibration to apply, residuals below uncertainty.
SKE510: PAR (W m^{-2})	1. Product = Data × $\left(\frac{10^6}{\text{Coefficient}}\right)$. Here product has units W m^2, data has units 10^{-5} V, the 10^6 scalar has units µV V^{-1}, and coefficient has units µV m^2 W^{-1}.
CMP6: TIR (W m^{-2})	1. Product = Data × $\left(\frac{10^6}{\text{Coefficient}}\right)$. Here product has units W m^2, data has units 10^{-5} V, the 10^6 scalar has units µV V^{-1}, and coefficient has units µV m^2 W^{-1}.
Windsonic: Wind speed (m s^{-1})	No calibration to apply.
Windsonic: Wind direction (m s^{-1})	No calibration to apply.

Note that while the residuals (difference of reference and measured) are below uncertainty and the output is considered calibrated for the SBE38, SBE45, HMP45A, HMP155, PTB110 and PTB210 instruments, a regression could still be made between the reference and measured data (see the calibration certificate) if desired. Follow the steps below:

1. Calculate $y = Bx + A$ from calibration data, where x is reference data.
2. Product = (Data − A)/B.

The NMF Surfmet system was run throughout the cruise, excepting times for cleaning, entering and leaving port, and whilst alongside. Please see the separate information sheet for details of the sensors used and whether their recorded data have calibrations applied or not.

Surface water sampling board maintenance

Path and pattern to event log CSV files:

/Ship_Systems/Data/EventLogs/current_csv_logs/techlogs/ underway_events.csv

The system was cleaned prior to the cruise.

Water samples were taken ~4x a day from the ships underway for Salinity analysis using an AutoSalinometer (serial number 68958). Results from Salinity analysis are found:

/Ship_Systems/Data/TSG_salinities
And compiled with the underway log in file DY157_TSG_underway_and_autosal.x.sx

3.3.2. WAVE RADAR

System	**WAMOS Wave Radar**	
Statement of Capability	/Ship_Systems/Documentation/Wamos	
Data product(s)	NetCDF: /Ship_Systems/Data/TechSAS/NetCDF/ Raw NMEA: /Ship_Systems/Data/RAM/ Raw: /Ship_Systems/Data/Wamos/RESULTS **Screencapture** /Ship_Systems/Data/Wamos/Screen_capture	
Data description	/Ship_Systems/Documentation/TechSAS /Ship_Systems/Documentation/RVDAS	
Other documentation	/Ship_Systems/Documentation/Wamos	
Statement of Capability	/Ship_Systems/Documentation/Wamos	
Component	**Purpose**	**Outputs**
Rutter OceanWaves WAMOS	Measure wave height, direction, period and spectra.	Summary statistics in NMEA to TechSAS and RVDAS. Spectra files.
RsAqua Rex2 Wave Height Sensor	Measure wave height at bow to provide calibration reference dataset.	Wave height NMEA, UDP to TechSAS, RVDAS.
Furuno Radar	Measures radar reflection on sea surface.	Radar data to WAMOS.

The wave radar was also used for capturing the sargassum extent around the ship. Screen shots were taken of the radar display and this data was acquired from 14/03-18/03 and is found in:

/Ship_Systems/Data/Wamos/Screen_capture

The wave radar magnetron requires annual replacement. Following replacement, WAMOS needs to collect wave data within 5 km of another wave height sensor over the full range of sea-states in order to derive wave height calibration coefficients for the new magnetron. This reference dataset can be derived by examining the ship's track for wave buoys and downloading their data, or by using the onboard RsAqua Wave Height sensor fitted on the ship's bow.

3.4. HYDROACOUSTIC SYSTEMS

System	Acoustics	
Statement of Capability	/Ship_Systems/Documentation/Acoustics	
Data product(s)	Raw: /Ship_Systems/Data/Acoustics NetCDF (EA640, EM122cb): /Ship_Systems/Data/TechSAS NMEA (EA640, EM122cb): /Ship_Systems/Data/RVDAS CSV: /Ship_Systems/Data/RAM/CSV	
Data description	/Ship_Systems/Documentation/Acoustics	
Other documentation	/Ship_Systems/Documentation/Acoustics	
Component	**Purpose**	**Operation and Outputs**
10 kHz Single beam (Kongsberg EA-640)	Primary depth sounder	Continuous, free running. NMEA over serial, raw files
12 kHz Multibeam (Kongsberg EM-122)	Full-ocean-depth multibeam swath.	Continuous, free running. Binary swath, centre-beam NMEA, *.all files, optional water column data
70 kHz Multibeam (Kongsberg EM-710)	Coastal/shallow multibeam swath.	Discrete. Leaving port Stanley until deep water was reached. Binary swath, centre-beam NMEA, *.all files.
EK80 (Simrad/Kongsberg)	Fisheries echo sounder	Continuous, k-sync (2sec)
Drop keel sound velocity sensor	Provide sound velocity at transducer depth.	Continuous, free running. Value over serial to Kongsberg SIS.
75 kHz ADCP (Teledyne OS75)	Along-track ocean current profiler.	Continuous, free running (via UHDAS).
150 kHz ADCP (Teledyne OS150)	Along-track ocean current profiler.	Continuous, free running. (via UHDAS).

3.4.1. Marine Mammal Protection

NMF policy is to follow JNCC guidelines for marine mammal observations before operating any equipment which causes significant acoustic disturbance in the water column. Such equipment includes the deep-water multibeam and sub-bottom profiler. For these systems, an MMO procedure is followed, which, in summary, involves a 60-minute bridge observation with a ramped start 45 minutes into the observation.

SSS was responsible for carrying out and recording MMO activities.

Table 4: ***Marine mammal observation events reported by SSS****.*

Date	***System***	***Obs. Start Time***	***Notes (inc. any observations or actions)***
2023-02-21	EM122	12:00 12:45	Undertaken by N Harker Dolphins sighted so start time reset.
2023-03-19	EM122	12:58	Undertaken by N Harker No comments.

3.4.2. Sound velocity profiles

Sound velocity profiles were derived from CTD and WOA13 model using Ifremer DORIS.

Path of sound velocity profile data on the cruise datastore:
/Ship_Systems/Data/Acoustics/Sound_Velocity

Details of when sound velocity profiles were taken and applied are in the event log:

Path and pattern to event log CSV files:
/Ship_Systems/Documentation/EventLogs/current_csv_logs/techlogs/acoustic_log.csv

3.4.3. Equipment-specific comments

ADCPs

Path of ADCP data on the cruise datastore:
/Ship_Systems/Data/Acoustics/ADCP

Attribute	Value
Acquisition software	UHDAS
Frequencies used	75& 150 kHz.
Running mode	Continuous free running

Bottom tracking was turned off at 2023-02-21 11:31 when deep water was reached and bottom could no longer be tracked

EK-80 Configuration and Surveys

Path of EK-80 data on the cruise datastore:

/Ship_Systems/Data/Acoustics/EK-80

<table>
<tr><th>Attribute</th><th>Value</th></tr>
<tr><td>Number of surveys</td><td>Run near-continuously (2 sec ping except during calibration at 1sec)</td></tr>
<tr><td>Last calibration environmental variables (4/01/2023 DY158)</td><td>Water temperature: 1.8 °C.
Water salinity: 33.8 PSU.
Water pH: 8.
Depth: 10 m.
Latitude: 53 °.</td></tr>
<tr><td>Offsets</td><td><table>
<tr><th>Item</th><th>X (m, + Forward)</th><th>Y (m, + Starboard)</th><th>Z (m, + Down)</th></tr>
<tr><td>18 kHz transducer</td><td>23.15</td><td>0.90</td><td>7.49</td></tr>
<tr><td>38 kHz transducer</td><td>24.02</td><td>0.91</td><td>7.49</td></tr>
<tr><td>70 kHz transducer</td><td>23.62</td><td>0.70</td><td>7.49</td></tr>
<tr><td>120 kHz transducer</td><td>23.53</td><td>1.16</td><td>7.49</td></tr>
<tr><td>200 kHz transducer</td><td>23.76</td><td>1.15</td><td>7.49</td></tr>
<tr><td>333 kHz transducer</td><td>23.67</td><td>0.98</td><td>7.49</td></tr>
</table></td></tr>
</table>

Drop Keel – The drop keel was not used during DY157. All data collection was with the transducers flush to the vessel baseline.

Draft – Vessel draft at the start of the cruise was 6.5 m. A waterline level (‘Installation → Sensor Configuration → Sensor → Water Level’) of 1m was applied to the system to match the ‘distance from transducer to waterline’ to the known (6.5 m) draft. This was achieved by temporarily outputting a DTP NMEA message from the EK-80, which contains ‘offset rel. to transducer’. With a 1 m ‘Waterline’ applied, the DTP ‘offset rel. to transducer’ was confirmed as 6.52m.

Pulse Type – All frequencies were run throughout with **CW** Pulse Type.

Item	**Pulse Duration (ms)**	**Power (W)**	**Ramping**
18 kHz transducer	1.024	1600	
38 kHz transducer	1.024	2000	Fast
70 kHz transducer	1.024	750	Fast
120 kHz transducer	1.024	250	Fast
200 kHz transducer	1.024	150	Fast
333 kHz transducer	0.256	50	

Synchronisation – K-sync used for EK-80 through with a 2s ping rate

Raw Data Collection & Output – Raw data was collected mainly to 1000 m depth. 100 MB file size was set throughout.

Transducer/Transceiver Information (Post-Calibration):

Variable	**18 kHz**	**38 kHz**	**70 kHz**	**120 kHz**	**200 kHz**	**333 kHz**
Transducer type	ES18-11	ES38-7	ES70-7C	ES120-7C	ES200-7C	ES333-7C
Transducer serial no.	2111	350	258	2250 (890*)	533	135

Transducer depth to waterline (m)	6.5	6.5	6.5	6.5	6.5	6.5
Transceiver Type	GPT	WBT	WBT	WBT	WBT	GPT
Transceiver serial no.	00907206 dc83	767751	400250	400256	998652	00907206 d0a4
Transmit power (W)	1600	2000	750	250	150	50
Pulse length (us)	1024	1024	1024	1024	1024	256 (1024)*
Transducer gain (dB)	22.99	26.91	27.83	26.15	26.66	25.0
Sa correction (dB)	-0.68	-0.11	0.01	-0.16	-0.15	0
3dB beam along (°)	10.09	6.68	6.55	6.65	6.58	7
3dB beam athwart (°)	10.18	6.68	6.50	6.74	6.60	7
Along offset (°)	-0.22	0	0.03	-0.07	-0.34	0
Athwart offset (°)	-0.18	-0.02	-0.02	-0.05	0.11	0
RMS Error (dB) [Calibration]	0.06	0.07	0.08	0.15	0.20	N/A
Calibration Applied (Time/Date)	04-01-23 20:25	04-01-23 17:34	04-01-23 19:47	04-01-23 19:11	04-01-23^ 12:21	N/A

ES333-7C not calibrated. Grey cell values are from EK80 software defaults for this transducer type

EM-122 Configuration and Surveys

The EM122 multibeam was run almost continuously for the duration of the cruise.

Path of Multibeam data on the cruise datastore:

/Ship_Systems/Data/Acoustics/EM-122

Offsets and rotations	Item	X (m, + Forward)	Y (m, + Starboard)	Z (m, + Down)
	Tx transducer	39.910	0.885	7.426

	Rx transducer	35.219	-0.005	7.438

Item	Roll (deg)	Pitch (deg)	Yaw (deg)
Tx transducer	-0.10	0.45	-1.15
Rx transducer	0.00	0.00	0.00

EM-710 Configuration and Surveys

The EM710 was run out of port Stanley until its depth range was exceeded.

Path of Multibeam data on the cruise datastore:

/Ship_Systems/Data/Acoustics/EM-710

Offsets and rotations

Item	X (m, + Forward)	Y (m, + Starboard)	Z (m, + Down)
Tx transducer	37.570	-1.994	7.425
Rx transducer	36.819	-2.051	7.427

Item	Roll (deg)	Pitch (deg)	Yaw (deg)
Tx transducer	-0.07	0.33	0.22
Rx transducer	0.01	0.12	359.97

3.5. Other Systems

3.5.1. Cable Logging and Monitoring

Winch activity is monitored and logged using the CLAM system.

Appendix 1 – Position of ARGO and Bio-ARGO float deployment

Model	Type	Hull SN	Requested Latitude	Requested Longitude	Date	Magnet off Time (UTC)	Deployment Time (UTC)	Latitude	Longitude	Closest CTD cast
Apex	Core	8980	-48.56	-52.7	22.02.2023	[redacted]	0316	-48.74955	-52.863725	DY157; CTD-Test; 21.02.2023; 1358 UTC -50.07056S -55.011968W
Apex	Core	9473	-44.45	-47	23.02.2023	[redacted]	1555	-45.50347	-47.828943	DY157; CTD02 23.02.2023; 1459 UTC -45.503464S -47.828928W
Apex	Core	9474	-34	-35.4	28.02.2023	[redacted]	1603	-34.916139	-36.433425	DY157; CTD10 28.02.2023; 1500 UTC -34.916256 -36.43298
Apex	Core	9475	-32	-32	01.03.2023	[redacted]	1746	-32.970694	-32.881436	DY157; CTD12 01.03.2023; 1400 UTC -33.273432 -33.337226
Apex	Core	9632	-28.5	-29	04.03.2023	[redacted]	0655	-28.382139	-25.081164	DY157; CTD18 04.03.2023; 0534 UTC -28.384471 -25.082336
Apex RBR-L3	Core	9622	-24.5	-25	05.03.2023	[redacted]	1457	-24.067217	-24.50018	DY157; CTD21 05.03.2023; 1401 UTC -24.073203 -24.500316
Apex		9468	46.5	-13.0	28.03.2023	[redacted]	0551	46.357871	-11.430813	DY157; CTD56: 26.03.2023; 1151 UTC +40.537146 -16.918107
Apex		9469	47.1	-12.0	28.03.2023	[redacted]	1111	46.97000	-10.45667	DY157; CTD56: 26.03.2023; 1151 UTC +40.537146 -16.918107
ProvBio	BGC	P44043-21UK005	-45.5	-50.5	23.02.2023	0810	0930	-46.096243	-48.739298	DY157; CTD01: 23.02.2023; 0824 UTC -46.097731S -48.738695W
ProvBio	BGC	P44043-21UK006	-27.1	-26.6	04.03.2023	1345	1505	-27.31193	-24.525752	DY157; CTD19: 04.03.2023; 1400 UTC

										-27.313686 -24.523682
ProvBio	BGC	P44043-21UK007	-11	-24	09.03.2023	1400	1506	-11.89443	-25.051489	DY157; CTD28: 09.03.2023; 1403 UTC -11.89435 -25.05172
ProvBio	BGC	P44043-21UK008	-1	-24	13.03.2023	0615	0748	-0.001728	-25.125197	DY157; CTD34: 13.03.2023; 0625 UTC -0.00105 -25.13700
ProvBio	BGC	22003	10-14		16.03.2023	1300	1505	10.425049	-25.290011	DY157; CTD41: 16.03.2023; 1357 UTC +10.42246 -25.291061
ProvBio	BGC	22004	44		26.03.2023	1154	1303	40.537762	-16.919161	DY157; CTD56: 26.03.2023; 1151 UTC +40.537146 -16.918107

Appendix 2 – AMT30 Log of events

START DATE AND TIME (GMT)	END DATE AND TIME (GMT)	GEAR	ACTIVITY	STATION	START LAT (+ve N)	START LON (+ve E)	END LAT (+ve N)	END LON (+ve E)	COMMENTS
21/02/2023 13:58	21/02/2023 14:54	CTD	CTD_TEST	TEST	-50.0706	-55.012	-50.0694	-55.0105	
22/02/2023 03:16		ARGO FLOAT	ARGO001	TEST	-48.7496	-52.8637			WMO ID: 1902094
22/02/2023 16:31	22/02/2023 18:05	MAMMOTH NET	MNET_TEST		-47.3402	-50.6393	-47.3535	-50.6491	
22/02/2023 16:35	24/02/2023 14:56	AEROSOL SAMPLER	AERO001		-47.3401	-50.6393	-43.3658	-44.6703	
22/02/2023 16:35	25/02/2023 14:57	AEROSOL SAMPLER	AERO002		-47.3401	-50.6393	-40.3469	-43.8436	
23/02/2023 06:07	23/02/2023 06:12	MARINE SNOW CATCHER	MSC001	1	-46.0942	-48.7322	-46.0942	-48.7322	
23/02/2023 06:18	23/02/2023 07:40	MAMMOTH NET	MNET001	1	-46.0942	-48.7322	-46.0979	-48.7359	
23/02/2023 06:49	23/02/2023 07:25	CAMERA RIG	CAM001	1	-46.0956	-48.7336	-46.0972	-48.7352	
23/02/2023 07:57	23/02/2023 08:10	TURBULENCE PROFILER	TURB001	1	-46.0986	-48.7365	-46.0978	-48.7385	
23/02/2023 08:19	23/02/2023 08:50	BONGO NET	BONGO001	1	-46.0977	-48.7387	-46.0977	-48.7387	
23/02/2023 08:24	23/02/2023 09:10	CTD	CTD001	1	-46.0977	-48.7387	-46.0977	-48.7387	
23/02/2023 09:09	23/02/2023 09:19	MARINE SNOW CATCHER	MSC002	1	-46.0977	-48.7387	-46.0977	-48.7387	
23/02/2023 09:30		ARGO FLOAT	ARGO002		-46.0962	-48.7393			WMO ID: 6904186
23/02/2023 14:59	23/02/2023 15:45	CTD	CTD002	2	-45.5035	-47.8289	-45.5035	-47.829	
23/02/2023 15:55		ARGO FLOAT	ARGO003		-45.5035	-47.8289			WMO ID: 1902095
24/02/2023 06:11	24/02/2023 07:32	MAMMOTH NET	MNET002	3	-44.0302	-45.6557	-44.0308	-45.6582	
24/02/2023 06:29	24/02/2023 06:37	MARINE SNOW CATCHER	MSC003	3	-44.0307	-45.6572	-44.031	-45.6581	
24/02/2023 06:47	24/02/2023 07:20	CAMERA RIG	CAM002	3	-44.031	-45.6581	-44.0309	-45.6581	
24/02/2023 07:37	24/02/2023 07:54	TURBULENCE PROFILER	TURB002	3	-44.0309	-45.6583	-44.0323	-45.66	
24/02/2023 08:08	24/02/2023 08:14	MARINE SNOW CATCHER	MSC004	3	-44.0323	-45.66	-44.0323	-45.6601	Deployed to 150m
24/02/2023 08:10	24/02/2023 09:06	CTD	CTD003	3	-44.0323	-45.6601			
24/02/2023 15:04	24/02/2023 15:56	CTD	CTD004	4	-43.3659	-44.6701	-43.3659	-44.6701	
24/02/2023 15:06	24/02/2023 15:41	GARRETT SCREEN	SML001	4	-43.3659	-44.6701	-43.3659	-44.6701	
24/02/2023 15:41	24/02/2023 15:47	MARINE SNOW CATCHER	MSC005	4	-43.3659	-44.6701	-43.3659	-44.6701	
24/02/2023 15:44	26/02/2023 14:50	AEROSOL SAMPLER	AERO003		-43.3659	-44.6701	-38.4518	-42.7585	
25/02/2023 06:02	25/02/2023 07:26	MAMMOTH NET	MNET003	5	-41.249	-43.8978	-41.2485	-43.8929	
25/02/2023 06:03	25/02/2023 06:09	MARINE SNOW CATCHER	MSC006	5	-41.249	-43.8977	-41.2489	-43.8974	
25/02/2023 06:18	25/02/2023 06:54	CAMERA RIG	CAM003	5	-41.2488	-43.8964	-41.2486	-43.8941	
25/02/2023 07:14	25/02/2023 07:44	BONGO NET	BONGO002	5	-41.2485	-43.8934	-41.2485	-43.8928	
25/02/2023 07:48	25/02/2023 08:00	TURBULENCE PROFILER	TURB003	5	-41.2483	-43.8926	-41.2469	-43.8903	

25/02/2023 08:06	25/02/2023 09:06	CTD	CTD005	5	-41.2469	-43.8903	-41.2458	-43.8891	
25/02/2023 08:47	25/02/2023 08:56	MARINE SNOW CATCHER	MSC007	5	-41.246	-43.8894	-41.2458	-43.8892	
25/02/2023 14:57	25/02/2023 15:37	GARRETT SCREEN	SML002	6	-40.3469	-43.8436	-40.3469	-43.8436	
25/02/2023 14:59	25/02/2023 15:48	CTD	CTD006	6	-40.3469	-43.8436	-40.3469	-43.8436	
25/02/2023 15:17	28/02/2023 16:13	AEROSOL SAMPLER	AERO004		-40.3469	-43.8436	-34.9123	-36.4335	
25/02/2023 19:18	25/02/2023 22:00	RAIN COLLECTOR	RAIN001		-39.8404	-44.1034	-39.5417	-43.9976	
26/02/2023 15:04	26/02/2023 18:55	CTD	CTD007	7	-38.4519	-42.7585	-38.2625	-42.3548	
26/02/2023 15:04		MARINE SNOW CATCHER	MSC008	7	-38.4519	-42.7585			
26/02/2023 15:07		GARRETT SCREEN	SML003	7	-38.4518	-42.7585			
26/02/2023 15:41	28/02/2023 16:13	AEROSOL SAMPLER	AERO005		-38.4523	-42.759	-34.9123	-36.4335	
27/02/2023 05:00	27/02/2023 05:07	MARINE SNOW CATCHER	MSC009	8	-37.4247	-40.7459	-37.4247	-40.7459	
27/02/2023 05:09	27/02/2023 05:15	MAMMOTH NET	MNET004	8	-37.4247	-40.7458	-37.4246	-40.7457	
27/02/2023 05:18	27/02/2023 05:52	CAMERA RIG	CAM004	8	-37.4246	-40.7457	-37.4246	-40.7457	
27/02/2023 05:43	27/02/2023 06:31	MAMMOTH NET	MNET005	8	-37.4246	-40.7457	-37.4246	-40.7457	
27/02/2023 06:36	27/02/2023 07:03	TURBULENCE PROFILER	TURB004	8	-37.4247	-40.7459	-37.4253	-40.7476	
27/02/2023 07:10	27/02/2023 08:04	CTD	CTD008	8	-37.4253	-40.7476	-37.4253	-40.7476	
27/02/2023 07:53	27/02/2023 08:02	MARINE SNOW CATCHER	MSC010	8	-37.4253	-40.7476	-37.4253	-40.7476	
27/02/2023 15:00	27/02/2023 16:02	CTD	CTD009	9	-36.7968	-39.6892	-36.7968	-39.6892	
27/02/2023 15:08	27/02/2023 15:50	OPTICS RIG	OPTICS001	9	-36.7968	-39.6893	-36.7968	-39.6893	
27/02/2023 15:12	27/02/2023 15:30	GARRETT SCREEN	SML004	9	-36.7968	-39.6893	-36.7968	-39.6892	
28/02/2023 04:56	28/02/2023 05:05	MARINE SNOW CATCHER	MSC011	10	-35.531	-37.5843	-35.531	-37.5843	
28/02/2023 05:00	28/02/2023 06:06	MAMMOTH NET	MNET006	10	-35.531	-37.5843	-35.531	-37.5843	
28/02/2023 05:14	28/02/2023 05:48	CAMERA RIG	CAM005	10	-35.531	-37.5843	-35.531	-37.5843	
28/02/2023 06:14		TURBULENCE PROFILER	TURB005	10	-35.5311	-37.5844			
28/02/2023 06:46	28/02/2023 07:19	BONGO NET	BONGO003	10	-35.5321	-37.5865	-35.5321	-37.5865	
28/02/2023 06:48	28/02/2023 07:41	CTD	CTD010	10	-35.5321	-37.5865	-35.5321	-37.5865	
28/02/2023 07:45	28/02/2023 07:50	MARINE SNOW CATCHER	MSC012	10	-35.5321	-37.5865	-35.5321	-37.5865	
28/02/2023 11:33	28/02/2023 12:15	RAIN COLLECTOR	RAIN002		-35.2075	-37.0136	-35.1468	-36.8893	
28/02/2023 15:00	28/02/2023 15:53	CTD	CTD011	11	-34.9163	-36.433	-34.9162	-36.433	
28/02/2023 15:06	28/02/2023 15:32	OPTICS RIG	OPTICS002	11	-34.9163	-36.433	-34.9163	-36.433	
28/02/2023 15:10		GARRETT SCREEN	SML005	11	-34.9163	-36.433			
28/02/2023 16:03		ARGO FLOAT	ARGO004		-34.9161	-36.4334			WMO ID: 1902096
28/02/2023 17:24	03/03/2023 13:50	AEROSOL SAMPLER	AERO006		-34.7969	-36.236	-29.5628	-27.132	

28/02/2023 17:24	02/03/2023 13:45	AEROSOL SAMPLER	AERO007		-34.7969	-36.236	-31.2738	-30.1999	
01/03/2023 03:54	01/03/2023 05:01	MAMMOTH NET	MNET007	12	-33.928	-34.439	-33.9297	-34.4427	
01/03/2023 04:07	01/03/2023 04:15	MARINE SNOW CATCHER	MSC013	12	-33.9283	-34.4396	-33.9285	-34.4401	
01/03/2023 04:21	01/03/2023 04:53	CAMERA RIG	CAM006	12	-33.9286	-34.4404	-33.9295	-34.4423	
01/03/2023 05:09	01/03/2023 05:37	TURBULENCE PROFILER	TURB006	12	-33.9301	-34.4434	-33.9348	-34.453	
01/03/2023 05:41	01/03/2023 06:19	BONGO NET	BONGO004	12	-33.935	-34.4534	-33.9358	-34.4553	
01/03/2023 05:44	01/03/2023 06:37	CTD	CTD012	12	-33.935	-34.4534	-33.9358	-34.4553	
01/03/2023 06:57	01/03/2023 07:01	MARINE SNOW CATCHER	MSC014	12	-33.9358	-34.4553	-33.9358	-34.4553	Deployed to 40m
01/03/2023 13:59	01/03/2023 14:43	OPTICS RIG	OPTICS003	13	-33.2734	-33.3372	-33.2734	-33.3356	End time is approximate
01/03/2023 14:00	01/03/2023 14:43	CTD	CTD013	13	-33.2734	-33.3372	-33.2734	-33.3356	
01/03/2023 17:46		ARGO FLOAT	ARGO005		-32.9707	-32.8814			WMO ID: 1902097
02/03/2023 03:55	02/03/2023 04:03	MARINE SNOW CATCHER	MSC015	14	-31.8707	-31.2906	-31.8707	-31.2906	Deployed to 80m
02/03/2023 04:09	02/03/2023 04:45	CAMERA RIG	CAM007	14	-31.8707	-31.2906	-31.8707	-31.2906	
02/03/2023 04:11	02/03/2023 05:11	MAMMOTH NET	MNET008	14	-31.8707	-31.2906	-31.8707	-31.2906	
02/03/2023 05:20	02/03/2023 05:38	TURBULENCE PROFILER	TURB007	14	-31.8709	-31.291	-31.8717	-31.2925	
02/03/2023 05:45	02/03/2023 06:36	CTD	CTD014	14	-31.8717	-31.2926	-31.8717	-31.2926	
02/03/2023 05:46	02/03/2023 06:20	BONGO NET	BONGO005	14	-31.8717	-31.2926	-31.8717	-31.2926	
02/03/2023 06:37	02/03/2023 06:41	MARINE SNOW CATCHER	MSC016	14	-31.8717	-31.2926	-31.8717	-31.2926	
02/03/2023 14:00	02/03/2023 14:42	OPTICS RIG	OPTICS004	15	-31.2746	-30.1955	-31.2746	-30.1955	
02/03/2023 14:01	02/03/2023 14:52	CTD	CTD015	15	-31.2745	-30.1955	-31.2746	-30.1955	
02/03/2023 14:50	04/03/2023 13:53	AEROSOL SAMPLER	AERO008		-31.2746	-30.1955	-27.3137	-24.5237	
03/03/2023 03:56	03/03/2023 05:00	MAMMOTH NET	MNET009	16	-30.1571	-28.1736	-30.1571	-28.1736	
03/03/2023 04:13	03/03/2023 04:19	MARINE SNOW CATCHER	MSC017	16	-30.1571	-28.1736	-30.1571	-28.1736	
03/03/2023 04:23	03/03/2023 05:00	CAMERA RIG	CAM008	16	-30.1571	-28.1736	-30.1571	-28.1736	
03/03/2023 05:10	03/03/2023 05:34	TURBULENCE PROFILER	TURB008	16	-30.1564	-28.1732	-30.1545	-28.1721	
03/03/2023 05:36	03/03/2023 06:00	BONGO NET	BONGO006	16	-30.1545	-28.1721	-30.1545	-28.1721	
03/03/2023 05:38	03/03/2023 06:32	CTD	CTD016	16	-30.1545	-28.1721	-30.1545	-28.1721	
03/03/2023 06:56	03/03/2023 07:04	MARINE SNOW CATCHER	MSC018	16	-30.1545	-28.1721	-30.1545	-28.1721	
03/03/2023 13:58	03/03/2023 14:40	OPTICS RIG	OPTICS005	17	-29.5629	-27.1319	-29.5629	-27.132	
03/03/2023 14:00	03/03/2023 14:53	CTD	CTD017	17	-29.5629	-27.1319	-29.5629	-27.1319	
03/03/2023 14:14	06/03/2023 13:49	AEROSOL SAMPLER	AERO009		-29.5629	-27.1319	-20.8472	-24.4964	
04/03/2023 03:52	04/03/2023 04:59	MAMMOTH NET	MNET010	18	-28.3859	-25.0854	-28.3859	-25.0854	
04/03/2023 03:55	04/03/2023 04:04	MARINE SNOW CATCHER	MSC019	18	-28.3859	-25.0854	-28.3859	-25.0854	

04/03/2023 04:09	04/03/2023 04:41	CAMERA RIG	CAM009	18	-28.3859	-25.0854	-28.3859	-25.0855	
04/03/2023 05:03	04/03/2023 05:26	TURBULENCE PROFILER	TURB009	18	-28.3857	-25.0851	-28.3845	-25.0825	
04/03/2023 05:34	04/03/2023 06:28	CTD	CTD018	18	-28.3845	-25.0823	-28.3845	-25.0823	
04/03/2023 05:34	04/03/2023 05:59	BONGO NET	BONGO007	18	-28.3845	-25.0823	-28.3845	-25.0823	
04/03/2023 06:43	04/03/2023 06:47	MARINE SNOW CATCHER	MSC020	18	-28.3845	-25.0823	-28.3845	-25.0823	
04/03/2023 06:55		ARGO FLOAT	ARGO006		-28.3821	-25.0812			WMO ID: 1902099
04/03/2023 13:59	04/03/2023 14:39	OPTICS RIG	OPTICS006	19	-27.3137	-24.5237	-27.3137	-24.5237	
04/03/2023 14:00	04/03/2023 15:03	CTD	CTD019	19	-27.3137	-24.5237	-27.3131	-24.5256	
04/03/2023 14:00	04/03/2023 14:52	GARRETT SCREEN	SML006	19	-27.3137	-24.5237	-27.3137	-24.5237	
04/03/2023 14:34	06/03/2023 13:49	AEROSOL SAMPLER	AERO010		-27.3137	-24.5237	-20.8472	-24.4964	
04/03/2023 15:05		ARGO FLOAT	ARGO007		-27.3119	-24.5258			WMO ID: 6904187
05/03/2023 03:53	05/03/2023 05:01	MAMMOTH NET	MNET011	20	-25.1589	-24.494	-25.159	-24.494	
05/03/2023 03:54	05/03/2023 04:10	MARINE SNOW CATCHER	MSC021	20	-25.1589	-24.494	-25.159	-24.494	
05/03/2023 04:14	05/03/2023 04:48	CAMERA RIG	CAM010	20	-25.1589	-24.494	-25.159	-24.494	
05/03/2023 04:40	05/03/2023 07:38	RAIN COLLECTOR	RAIN003		-25.159	-24.494	-25.0374	-24.5014	
05/03/2023 05:04	05/03/2023 05:30	TURBULENCE PROFILER	TURB010	20	-25.1588	-24.4938	-25.1578	-24.4914	
05/03/2023 05:31	05/03/2023 06:25	CTD	CTD020	20	-25.1578	-24.4914	-25.1578	-24.4914	
05/03/2023 05:31	05/03/2023 06:03	BONGO NET	BONGO008	20	-25.1578	-24.4914	-25.1578	-24.4914	
05/03/2023 06:42	05/03/2023 06:46	MARINE SNOW CATCHER	MSC022	20	-25.1578	-24.4914	-25.1578	-24.4914	Deployed to 50m
05/03/2023 13:57	05/03/2023 14:34	OPTICS RIG	OPTICS007	21	-24.0732	-24.5003	-24.0732	-24.5003	
05/03/2023 14:01		CTD	CTD021	21	-24.0732	-24.5003			
05/03/2023 14:06		GARRETT SCREEN	SML007	21	-24.0732	-24.5003			
05/03/2023 14:57		ARGO FLOAT	ARGO008		-24.0672	-24.5002			WMO ID: 1902098
06/03/2023 03:53	06/03/2023 05:02	MAMMOTH NET	MNET012	22	-21.962	-24.4972	-21.962	-24.4972	
06/03/2023 03:54	06/03/2023 03:58	MARINE SNOW CATCHER	MSC023	22	-21.962	-24.4972	-21.962	-24.4972	Deployed to 150m
06/03/2023 04:04	06/03/2023 04:35	CAMERA RIG	CAM011	22	-21.962	-24.4972	-21.962	-24.4972	
06/03/2023 05:04	06/03/2023 05:28	TURBULENCE PROFILER	TURB011	22	-21.9619	-24.497	-21.9612	-24.495	
06/03/2023 05:31	06/03/2023 05:54	BONGO NET	BONGO009	22	-21.9612	-24.495	-21.9612	-24.495	
06/03/2023 05:34	06/03/2023 06:27	CTD	CTD022	22	-21.9612	-24.495	-21.9612	-24.495	
06/03/2023 06:37	06/03/2023 06:45	MARINE SNOW CATCHER	MSC024	22	-21.9612	-24.495	-21.9612	-24.495	
06/03/2023 07:20	06/03/2023 08:00	RAIN COLLECTOR	RAIN004		-21.8901	-24.4962	-21.7822	-24.5004	
06/03/2023 13:57	06/03/2023 14:39	OPTICS RIG	OPTICS008	23	-20.8471	-24.4963	-20.8471	-24.4963	
06/03/2023 14:02	06/03/2023 14:58	CTD	CTD023	23	-20.8471	-24.4963	-20.8471	-24.4963	
06/03/2023 14:44	07/03/2023 13:52	AEROSOL SAMPLER	AERO011		-20.8471	-24.4963	-18.0231	-25.0632	

06/03/2023 14:44	09/03/2023 13:51	AEROSOL SAMPLER	AERO012		-20.8471	-24.4963	-11.8944	-25.0516	
07/03/2023 09:22	07/03/2023 10:25	AEROSOL SAMPLER	MOOR_REC01		-18.5425	-25.073	-18.5325	-25.0863	
07/03/2023 13:59	07/03/2023 14:43	OPTICS RIG	OPTICS009	24	-18.0231	-25.0635	-18.0231	-25.0635	
07/03/2023 13:59	07/03/2023 14:45	CTD	CTD024	24	-18.0231	-25.0635	-18.0231	-25.0635	
07/03/2023 14:38	08/03/2023 13:52	AEROSOL SAMPLER	AERO013		-18.0231	-25.0635	-14.8966	-25.055	
08/03/2023 03:56	08/03/2023 04:01	MARINE SNOW CATCHER	MSC025	25	-16.0134	-25.064	-16.0134	-25.064	
08/03/2023 03:57	08/03/2023 05:02	MAMMOTH NET	MNET013	25	-16.0134	-25.064	-16.0134	-25.064	
08/03/2023 04:09	08/03/2023 04:42	CAMERA RIG	CAM011	25	-16.0134	-25.064	-16.0134	-25.064	
08/03/2023 05:31		TURBULENCE PROFILER	TURB012	25	-16.0148	-25.0613			
08/03/2023 05:35	08/03/2023 06:28	CTD	CTD025	25	-16.0148	-25.0613	-16.0148	-25.0613	
08/03/2023 06:39	08/03/2023 06:47	MARINE SNOW CATCHER	MSC026	25	-16.0148	-25.0613	-16.0148	-25.0613	
08/03/2023 14:01	08/03/2023 14:59	CTD	CTD026	26	-14.8966	-25.0546	-14.8966	-25.0546	
08/03/2023 14:04	08/03/2023 14:46	OPTICS RIG	OPTICS010	26	-14.8966	-25.0546	-14.8966	-25.0546	
08/03/2023 14:29	09/03/2023 13:51	AEROSOL SAMPLER	AERO014		-14.8966	-25.0546	-11.8944	-25.0516	
09/03/2023 03:53	09/03/2023 04:59	MAMMOTH NET	MNET014	27	-12.8044	-25.0551	-12.8042	-25.0552	
09/03/2023 03:55	09/03/2023 03:59	MARINE SNOW CATCHER	MSC027	27	-12.8044	-25.0551	-12.8043	-25.0551	
09/03/2023 04:05	09/03/2023 04:54	CAMERA RIG	CAM012	27	-12.8043	-25.0552	-12.8042	-25.0552	
09/03/2023 05:06	09/03/2023 05:29	TURBULENCE PROFILER	TURB013	27	-12.8043	-25.0553	-12.8045	-25.0536	
09/03/2023 05:38	09/03/2023 06:33	CTD	CTD027	27	-12.8046	-25.0533	-12.8046	-25.0533	
09/03/2023 07:04	09/03/2023 07:39	BONGO NET	BONGO010	27	-12.8046	-25.0533	-12.8026	-25.0548	
09/03/2023 07:43	09/03/2023 08:01	MARINE SNOW CATCHER	MSC028	27	-12.8023	-25.0551	-12.8011	-25.056	Deployed to 50m
09/03/2023 13:58	09/03/2023 14:44	OPTICS RIG	OPTICS011	28	-11.8945	-25.0517	-11.8947	-25.0518	
09/03/2023 14:03	09/03/2023 14:56	CTD	CTD028	28	-11.8945	-25.0517	-11.8948	-25.0518	
09/03/2023 14:28	10/03/2023 13:51	AEROSOL SAMPLER	AERO015		-11.8945	-25.0517	-8.7443	-25.1569	
09/03/2023 14:28	12/03/2023 13:48	AEROSOL SAMPLER	AERO016		-11.8945	-25.0517	-2.5074	-25.1699	
09/03/2023 15:06		ARGO FLOAT	ARGO009		-11.8944	-25.0515			WMO ID: 6904188
10/03/2023 03:57	10/03/2023 05:03	MAMMOTH NET	MNET015	29	-9.8622	-25.0451	-9.8622	-25.0451	
10/03/2023 03:58	10/03/2023 04:04	MARINE SNOW CATCHER	MSC029	29	-9.8622	-25.0451	-9.8622	-25.0451	Deployed to 150m
10/03/2023 04:10	10/03/2023 04:47	CAMERA RIG	CAM013	29	-9.8622	-25.0451	-9.8622	-25.0451	
10/03/2023 05:06	10/03/2023 05:34	TURBULENCE PROFILER	TURB014	29	-9.8622	-25.0451	-9.864	-25.0426	
10/03/2023 05:39	10/03/2023 06:38	CTD	CTD029	29	-9.864	-25.0426	-9.864	-25.0426	
10/03/2023 05:39	10/03/2023 06:12	BONGO NET	BONGO011	29	-9.864	-25.0426	-9.864	-25.0426	
10/03/2023 06:43	10/03/2023 06:51	MARINE SNOW CATCHER	MSC030	29	-9.864	-25.0426	-9.864	-25.0426	Deployed to 150m

10/03/2023 13:57	10/03/2023 14:35	OPTICS RIG	OPTICS012	30	-8.744	-25.1568	-8.744	-25.1568	
10/03/2023 14:01	10/03/2023 15:00	CTD	CTD030	30	-8.744	-25.1568	-8.744	-25.1568	
10/03/2023 14:24	11/03/2023 13:48	AEROSOL SAMPLER	AERO017		-8.744	-25.1568	-5.6499	-25.167	
11/03/2023 03:53	11/03/2023 05:04	MAMMOTH NET	MNET016	31	-6.6814	-25.1932	-6.6814	-25.1931	
11/03/2023 04:02	11/03/2023 04:08	MARINE SNOW CATCHER	MSC031	31	-6.6814	-25.1932	-6.6814	-25.1932	Deployed to 150m
11/03/2023 04:17	11/03/2023 04:48	CAMERA RIG	CAM014	31	-6.6814	-25.1932	-6.6814	-25.1931	
11/03/2023 05:06	11/03/2023 05:29	TURBULENCE PROFILER	TURB015	31	-6.6815	-25.1929	-6.6825	-25.1913	
11/03/2023 05:35	11/03/2023 06:35	CTD	CTD031	31	-6.6825	-25.1912	-6.6825	-25.1912	
11/03/2023 05:42	11/03/2023 06:09	BONGO NET	BONGO012	31	-6.6825	-25.1912			
11/03/2023 06:53	11/03/2023 07:01	MARINE SNOW CATCHER	MSC032	31	-6.6825	-25.1912	-6.6825	-25.1912	
11/03/2023 13:56		CTD	CTD032	32	-5.6501	-25.1669			
11/03/2023 13:57		OPTICS RIG	OPTICS013	32	-5.6501	-25.1669			
11/03/2023 14:24	12/03/2023 13:48	AEROSOL SAMPLER	AERO018		-5.6501	-25.1669	-2.5074	-25.1699	
12/03/2023 03:51	12/03/2023 04:59	MAMMOTH NET	MNET017	33	-3.6388	-25.1665	-3.6391	-25.1663	
12/03/2023 03:57	12/03/2023 04:00	MARINE SNOW CATCHER	MSC033	33	-3.6389	-25.1665	-3.639	-25.1664	
12/03/2023 04:06	12/03/2023 04:40	CAMERA RIG	CAM015	33	-3.6391	-25.1663	-3.6391	-25.1663	
12/03/2023 05:00	12/03/2023 05:24	TURBULENCE PROFILER	TURB016	33	-3.6391	-25.1663	-3.64	-25.1645	
12/03/2023 05:31	12/03/2023 06:22	CTD	CTD033	33	-3.64	-25.1645	-3.64	-25.1645	
12/03/2023 05:32	12/03/2023 05:59	BONGO NET	BONGO013	33	-3.64	-25.1645	-3.64	-25.1645	
12/03/2023 06:43	12/03/2023 06:51	MARINE SNOW CATCHER	MSC034	33	-3.64	-25.1645	-3.64	-25.1645	
12/03/2023 14:24	13/03/2023 13:49	AEROSOL SAMPLER	AERO019		-2.4045	-25.1702	0.9274	-25.3771	
12/03/2023 14:24	13/03/2023 13:49	AEROSOL SAMPLER	AERO020		-2.4045	-25.1702	0.9274	-25.3771	
12/03/2023 23:57	13/03/2023 00:15	RAIN COLLECTOR	RAIN005		-0.7552	-25.1658	-0.7044	-25.1663	
13/03/2023 01:13	13/03/2023 01:31	RAIN COLLECTOR	RAIN006		-0.5341	-25.1657	-0.482	-25.1665	
13/03/2023 03:00	13/03/2023 04:00	RAIN COLLECTOR	RAIN007		-0.2263	-25.1631	-0.0572	-25.1607	
13/03/2023 04:31	13/03/2023 05:42	MAMMOTH NET	MNET018	34	0	-25.1606	-0.001	-25.1488	
13/03/2023 04:32	13/03/2023 04:43	MARINE SNOW CATCHER	MSC035	34	0	-25.1606	-0.0002	-25.1573	
13/03/2023 04:48	13/03/2023 05:20	CAMERA RIG	CAM016	34	-0.0004	-25.1556	-0.0007	-25.1527	
13/03/2023 05:48	13/03/2023 06:15	TURBULENCE PROFILER	TURB017	34	-0.0011	-25.1474	-0.0011	-25.1375	
13/03/2023 06:22	13/03/2023 07:17	CTD	CTD034	34	-0.0011	-25.137	-0.0013	-25.1286	
13/03/2023 06:23	13/03/2023 06:38	BONGO NET	BONGO014	34	-0.0011	-25.137	-0.0012	-25.1358	Recovered due to wire angle
13/03/2023 07:27	13/03/2023 07:34	MARINE SNOW CATCHER	MSC036	34	-0.0013	-25.1284	-0.0014	-25.1275	Deployed to 150m
13/03/2023 07:48		ARGO FLOAT	ARGO010		-0.0017	-25.1252			WMO ID: 6904189

13/03/2023 09:21	13/03/2023 09:31	RAIN COLLECTOR	RAIN008		0.2181	-25.2163	0.2456	-25.2234	
13/03/2023 13:57	13/03/2023 14:54	CTD	CTD035	35	0.9298	-25.3773	0.9298	-25.3773	
13/03/2023 14:01	13/03/2023 14:46	OPTICS RIG	OPTICS014	35	0.9297	-25.3773	0.9298	-25.3773	
13/03/2023 14:42	14/03/2023 13:51	AEROSOL SAMPLER	AERO021		0.9297	-25.3773	4.156	-25.4058	
13/03/2023 14:42	14/03/2023 13:51	AEROSOL SAMPLER	AERO022		0.9297	-25.3773	4.156	-25.4058	
14/03/2023 03:57	14/03/2023 05:00	MAMMOTH NET	MNET019	36	3.0147	-25.4176	3.0149	-25.4176	
14/03/2023 04:03	14/03/2023 04:06	MARINE SNOW CATCHER	MSC037	36	3.0148	-25.4176	3.0149	-25.4176	Deployed to 50m
14/03/2023 04:12	14/03/2023 04:48	CAMERA RIG	CAM017	36	3.0149	-25.4176	3.0149	-25.4176	
14/03/2023 05:03	14/03/2023 05:26	TURBULENCE PROFILER	TURB018	36	3.0151	-25.4176	3.0183	-25.4177	
14/03/2023 05:33	14/03/2023 06:32	CTD	CTD036	36	3.0185	-25.4177	3.0185	-25.4177	
14/03/2023 05:39	14/03/2023 06:01	BONGO NET	BONGO015	36	3.0185	-25.4177	3.0185	-25.4177	
14/03/2023 06:42	14/03/2023 06:50	MARINE SNOW CATCHER	MSC038	36	3.0185	-25.4177	3.0185	-25.4177	Deployed to 150m
14/03/2023 10:25	14/03/2023 10:32	RAIN COLLECTOR	RAIN009		3.6037	-25.4104	3.624	-25.4097	
14/03/2023 13:59		CTD	CTD037	37	4.1562	-25.4058			
14/03/2023 13:59	14/03/2023 14:40	OPTICS RIG	OPTICS015	37	4.1562	-25.4058	4.1562	-25.4058	
14/03/2023 14:44	15/03/2023 13:53	AEROSOL SAMPLER	AERO023		4.1562	-25.4058	7.2688	-25.3455	
14/03/2023 14:44	15/03/2023 13:53	AEROSOL SAMPLER	AERO024		4.1562	-25.4058	7.2688	-25.3455	
15/03/2023 03:55	15/03/2023 05:02	MAMMOTH NET	MNET020	38	6.1758	-25.3674	6.1758	-25.3674	
15/03/2023 03:58	15/03/2023 04:00	MARINE SNOW CATCHER	MSC039	38	6.1758	-25.3674	6.1758	-25.3674	Deployed to 50m
15/03/2023 04:08	15/03/2023 04:41	CAMERA RIG	CAM018	38	6.1758	-25.3674	6.1758	-25.3674	
15/03/2023 05:07	15/03/2023 05:26	TURBULENCE PROFILER	TURB019	38	6.1761	-25.3676	6.178	-25.3687	
15/03/2023 05:31	15/03/2023 06:28	CTD	CTD038	38	6.1781	-25.3688	6.1781	-25.3688	
15/03/2023 05:31	15/03/2023 05:56	BONGO NET	BONGO016	38	6.1781	-25.3688	6.1781	-25.3688	
15/03/2023 06:47	15/03/2023 06:55	MARINE SNOW CATCHER	MSC040	38	6.1781	-25.3688	6.178	-25.3688	Deployed to 150m
15/03/2023 13:57	15/03/2023 14:35	OPTICS RIG	OPTICS016	39	7.2689	-25.3455	7.2688	-25.3455	
15/03/2023 13:57	15/03/2023 14:57	CTD	CTD039	39	7.2689	-25.3455	7.2689	-25.3455	
15/03/2023 14:44	16/03/2023 13:50	AEROSOL SAMPLER	AERO025		7.2688	-25.3455	10.4224	-25.291	
15/03/2023 14:44	16/03/2023 13:50	AEROSOL SAMPLER	AERO026		7.2688	-25.3455	10.4224	-25.291	
16/03/2023 03:53	16/03/2023 05:02	MAMMOTH NET	MNET021	40	9.2607	-25.3124	9.2607	-25.3124	
16/03/2023 03:59	16/03/2023 04:05	MARINE SNOW CATCHER	MSC041	40	9.2607	-25.3124	9.2608	-25.3124	Deployed to 50m
16/03/2023 04:09	16/03/2023 04:41	CAMERA RIG	CAM019	40	9.2607	-25.3124	9.2608	-25.3124	
16/03/2023 05:09	16/03/2023 05:30	TURBULENCE PROFILER	TURB020	40	9.2613	-25.3124	9.2642	-25.3122	
16/03/2023 05:35	16/03/2023 05:54	BONGO NET	BONGO017	40	9.2644	-25.3122	9.2644	-25.3122	
16/03/2023 05:37	16/03/2023 06:33	CTD	CTD040	40	9.2644	-25.3121	9.2644	-25.3121	

16/03/2023 06:42	16/03/2023 06:49	MARINE SNOW CATCHER	MSC042	40	9.2644	-25.3121	9.2644	-25.3121	Deployed to 150m
16/03/2023 13:57	16/03/2023 14:56	CTD	CTD041	41	10.4225	-25.2911	10.4225	-25.291	
16/03/2023 14:33	16/03/2023 20:30	AEROSOL SAMPLER	AERO027		10.4225	-25.2911	11.2663	-25.2782	
16/03/2023 14:33	16/03/2023 20:30	AEROSOL SAMPLER	AERO028		10.4225	-25.2911	11.2663	-25.2782	
16/03/2023 15:05		ARGO FLOAT	ARGO011		10.425	-25.29			WMO ID: 3901578
19/03/2023 12:07	20/03/2023 12:52	AEROSOL SAMPLER	AERO029		20.6014	-25.0006	23.7293	-24.9999	
19/03/2023 12:07	20/03/2023 12:52	AEROSOL SAMPLER	AERO030		20.6014	-25.0006	23.7293	-24.9999	
19/03/2023 12:58	19/03/2023 13:52	CTD	CTD042	42	20.6988	-24.9978	20.6988	-24.9978	
19/03/2023 12:59	19/03/2023 13:42	OPTICS RIG	OPTICS017	42	20.6988	-24.9978	20.6988	-24.9978	
20/03/2023 02:53	20/03/2023 03:59	MAMMOTH NET	MNET022	43	22.6133	-25.0058	22.6133	-25.0058	
20/03/2023 02:53	20/03/2023 02:59	MARINE SNOW CATCHER	MSC043	43	22.6133	-25.0058	22.6133	-25.0058	Deployed to 160m
20/03/2023 03:07	20/03/2023 03:38	CAMERA RIG	CAM020	43	22.6133	-25.0058	22.6133	-25.0058	
20/03/2023 04:02	20/03/2023 04:28	TURBULENCE PROFILER	TURB021	43	22.6134	-25.0057	22.6149	-25.004	
20/03/2023 04:31	20/03/2023 04:56	BONGO NET	BONGO018	43	22.6149	-25.004	22.6149	-25.004	
20/03/2023 04:37	20/03/2023 05:33	CTD	CTD043	43	22.6149	-25.004	22.6149	-25.0041	
20/03/2023 05:08	20/03/2023 05:12	MARINE SNOW CATCHER	MSC044	43	22.6149	-25.004	22.6149	-25.004	Deployed to 60m
20/03/2023 12:58	20/03/2023 13:37	OPTICS RIG	OPTICS018	44	23.7294	-24.9999	23.7293	-24.9999	
20/03/2023 12:59	20/03/2023 13:53	CTD	CTD044	44	23.7294	-24.9999	23.7294	-24.9999	
20/03/2023 13:29	21/03/2023 12:50	AEROSOL SAMPLER	AERO031		23.7294	-24.9999	26.6516	-24.9962	
20/03/2023 13:29	22/03/2023 12:56	AEROSOL SAMPLER	AERO032		23.7294	-24.9999	29.2721	-23.6775	
21/03/2023 02:53	21/03/2023 04:03	MAMMOTH NET	MNET023	45	25.6986	-25.0023	25.6985	-25.0023	
21/03/2023 02:55	21/03/2023 03:02	MARINE SNOW CATCHER	MSC045	45	25.6986	-25.0023	25.6986	-25.0023	Deployed to 160m
21/03/2023 03:10	21/03/2023 03:42	CAMERA RIG	CAM021	45	25.6986	-25.0023	25.6985	-25.0023	
21/03/2023 04:06	21/03/2023 04:31	TURBULENCE PROFILER	TURB022	45	25.6987	-25.0022	25.7004	-25.0011	
21/03/2023 04:34	21/03/2023 04:59	BONGO NET	BONGO019	45	25.7005	-25.0011	25.7005	-25.0011	
21/03/2023 04:39	21/03/2023 05:34	CTD	CTD045	45	25.7005	-25.0011	25.7005	-25.0011	
21/03/2023 05:47	21/03/2023 07:06	RAIN COLLECTOR	RAIN010		25.7005	-25.001	25.8224	-25.001	
21/03/2023 06:03	21/03/2023 06:08	MARINE SNOW CATCHER	MSC046	45	25.7005	-25.001	25.7004	-25.001	Deployed to 60m
21/03/2023 10:03	21/03/2023 10:15	RAIN COLLECTOR	RAIN011		26.2587	-25.0003	26.2879	-25.0006	
21/03/2023 12:51	21/03/2023 13:32	OPTICS RIG	OPTICS019	46	26.6516	-24.9962	26.6516	-24.9962	
21/03/2023 12:52	21/03/2023 13:46	CTD	CTD046	46	26.6516	-24.9962	26.6512	-24.9958	
21/03/2023 13:23	22/03/2023 12:56	AEROSOL SAMPLER	AERO033		26.6516	-24.9962	29.2721	-23.6775	
22/03/2023 02:57	22/03/2023 04:06	MAMMOTH NET	MNET024	47	28.3465	-24.1502	28.3464	-24.1502	

22/03/2023 02:58	22/03/2023 03:02	MARINE SNOW CATCHER	MSC047	47	28.3465	-24.1503	28.3465	-24.1502	Deployed to 60m
22/03/2023 03:09	22/03/2023 03:39	CAMERA RIG	CAM022	47	28.3464	-24.1502	28.3464	-24.1502	
22/03/2023 04:09	22/03/2023 04:33	TURBULENCE PROFILER	TURB023	47	28.3465	-24.1502	28.3482	-24.1477	
22/03/2023 04:39	22/03/2023 05:02	BONGO NET	BONGO020	47	28.3482	-24.1475	28.3483	-24.1476	
22/03/2023 04:46	22/03/2023 05:37	CTD	CTD047	47	28.3483	-24.1476	28.3483	-24.1476	
22/03/2023 05:46	22/03/2023 05:54	MARINE SNOW CATCHER	MSC048	47	28.3483	-24.1476	28.3483	-24.1476	Deployed to 160m
22/03/2023 12:55	22/03/2023 13:34	OPTICS RIG	OPTICS020	48	29.2721	-23.6775	29.2721	-23.6775	
22/03/2023 12:57	22/03/2023 13:57	CTD	CTD048	48	29.2721	-23.6775	29.2721	-23.6775	
22/03/2023 13:36	24/03/2023 12:51	AEROSOL SAMPLER	AERO034		29.2721	-23.6775	35.0978	-20.6301	
22/03/2023 13:36	24/03/2023 12:51	AEROSOL SAMPLER	AERO035		29.2721	-23.6775	35.0978	-20.6301	
23/03/2023 02:49	23/03/2023 03:58	MAMMOTH NET	MNET025	49	31.0481	-22.7729	31.0481	-22.7728	
23/03/2023 02:54	23/03/2023 03:02	MARINE SNOW CATCHER	MSC049	49	31.0481	-22.7729	31.0481	-22.7729	Deployed to 160m
23/03/2023 03:10	23/03/2023 03:42	CAMERA RIG	CAM023	49	31.0481	-22.7729	31.0481	-22.7727	
23/03/2023 04:00	23/03/2023 04:26	TURBULENCE PROFILER	TURB024	49	31.0482	-22.7727	31.0507	-22.7711	
23/03/2023 04:30	23/03/2023 04:54	BONGO NET	BONGO021	49	31.0507	-22.7711	31.0507	-22.7711	
23/03/2023 04:30	23/03/2023 05:25	CTD	CTD049	49	31.0507	-22.7711	31.0507	-22.7711	
23/03/2023 05:42	23/03/2023 05:46	MARINE SNOW CATCHER	MSC050	49	31.0507	-22.7711	31.0507	-22.7711	Deployed to 60m
23/03/2023 12:54	23/03/2023 13:40	CTD	CTD050	50	32.1055	-22.2235	32.1055	-22.2235	
23/03/2023 12:58	23/03/2023 13:40	OPTICS RIG	OPTICS021	50	32.1055	-22.2235	32.1055	-22.2235	
24/03/2023 02:52	24/03/2023 04:02	MAMMOTH NET	MNET026	51	34.0624	-21.1878	34.0624	-21.1879	
24/03/2023 02:53	24/03/2023 03:00	MARINE SNOW CATCHER	MSC051	51	34.0624	-21.1879	34.0624	-21.1879	Deployed to 160m
24/03/2023 03:08	24/03/2023 03:40	CAMERA RIG	CAM024	51	34.0624	-21.1879	34.0624	-21.1879	
24/03/2023 04:04	24/03/2023 04:34	TURBULENCE PROFILER	TURB025	51	34.0625	-21.1879	34.0653	-21.1885	
24/03/2023 04:35	24/03/2023 05:30	CTD	CTD051	51	34.0653	-21.1885	34.0653	-21.1885	
24/03/2023 04:36	24/03/2023 05:00	BONGO NET	BONGO022	51	34.0653	-21.1885	34.0653	-21.1885	
24/03/2023 05:44	24/03/2023 05:49	MARINE SNOW CATCHER	MSC052	51	34.0653	-21.1885	34.0653	-21.1885	Deployed to 60m
24/03/2023 12:58	24/03/2023 13:43	OPTICS RIG	OPTICS022	52	35.0978	-20.6301	35.0982	-20.6296	
24/03/2023 12:58	24/03/2023 13:55	CTD	CTD052	52	35.0978	-20.6301	35.0982	-20.6296	
24/03/2023 13:30	25/03/2023 11:54	AEROSOL SAMPLER	AERO036		35.0982	-20.6296	37.7966	-18.7806	
24/03/2023 13:30	25/03/2023 11:54	AEROSOL SAMPLER	AERO037		35.0982	-20.6296	37.7966	-18.7806	
25/03/2023 01:53	25/03/2023 02:59	MAMMOTH NET	MNET027	53	36.7928	-19.4604	36.7919	-19.4609	
25/03/2023 01:58	25/03/2023 02:05	MARINE SNOW CATCHER	MSC053	53	36.7927	-19.4604	36.7926	-19.4605	Deployed to 160m
25/03/2023 02:10	25/03/2023 02:43	CAMERA RIG	CAM025	53	36.7925	-19.4606	36.7919	-19.461	

25/03/2023 03:07	25/03/2023 03:33	TURBULENCE PROFILER	TURB026	53	36.792	-19.4608	36.7942	-19.4606	
25/03/2023 03:37	25/03/2023 04:08	BONGO NET	BONGO023	53	36.7942	-19.4606	36.7942	-19.4606	
25/03/2023 03:39	25/03/2023 04:34	CTD	CTD053	53	36.7942	-19.4606	36.7942	-19.4606	
25/03/2023 04:46	25/03/2023 04:50	MARINE SNOW CATCHER	MSC054	53	36.7942	-19.4606	36.7942	-19.4606	Deployed to 60m
25/03/2023 11:58	25/03/2023 12:40	OPTICS RIG	OPTICS023	54	37.7968	-18.7806	37.7968	-18.7806	
25/03/2023 11:59	25/03/2023 12:58	CTD	CTD054	54	37.7968	-18.7806	37.7968	-18.7806	
25/03/2023 12:35	26/03/2023 11:52	AEROSOL SAMPLER	AERO038		37.7968	-18.7806	40.5372	-16.9181	
25/03/2023 12:35	26/03/2023 16:24	AEROSOL SAMPLER	AERO039		37.7968	-18.7806	41.042	-16.5687	
26/03/2023 01:54	26/03/2023 03:01	MAMMOTH NET	MNET028	55	39.6635	-17.528	39.6635	-17.528	Net malfunctioned - first net did not fire
26/03/2023 02:01	26/03/2023 02:08	MARINE SNOW CATCHER	MSC055	55	39.6635	-17.528	39.6635	-17.528	Deployed to 160m
26/03/2023 02:15	26/03/2023 02:45	CAMERA RIG	CAM026	55	39.6635	-17.528	39.6635	-17.528	
26/03/2023 03:06	26/03/2023 03:32	TURBULENCE PROFILER	TURB027	55	39.6634	-17.528	39.6612	-17.526	
26/03/2023 03:36	26/03/2023 04:00	BONGO NET	BONGO024	55	39.6611	-17.526	39.6611	-17.5259	
26/03/2023 03:40	26/03/2023 04:39	CTD	CTD055	55	39.6611	-17.526	39.6611	-17.5259	
26/03/2023 05:01	26/03/2023 05:05	MARINE SNOW CATCHER	MSC056	55	39.6612	-17.5257	39.6612	-17.5257	Deployed to 60m
26/03/2023 11:51	26/03/2023 12:50	CTD	CTD056	56	40.5371	-16.9181	40.5372	-16.9181	
26/03/2023 12:19	26/03/2023 12:56	OPTICS RIG	OPTICS024	56	40.5372	-16.9181	40.5371	-16.9181	
26/03/2023 13:03		ARGO FLOAT	ARGO012		40.5378	-16.9192			WMO ID: 3901579
28/03/2023 05:51		ARGO FLOAT	ARGO013		46.3579	-11.4308			WMO ID: 2903773
28/03/2023 11:11		ARGO FLOAT	ARGO014		46.97	-10.4567			WMO ID: 5906967