SAMS PRIZE glider deployments report
January to June 2018

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This report provides an overview of the glider activities carried out in the Barents Sea between January and June 2018 for the project Arctic PRIZE (Arctic productivity in the seasonal ice zone), part of the NERC CAO (Changing Arctic Ocean) programme.
We would like to thank our funder NERC (Natural Environment Research Council); the British Antarctic Survey; our project partners at the University of Tromsø (UiT) for their logistical help and fieldwork support, especially Daniel Vogedes; the crews of the RV Helmer Hanssen and RRS James Clark Ross for their expert handling of the glider deployments and recoveries; the glider team at MARS for supplying the gliders and piloting; Johnny Johansen (UiT vessel manager) and Andreia Aletia Plaza Faverola (UiT CAGE-May18 cruise leader) for their assistance in an emergency glider recovery; and finally Norwegian authorities (including the Norwegian Joint Headquarters FOH and the Norwegian Directorate of Fisheries) for giving us Diplomatic Clearance to operate the gliders in their waters.

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1. Project overview

The Arctic PRIZE project is seeking to understand and predict how change in sea ice and ocean properties will affect the large-scale ecosystem structure of the Arctic Ocean. We investigate the seasonally and spatially varying relationship between sea ice, water column structure, light, nutrients and productivity and the roles they play in structuring energy transfer to pelagic zooplankton and benthic megafauna. We focus on the seasonal ice zone (SIZ) of the Barents Sea – a highly productive region that is undergoing considerable change in its sea ice distribution – and target the critically important but under-sampled seasonal transition from winter into the post-bloom summer period.
The core objective of Arctic PRIZE is to investigate the seasonally-varying interplay between physical forcings and nutrient fluxes, and their impact on primary productivity (PP) and related zooplankton dynamics and benthic communities, and support development of enhanced modelling capabilities to make projections of ecosystem response to reducing sea ice cover. In order to investigate and model fundamental processes driving the Arctic Ocean ecosystem to predict its response to sea ice retreat, new observations of water column properties and community composition were made in 2017 and 2018 using standard ship-based techniques, autonomous and moored platforms, and remote sensing (core measurements relevant to the wider NERC Changing Arctic Ocean programme). From these data, new, well-validated models will be developed that will be merged back into UK and international efforts to project the future of pan-Arctic ecosystems through collaboration with leading modelling groups.

2. Glider missions overview

This report summarises the underwater glider missions conducted in the Barents Sea in the vicinity of sea-ice, throughout winter to summer 2018.
In order to assess the piloting conditions a test glider deployment was carried out in summer 2017 for two weeks (PRIZE1). The glider was deployed and recovered from RRS James Clark Ross during cruise JR16006. The full details and mission report can be found in the cruise report: https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/jr16006.pdf

Ahead of the 2018 glider deployments diplomatic clearance was requested by SAMS and granted by the Norwegian authorities, under reference 2017/000199-056/DEFNON/414 (Norwegian Joint Headquarters) and 11.07.2017, 05.01.-31.08.2018, 17/9715 (Norwegian Directorate of Fisheries). In accordance with the diplomatic clearance, the gliders positions were reported via email to the Norwegian Armed Forces Joint Headquarters every 72 hours.

The initial plan was to conduct two sets of three months deployments (Jan-Apr and Apr-Jun) of 3 gliders each, two of them doing transects perpendicular to the ice edge, and the last one along the ice edge (~20km away). Due to operational, piloting and financial constraints the plan was revised to two gliders before the first set of deployments.
Field operations were carried out by SAMS personnel, while the piloting was shared between MARS (Marine Autonomous Robotics Systems, Southampton) and SAMS. Particular attention was paid to the sea-ice conditions, especially when the gliders were heading north. Pilots closely monitored the ice edge location and wind and sea-ice forecast in order to minimise the risk of the gliders becoming trapped in sea ice, or entering waters where the surface density would be too low for them to surface (e.g. in patches of surface ice-melt water near the ice edge). For this purpose the pilots used forecasts from Copernicus (Daily Global Ocean 1/12° Physics Analysis and Forecast, http://marine.copernicus.eu/) and real-time SAR satellite images from Polar View (https://www.polarview.aq/arctic). Battery usage was also closely monitored, and the sensor sampling lowered as needed to maintain the required endurance.
During the first round of deployments (PRIZE2), two gliders were deployed. One glider suffered a technical failure a few hours after deployment, and was recovered. In March a replacement glider deployment was attempted off the coast of northern Norway but was lost on deployment. Therefore only one glider remained in the water until the turn-around in April. Two new gliders were deployed at that time (PRIZE3). One of them malfunctioned three weeks later and was recovered, leaving only one glider in the water until the final recovery in June.

Summary of deployments:

Mission	SAMS mission #	Glider S/N	Deployment date	Recovery date	Duration (days)	No of dives	Distance (km)
PRIZE 2	28	400	11/01/18 15:30	26/04/18 12:20	104.9	3033	2,129
PRIZE 2	29	305	11/01/18 13:45	12/01/18 01:50	0.5	15	7
PRIZE 2b	N/A	419	03/03/18 14:05	03/03/18 14:05	0	0	0
PRIZE 3	30	306	26/04/18 17:15	30/06/18 06:50	64.6	1765	1,007
PRIZE 3	31	399	26/04/18 16:45	18/05/18 16:30	22.0	593	278

Map of deployments:

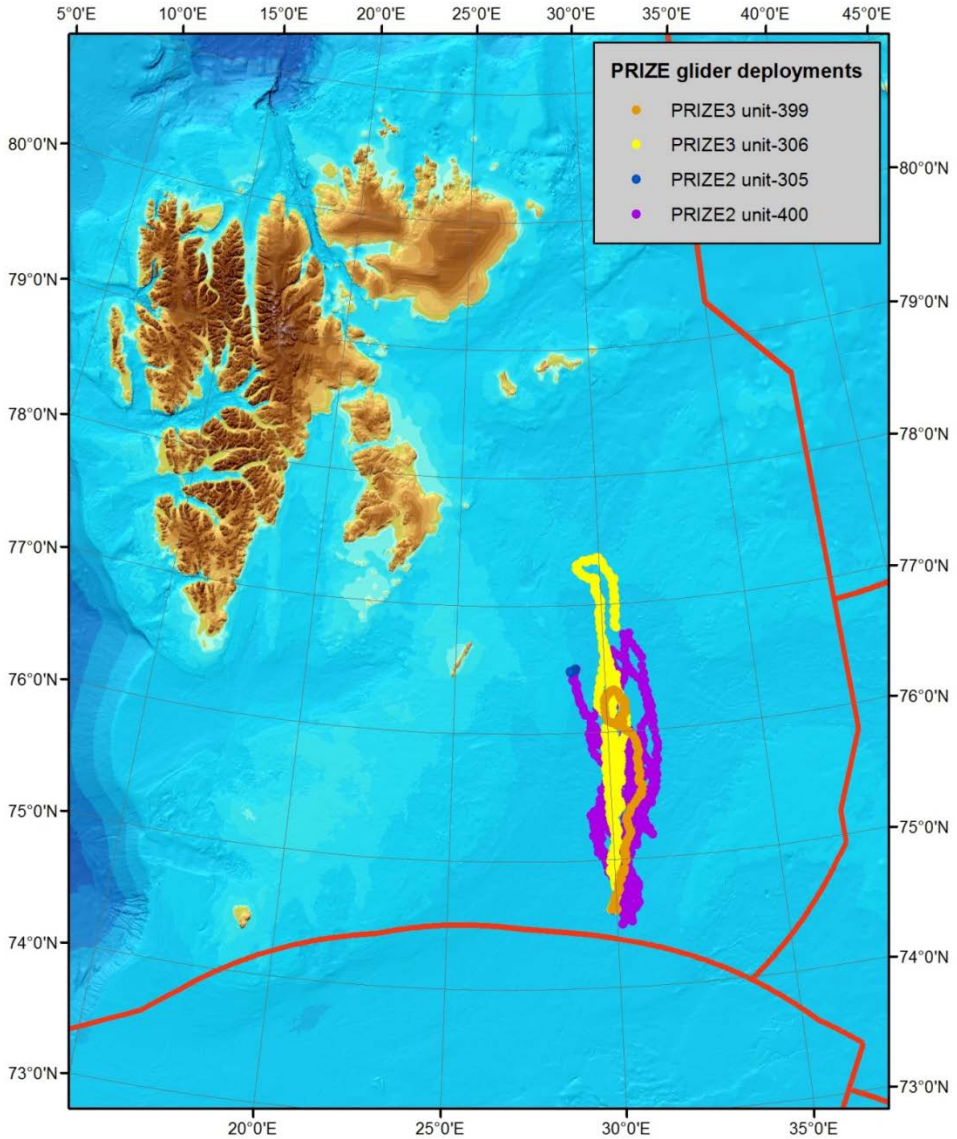

Figure 1: Map of PRIZE 2 and 3 glider deployments (January to June 2018). Bathymetry and topography data source: GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003. Red lines indicate EEZ (Exclusive Economic Zone) limits, source: Flanders Marine Institute (2018). Maritime Boundaries Geodatabase, version 10. Available online at http://www.marineregions.org/.

3. Deployments narrative

3.1. Mission PRIZE2 unit 400 'Drake'

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

The glider was deployed on the 11th January 2018 during cruise number HH04012018 aboard R/V Helmer Hanssen (University of Tromsø), in position 76° 30.28'N, 29° 02.19'E at 15:30 UTC. The standard functional checks were carried out successfully on deck prior to deployment. Before launch the glider was craned into the Polarcirkel small boat, then personnel joined the small boat from the trawl deck level. Standard small boat launch procedure was followed, using the cradle over the fold-down section of the Polarcirkel to slide the glider into the water. The glider was launched with a float and tag line in the first instance, as no on board ballasting was possible. Once it was ascertained that the glider floated, this was removed and remote control handed over to the pilot via Iridium.

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

The glider was first directed South, away from the sea-ice, while the pilots familiarised themselves with piloting conditions. The mission started by one long transect down to 74.5°N, then back up North up to ~30km of the sea-ice edge in early February. Shorter transects followed for 2.5 months, down to 75° to 75.5°N, and up to within 20 or 30km of the sea-ice edge. One long transect down to 74.5° N was performed in April. On the 21st April, a few days after it started the next transect North, the glider suffered a leak in the forward section. Not able to dive anymore it was left drifting at the surface and closely monitored by the pilots.

The glider was recovered on the 26th April 2018 during cruise number HH23042018 aboard R/V Helmer Hanssen, in position 74° 37.308' N, 29° 52.010' E at 12:20 UTC. The glider was recovered using the PolarCirkel small boat.

Transect summary:

#	Direction	Start date	Start dive	End date	End dive	Duration (days)	Distance (km, direct line)	Min latitude	Max latitude
1	N→S	11/01/18	1	26/01/18	489	15.1	226	74.5	76.5
2	S→N	26/01/18	489	06/02/18	819	11.2	239	74.5	76.6
3	N→S	06/02/18	819	13/02 /18	1019	6.7	129	75.5	76.6
4	S→N	13/02/18	1019	19/02/18	1203	6.1	144	75.5	76.8
5	N→S	19/02/18	1203	01/03 /18	1502	10.0	208	74.9	76.8
6	S→N	01/03/18	1502	06/03/18	1666	5.0	74	74.9	75.5
7	N→S	06/03/18	1666	10/03/18	1787	4.0	47	75.1	75.5
8	S→N	10/03/18	1787	15/03/18	1914	4.2	78	75.1	75.8
9	N→S	15/03/18	1914	19/03/18	2040	4.2	49	75.4	75.8
10	S→N	19/03/18	2040	22/03/18	2149	3.5	69	75.4	76.0
11	N→S	22/03/18	2149	27/03/18	2294	4.9	94	75.2	76.0
12	S→N	27/03/18	2294	31/03/18	2417	4.1	77	75.2	75.8
13	N→S	31/03/18	2417	12/04/18	2768	11.7	144	74.5	75.8
14	S→N	12/04/18	2768	17/04/18	2926	5.4	110	74.5	75.5
15	N→S	17/04/18	2926	21/04/18	3033	3.5	69	74.9	75.5

Sensor information:

Sensor type	Parameters	Model	Serial number	Calibration date
CTD	Temperature, conductivity	SeaBird Slocum CTD	9137	26-Jul-2017
Oxygen optode	Dissolved oxygen	Aanderaa 4831	119	12-Nov-2014
Eco-puck	Fluorescence (chl-a), CDOM, backscatter 700nm	WetLabs FLBBCDSLC	3352	27-Jul-2017

Sampling summary:

Dates	CTD	Optode	WetLabs	Reason for change
11/01 – 22/01	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	/
22/01 – 07/02	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Every 5 yo, climb only, 20s interval	Reduce energy usage (no chl in water column)
07/02 – 08/02	Every yo, dive & climb, continuous	Every yo, dive & climb, 10s interval	Every 5 yo, climb only, 20s interval	Reduce energy usage
08/02 – 12/02	Every yo, dive & climb, continuous	Every 2 yo, climb only, 20s interval	Every 5 yo, climb only, 20s interval	Reduce energy usage
12/02 – 14/02	Every yo, dive & climb, continuous	Every 2 yo, climb only, 20s interval	Every 5 yo, climb only, 40s interval	Reduce energy usage
14/02 – 18/02	Every 2 yo, dive & climb, continuous	Every 2 yo, climb only, 20s interval	Every 5 yo, climb only, 40s interval	Reduce energy usage
18/02 – 20/02	Every yo, dive & climb, continuous	Every 2 yo, climb only, 20s interval	Every 5 yo, climb only, 40s interval	Increase sampling in polar waters
20/02 – 09/04	Every 2 yo, dive & climb, continuous	Every 2 yo, climb only, 20s interval	Every 6 yo, climb only, 40s interval	Out of polar waters
09/04 – 11/04	Every 2 yo, dive & climb, continuous	Every 2 yo, climb only, 20s interval	Every 2 yo, climb only, 30s interval	Increase in chl-a, increase sampling
11/04 – 14/04	Every 2 yo, dive & climb, continuous	Every 2 yo, climb only, 10s interval	Every 2 yo, climb only, 10s interval	Increase in chl-a, increase sampling
14/04 – 21/04	Every yo, dive & climb, continuous	Every yo, climb only, 10s interval	Every yo, climb only, 10s interval	Enough energy to last until recovery

Technical plots (whole mission):

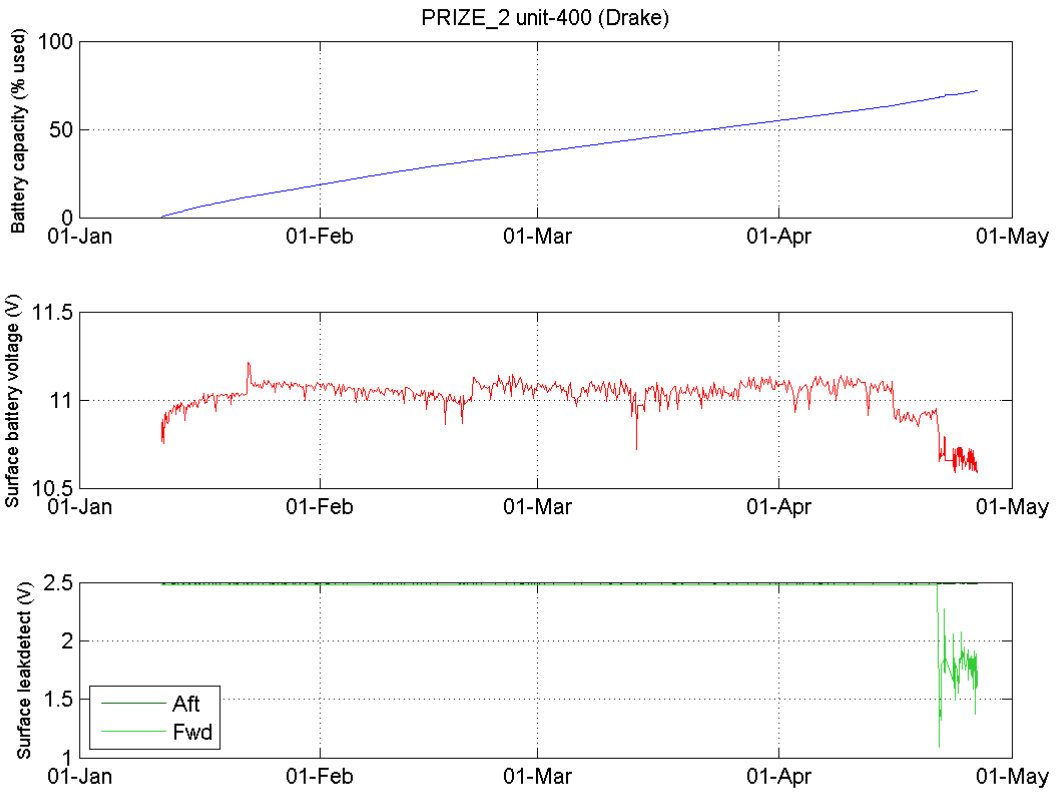

Figure 2: engineering readings for unit-400's mission. The leak which triggered the end of the mission is clearly visible on the bottom plot, indicated by the sharp drop in the forward leakdetect voltage. Total energy used: 71.8% in 105 days.

3.2. Mission PRIZE2 unit 305 'Dolomite'

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

Dolomite was deployed on the 11th January 2018 during cruise number 4012018 aboard R/V Helmer Hanssen (University of Tromsø), in position 76° 30.03'N, 28° 59.74'E at 13:45 UTC. The standard functional checks were carried out successfully on deck prior to deployment. Before launch the glider was craned into the Polarcirkel small boat, then personnel joined the small boat from the trawl deck level. Standard small boat launch procedure was followed, using the cradle over the fold-down section of the Polarcirkel to slide the glider into the water. The glider was launched with a float and tag line in the first instance, as no on board ballasting was possible. Once it was ascertained that the glider floated, this was removed and remote control handed over to the pilot via Iridium.

At 20:45 UTC (after 14 dives) the glider detected a leak in the forward section. The pilots determined that the detection was real and stopped the glider from diving. R/V Helmer Hanssen was still nearby and turned around to go recover the glider. This was achieved from the Polarcirkel at 01:50 UTC in position 76° 29.19'N, 28° 50.48'E.

After the cruise Dolomite was shipped back to MARS where the cause of the leak was investigated. Back at the lab, salt trails were observed in the nose cone and it looked like a leak in the vicinity of the leak detector, at the bottom of the hull.

Sensor information:

Sensor type	Parameters	Model	Serial number	Calibration date
CTD	Temperature, conductivity	SeaBird Slocum CTD	9100	28-Apr-2017
Oxygen optode	Dissolved oxygen	Aanderaa 4831	234	23-Aug-2017
Eco-puck	Fluorescence (chl-a), CDOM, backscatter 700nm	WetLabs FLBBCDSLC	3289	05-May-2017

Sampling summary:

Dates	CTD	Optode	WetLabs	Reason for change
11/01	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	/

Technical plots (whole mission):

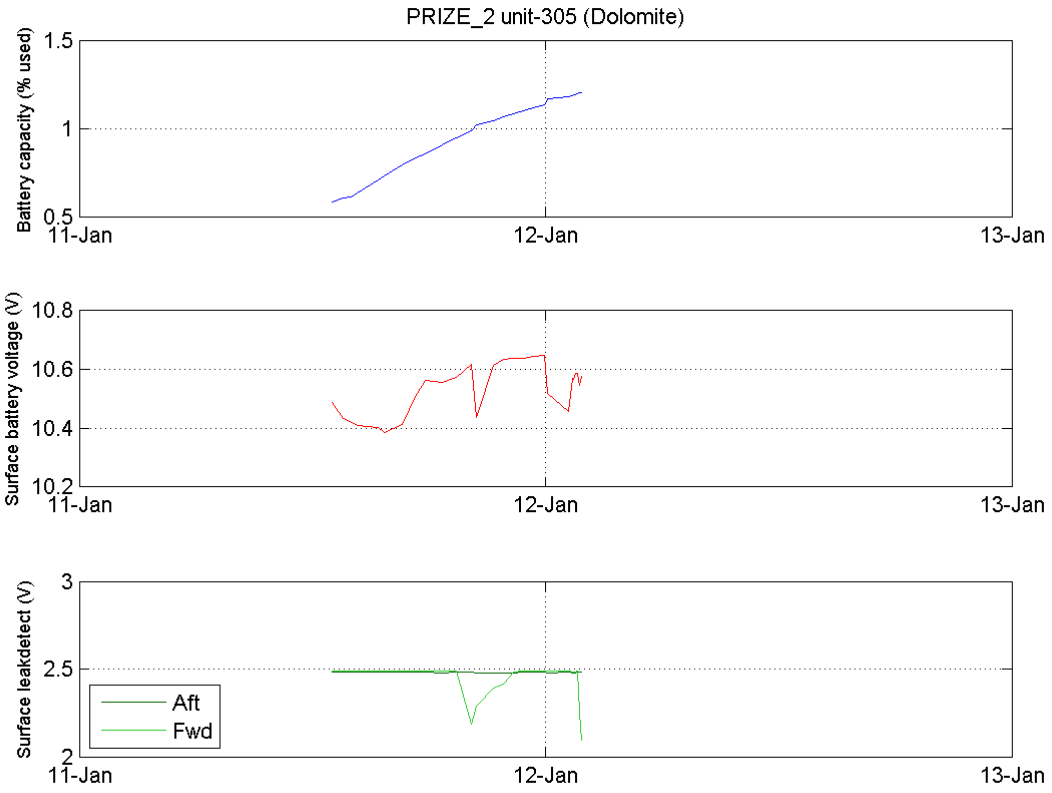

Figure 3: engineering readings for unit-305's mission. The leak which triggered the end of the mission is clearly visible on the bottom plot, indicated by the sharp drop in the forward leakdetect voltage. Total energy used: 1.2% in <0.5 days.

3.3. Mission PRIZE2b unit 419 ‘Fortyniner’

Following the failure of unit 305 a replacement glider was set to be deployed a few weeks later. Fortyniner was originally scheduled to be deployed in January but a leak was detected during deck tests prior to deployment (internal vacuum not holding). The problem could not be fixed onboard and the glider was shipped back to NOC in February. Subsequent lab tests showed that the rate of leakage was linked to the ballast pump position, being quite slow if the glider was in ballast mode (pump piston fully retracted) and more noticeable with the piston fully extended. The forward section (including the ballast pump) was swapped for a different unit, and this showed no leak over 24 hours. Fortyniner was then shipped back to Tromsø for deployment in March.
This glider was a shallow G2 Slocum supplied by MARS and equipped with a pumped CTD sensor, oxygen optode, triplet Eco-Puck measuring backscatter, chlorophyll fluorescence and CDOM (coloured dissolved organic matter) and PAR (Photosynthetically Active Radiation) sensor.

The deployment was planned from the fishing vessel Finnmarksfisk, a 30-metre Maritime College fishing vessel used for training and based in Honningsvåg, northern Norway. A glider technician from SAMS and an instrument technician from the University of Tromsø were in charge of the glider deployment onboard the vessel. The deployment technique using the vessel’s crane and quick-release hook was discussed between the crew and the technician, and tested while in port. The vessel headed out for the nominal deployment location of 71° 30’N, 27° E (~50 nautical miles off the coast, out of the two heavy shipping lanes) on the 3rd March. They reached the site around 12:00 UTC. The standard functional checks were carried out successfully on deck, and the team proceeded with the launch. While the glider was being lifted using a crane, a mix of vessel movement and miscommunication between the UK technician and Norwegian crew resulted in the glider being let go and starting to swing mid-air. It quickly gained momentum and it became too dangerous for anyone to attempt to grab it. The glider then hit the side of the ship and broke at one of the main sections. The Captain ordered to release the glider as soon as it hit the water as it would have been too hazardous for the crew to attempt to recover it, and water had probably gotten inside the instrument by that point. The glider sank immediately at 14:05 UTC, in position 72° 27.036' N, 26° 56.474' E. Norwegian authorities were notified the same day.

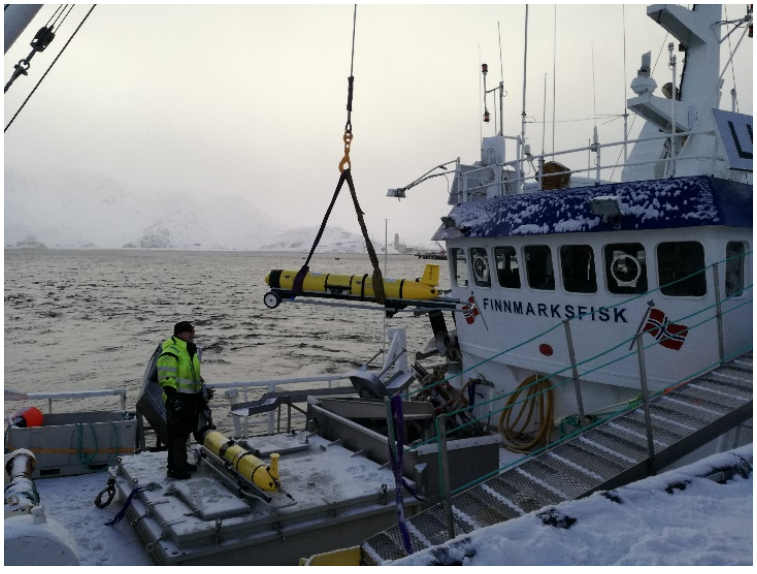

Figure 4: unit-419 (and spare glider, not deployed) being loaded onbaord Finnmarksfisk. Credit: Emily Venables.

3.4. Mission PRIZE3 unit 399 ‘Raleigh’

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

Raleigh was deployed on the 26th April 2018 during cruise number 18042018 aboard R/V Helmer Hanssen (University of Tromsø), in position 74° 36.993' N, 29° 50.316' E at 16:45 UTC. The standard functional checks were carried out successfully on deck prior to deployment. Before launch the glider was craned into the Polarcirkel small boat, then personnel joined the small boat from the trawl deck level. Standard small boat launch procedure was followed, using the cradle over the fold-down section of the Polarcirkel to slide the glider into the water. The glider was launched without a float and tag line, so as to reduce risk of damage when trying to remove it knowing that it had been ballasted the same as the successful 400 on PRIZE2. Once in the water remote control was handed over to the pilot via Iridium.

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

After a few test dives Raleigh was sent North along the 30°E meridian. On the 8th May it aborted its mission after the digifin (rudder) stopped working. The pilots tried to reactivate it remotely but without success. After this point the glider was still able to dive but was mostly looping under water and was therefore moving in whichever direction the currents pushed it. Initially the currents pushed it North-East towards the sea ice, then South from the 9th May onwards. Although the pilots could not direct the glider exactly where to go the Southerly direction was deemed safer than leaving it drifting at the surface (possibly heading toward the sea-ice).
Around the same time Raleigh also started aborting due to file transfer errors. The exact cause could not be determined and the problem could not be solved remotely. The scripts on the dockserver were set to not ask for an automatic file transfer, instead the pilots manually paused the mission and transferred files manually on a daily basis.

Since the glider's trajectory was fairly uncontrollable help was sought from nearby vessels for an emergency recovery. R/V Helmer Hanssen, who was conducting a cruise in the area for the UiT CAGE project, agreed to help. Once the ship had the glider in view the pilot released the burnt wire in the nose section remotely, deploying a line that the crew grappled. The line was then attached to the vessel's crane and the glider lifted out of the water. The recovery took place on the 18th May 2018 at 16:30UTC in position 76° 04.646' N, 30° 30.275' E. Raleigh was then offloaded in Longyearbyen a few weeks later and transferred onto the RRS James Clark Ross which brought it back to the UK.

Transects summary:

#	Direction	Start date	Start dive	End date	End dive	Duration (days)	Distance (km, direct line)	Min latitude	Max latitude
1	S→N	26/04/18	1	09/05/18	362	13.2	192	74.6	76.3
2	N→S	09/05/18	362	18/05/18	593	8.4	28	76.1	76.3

Sensor information:

Sensor type	Parameters	Model	Serial number	Calibration date
CTD	Temperature, conductivity	SeaBird Slocum CTD	9110	09-Jan-2018
Oxygen optode	Dissolved oxygen	Aanderaa 4831	232	13-Feb-2018
Eco-puck	Fluorescence (chl-a), CDOM, backscatter 700nm	WetLabs FLBBCDSLC	3325	25-Sep-2013

Sampling summary:

Dates	CTD	Optode	WetLabs	Reason for change
26/04 – 18/05	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	Every yo, dive & climb, continuous	"Short" mission, should have enough battery to have all sensors on at full resolution

Technical plots (whole mission):

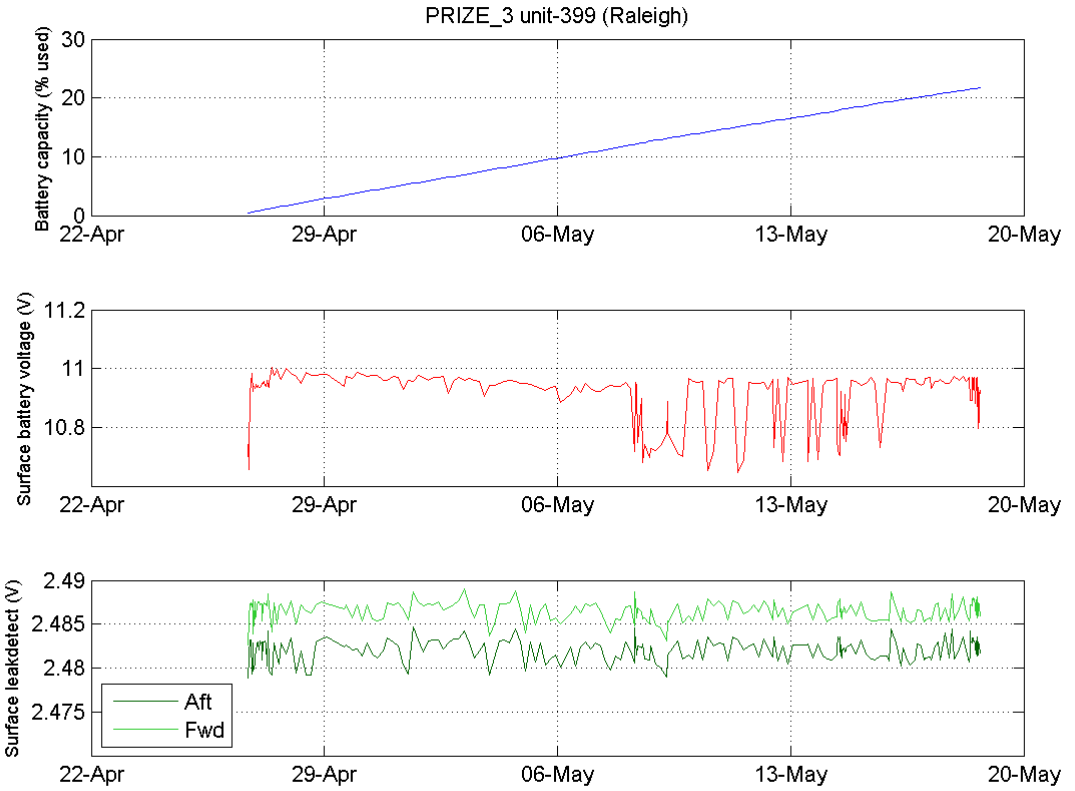

Figure 5: engineering readings for unit-399's mission. Total energy used: 21.7% in 22 days.

3.5. Mission PRIZE3 unit 306 'Zephyr'

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

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

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

After a few test dives Zephyr was sent North (T1) along the 30°E meridian. All the sensors data looked fine except for the CDOM which appeared suspiciously low (compared to the data from Raleigh and the previously deployed glider Drake). The calibration coefficients were initially suspected but seemed correct, and the cause for the low values remained undetermined. This will be investigated further in the lab post-recovery. When Zephyr got to within 20 to 30km of the ice edge it

was sent South (T2). Once it reached Atlantic waters it was sent back North (T3). On the 1st June the science logger started recording an increasing number of oddities, and a higher power consumption became observable. Pilots carried out a series of tests, switching sensors on and off in turn, and reducing sampling rates. They came to the conclusion that the oxygen optode was the likely culprit, the suspected reason being water ingress inside the sensor's cable or connector. The optode was therefore turned off for the remainder of the mission. Unfortunately this appeared to have a knock-on effect on the WetLabs sensor, which also had to be turned off. The CTD and PAR sensors remained active.
By that time the sea ice had receded a lot, and scientists decided to not go up to the ice edge but instead to turn the glider around (T4) once it had crossed the polar front and entered Arctic waters . A final South to North transect was performed, only up to 75°N in order to meet up with the recovery ship.

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

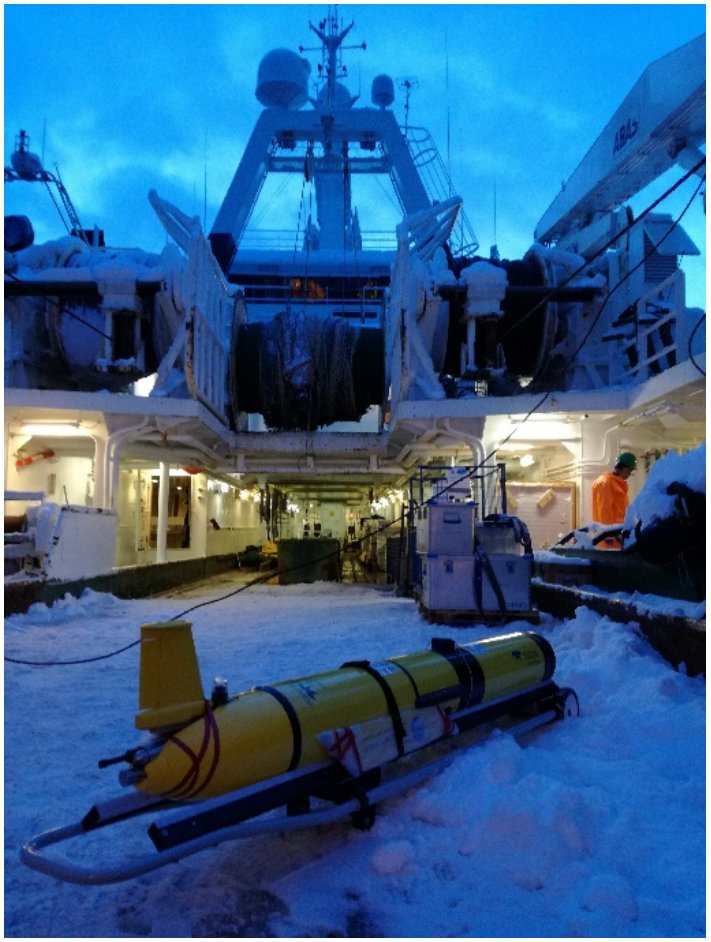

Figure 6: unit-306 being tested on deck prior to deployment. Credit: Emily Venables.

Transects summary:

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

Sensor information:

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

Sampling summary:

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

Technical plots (whole mission):

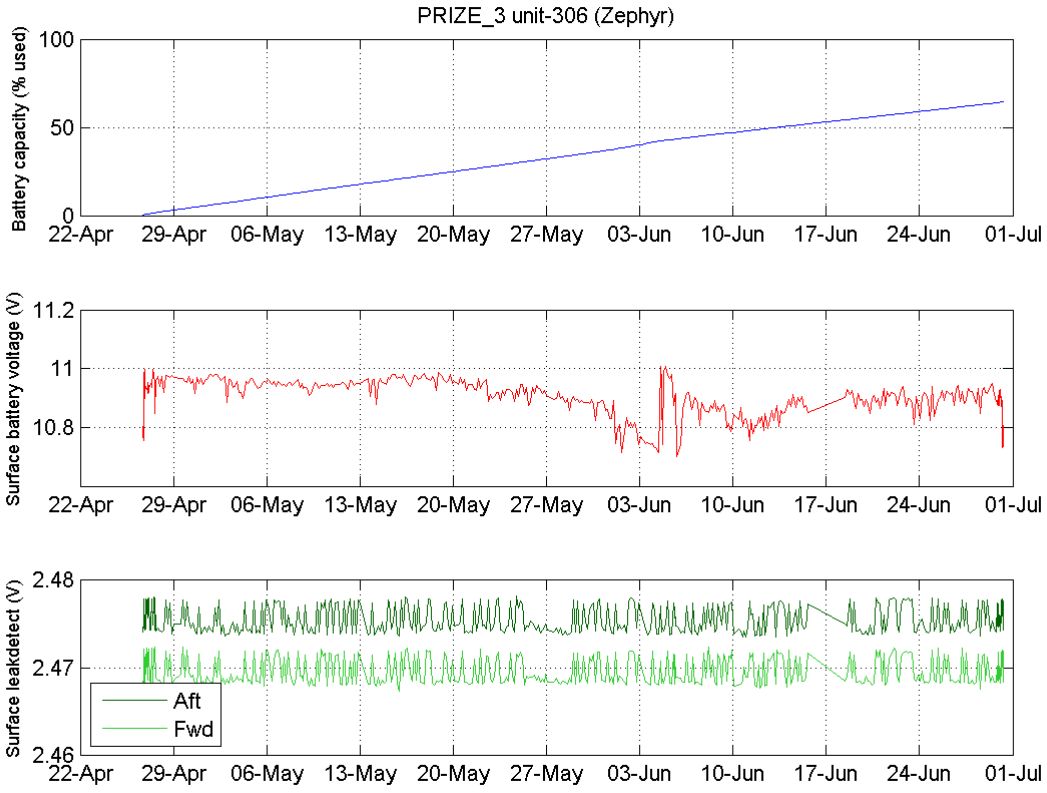

Figure 7: engineering readings for unit-306's mission. Total energy used: 64.5% in 65 days

4. Preliminary data overview

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

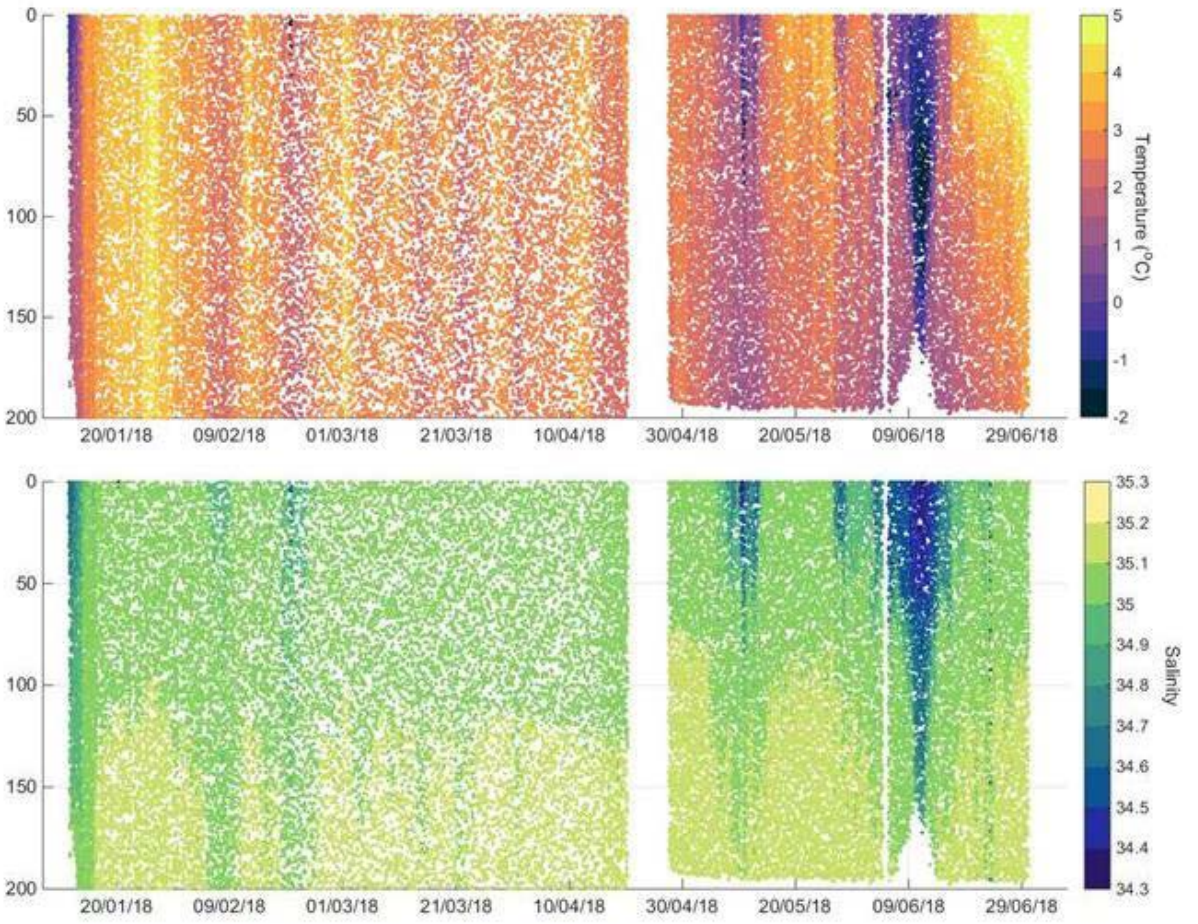

Figure 8: raw temperature and salinity timeseries from January to July 2018, from the surface down to 200m. The periods of lower temperature (<0°C) and lower salinity (<34.7psu) throughout the water column indicate the Northern end of the transects after the gliders crossed the polar front. Conversely, periods of higher temperature (>3°C) and salinity (>34.8psu) show the presence of Atlantic water towards the southern end of the transects.

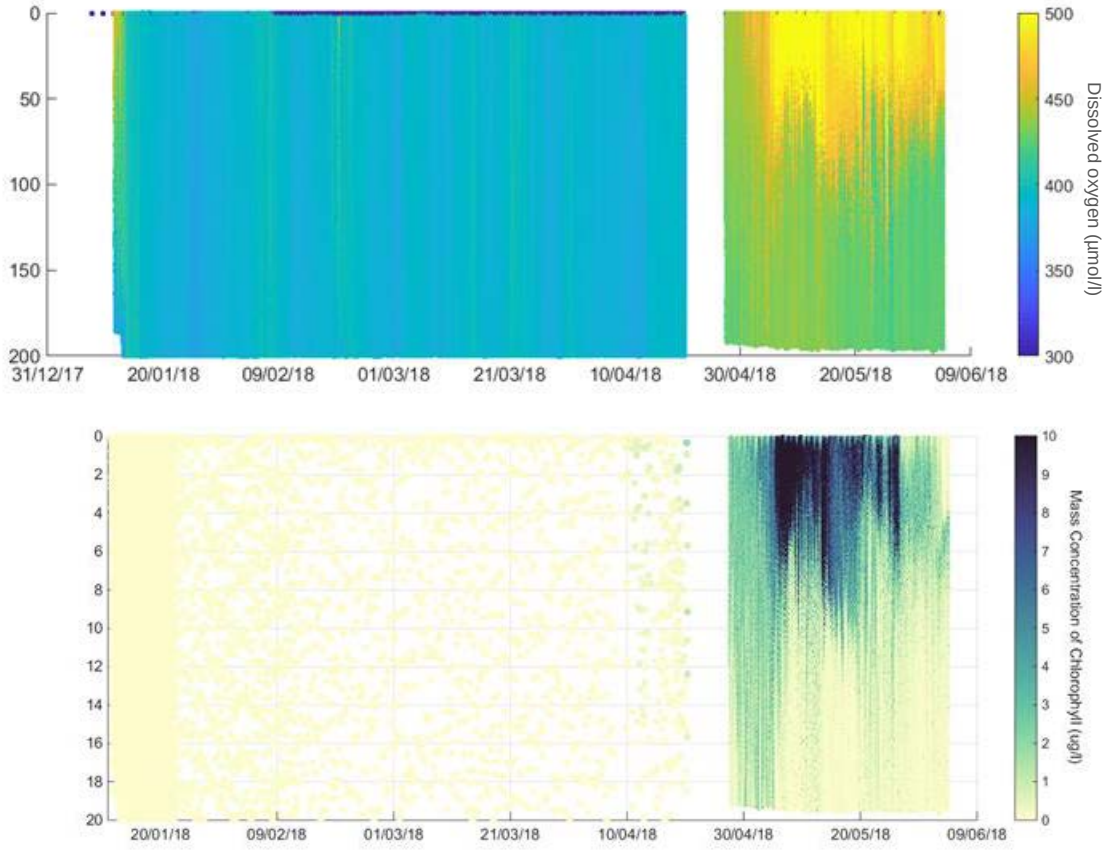

Figure 9: raw dissolved oxygen and chlorophyll-a timeseries from January to June 2018, from the surface down to 200m for O2, and zoomed in to the top 30m for chl-a. The O2 values are raw and need correcting for pressure and salinity effect, this will have a significant effect on the values (lowering them by about 20 to 30%). Both variables remained low during winter until the onset of the spring bloom in early May. Faulty sensors on unit-306 in early June meant no data was collected for the last 4 weeks of the mission.