5. PHYSICAL OCEANOGRAPHY AND ASSOCIATED TASKS DURING MOSAIC LEG 5

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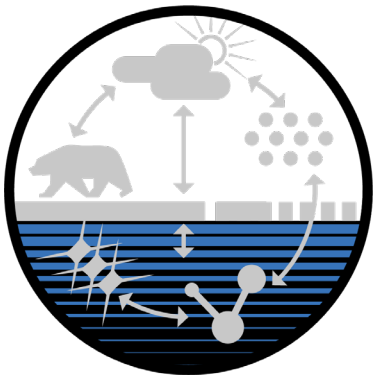

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A comprehensive summary of the physical-oceanographic measurements during all 5 cruise legs can be found in Rabe et al., 2022.

Background and Objectives

General background and objectives of the physical oceanography within the MOSAiC project have been described in the expedition booklet, the report by legs 1, 2, 3 and 4 and the individual proposals within team OCEAN. Major overarching aims are

1. To develop improved parametrizations for ocean boundary-layer mixing including treatment of brine rejection from sea-ice formation and the dissipation of surface momentum fluxes.
2. To better understand heat fluxes from the warm Atlantic water across the halocline.
3. At the mesoscale, to develop a better understanding of the processes controlling eddies, upwelling and restratification at water mass fronts, and improve the model representation of these processes.

One specific focus of leg 5 was to study turbulent mixing in the near-surface ocean with respect to expected changes with the freeze-up. Studying this seasonal change is of major importance for a better understanding of the heat exchange between the ocean and the

atmosphere and thus one of the main objectives within MOSAiC. Another specific focus was to look at the deep water and their transformation in regard with climate change

The leg 5 MOSAiC drift started off on August 21st in the Eurasian Basin, i.e., in the central Arctic Ocean. We drifted for 4 weeks in the Amundsen Basin (Figure 5.1). Detailed description of the Arctic Basins, their water masses, and the ocean circulation are described in the expedition report of MOSAiC leg 1 (PS122/1).

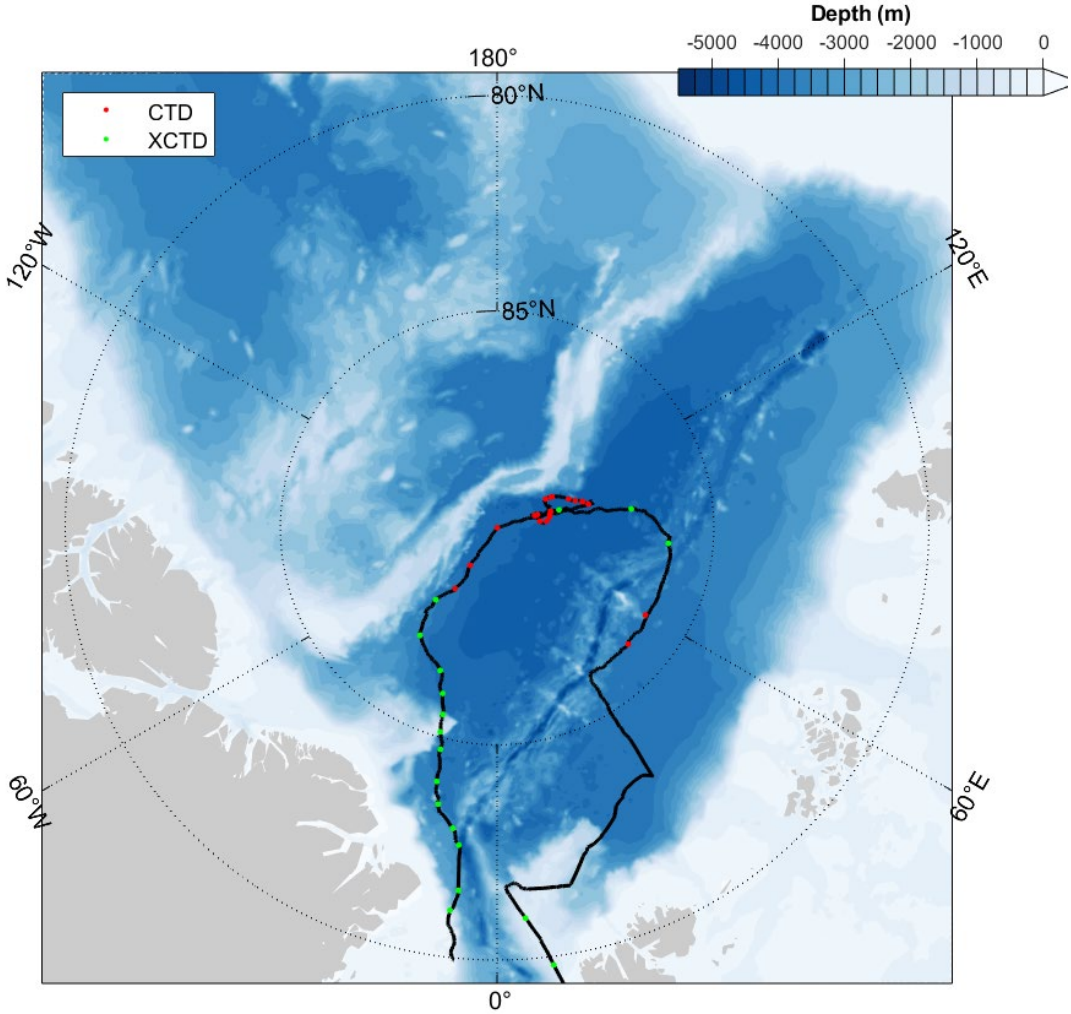


Figure 5.1: Bathymetric map of the Arctic Ocean. The black line shows the cruise track of the entire leg 5 (transit and camp). The red dots indicate the location of the ship CTD stations, and the green ones of the xCTDs.

Work at sea

Expendable CTDs (xCTDs)

During the transits to and from the main ice floe, we obtained a total of 18 CTD profiles from the ocean surface to a maximum depth of 1100 m using xCTD probes launched from the aft deck (see Table 5.1). 13 profiles were taken during transit to the new ice floe, and 5 more

during the transit back to Svalbard. These data complement hydrographic data collected in the previous years, as well as the regular CTD work during the MOSAiC expedition.

Figure 5.2: xCTD deployment from the aft working deck

Table 5.1: Overview of xCTD casts

ID	Serial Number	Latitude	Longitude	Time	Probe depth	Water depth	DSHIP name	file name
1	16103070	81.0957	-7.0324	20200813T17:10:00	366	1710	PS122-5_59-10	XCTD-002608132020
2	16103071	81.5746	-6.0888	20200813T22:10:00	1100	3350	PS122-5_59-12	XCTD-002708132020
3	16103067	82.6244	-6.8885	20200814T06:20:00	1100	4000	PS122-5-59_13	XCTD-002808142020
4	16103066	82.9925	-8.3919	20200814T11:20:00	1100	3260	PS122-5_59-23	XCTD-002908142020
5	16103065	83.4824	-12.0507	20200814T17:20:00	1100	3500	PS122-5_59-25	XCTD-003008142020
6	16103068	83.9888	-13.3771	20200814T22:45:00	1100	3683	PS122-5_59-27	XCTD-003108142020
7	16103063	84.7317	-14.3426	20200815T06:20:00	1100	3840	PS122-5_59-28	XCTD-003208152020
8	16103064	85.1220	-15.5786	20200815T10:44:00	1100	940	PS122-5_59-33	XCTD-003308252020
9	16103073	85.5232	-16.2535	20200815T17:45:00	1100	2473	PS122-5_59-35	XCTD-003408152020
10	16103062	85.9840	-18.2080	20200815T23:52:00	1100	4008	PS122-5_59-37	XCTD-003508152020
11	16103087	86.4635	-21.74794	20200816T06:15:00	1100	4104	PS122-5_59-38	XCTD-003608162020
12	16103088	86.9521	-35.7152	20200816T16:40:00	356	3741	PS122-5_59-58	XCTD-003708162020

13	16103094	87.8251	-40.4594	20200817T05:08:00	1100	3795	PS122-5_59-60	XCTD-003808172020
14	16103092	88.5145	106.1818	20200921T08:45:00	1100	4305	PS122-5_63-2	XCTD-003909212020
15	16103086	86.8767	98.0200	20200921T12:35:00	1100	4081	PS122-5_63-8	XCTD-004009222020
16	16103091	86.0333	84.8552	20200923T05:05:00	1100	3943	PS122-5_63-9	XCTD-004109232020
17	16103090	80.9548	4.1751	20201001T00:00:00	700	700	PS122-5_63-135	XCTD-009910012020
18	16103044	79.8021	7.3989	20201001T13:56:00	770	770	PS122-5_63-146	XCTD-004210012020

CTD operations from Polarstern

Following up all the previous MOSAIC legs, we operated a CTD/Rosette system with various additional sensors and 24 OTE-Niskin bottles (in the following referred to as CTD) through a hydrohole from the ship. The 3 x 3 m big hydrohole was established 3 times (one time each week) during leg 5 at approximately 3 m away from the ship. The hole has to be remade every week as it broke several times because of ice pressure. With the first hole, an additional block on the cargo crane was used in order to operate the CTD with the ship's crane and winch. With the two other holes, we run the CTD using the Schiebebalken. More details on the CTD deployment using the cargo crane are given in the cruise report of leg 1. The hole was made using an ice corer and lifting the ice blocks with the crane of the ship.

During MOSAiC Leg 5, we planned to carry out weekly deep CTD casts (i.e., down to 10 m above the seafloor) on Thursdays, and shallow CTD casts (down to 1000 or 2000m depth for water sampling mainly by team ECO) the other days. Although we managed to always have the deep cast on thursdays, the shallow cast did not happen everyday as the hole broke several times.

Figure 5.3: CTD deployment from Polarstern in the first of 3 hydroholes.

Ship-based CTD measurements

The Polarstern CTD/Rosette with 24 12-liter OTE-Niskin bottles had been assembled at the Alfred Wegener Institute in Bremerhaven. The standard SeaBird SBE911plus system was equipped with dual sensors to measure temperature, conductivity, and oxygen, and single sensors measuring pressure, substance fluorescence (Chl-*a* and CDOM), irradiance, beam transmission, nitrate, and rhodamine (Table 5.2). An altimeter was mounted to monitor the distance to the seafloor. Additionally, a stand-alone recording, battery-powered Underwater Vision Profiler (UVP, see Team ECO chapter 6.2) was attached.

Rhodamine sensor issue

On the evening of 19 August 2020, we performed a deep CTD cast (4211 m depth) at the North Pole. On the way up, and after having closed 10 bottles, the CTD stopped transmitting data at about 1088 m depth. The deck unit LEDs, which were supposed to be indicating a working system, were off. The error LED was also off though, and there was no beep or anything that indicated any problem with the connection. We restarted the deck unit several times and deactivated the carousel, without any success. The CTD was brought back to surface (it was still there…), and no damage was visible.

On 20 August 2020, we started troubleshooting the system with the help of the lab electrician Olaf, the winch electrician Lars and Team Data member Jo. We found out that the fuse of the deck unit in the winch control room went off, and this was easily replaced. This was the first indication of a short in the system. Second, we checked the wire termination of the ship winch and it looked rusty and worn off, but after an electronic check of the cable, it seemed generally still intact. Next we performed a test with a spare deck unit from the former Ocean City CTD system, but the SBE9+ still did not work. Finally, we tested another SBE9+ from the former Ocean City CTD system with both deck units in order to ensure we set up the system correctly, and indeed both configurations worked. At this point it seemed clear to us that the SBE9+ datalogger must be the problem, and we suspected it died due to a short somewhere in the system (which would later turn out to not be true, see below).

We studied the manual and considered to open the unit for further troubleshooting, but given that the next CTD cast was scheduled within the next 2 days, our group decided that the highest priority would be to have a working system ready as soon as possible.

Finally we decided to swap the broken SBE9+ with the working one from Ocean City, but keeping all the sensors from the original CTD. We also decided to use a different winch, as the cable that has been in use so far looked quite worn off and the deck crew recommended to switch it. After exchanging the 2 SBE9+ units, and mounting and plugging in all the sensors on the ship rosette, the CTD deck unit suddenly gave an error signal (red error LED and beeping noise). We were puzzled because this new SBE9+ had successfully been tested earlier. We unplugged all the sensors (upon which the system suddenly worked) and re-plugged them one by one. We also added grease to all the plugs. After reconnecting almost all the sensors without any problems, we were finally able to consistently reproduce the error by plugging the rhodamine sensor to the custom-made three-way cable. The rhodamine sensor did not show any external damage, but it was definitely causing the SBE9+ communication to fail. At this point, a broken three-way cable could not be ruled out either, but first we focused on the sensor.

We investigated the rhodamine sensor with an external lab power supply, and there was no voltage, which already indicated a short in the sensor itself. We decided to open it and water splashed out immediately after loosening the first few screws. In fact, the entire sensor was completely flooded with water, which explained the short. We rinsed it with seawater and let it dry for a while.

Based on this new information, we performed another final test with the potentially broken original SBE9+ unit, and indeed it worked with the rhodamine sensor now unplugged. The exchange of the logger could have been avoided if we would have unplugged all sensors during the troubleshooting. We connected the spare rhodamine sensor to the new system, which immediately worked.

Pressure sensor issue

On 10 September 2020, the pressure sensor of the current SBE9+ unit (SN 935) showed unreasonable values (280 m when switched on deck, and also during a test in the water). Restarting the software and deck unit several times did not resolve the issue, so the pressure sensor itself was investigated more closely. After consulting the manual, we exchanged the plastic components of pressure sensor tubing and outlet, and refilled the silicone oil in the sensor according to the manual. During a first test afterwards, the issue was still not resolved, so as a next step we decided to exchange the entire SBE9+ unit again. However, during a final test about 20 minutes after the replacement of the silicone oil, the sensor of unit 935 was suddenly working again, so the exchange became unnecessary. The issue never came back. The origin of the problem remains unclear.

Surface PAR sensor issue

During Leg5, there were several issues with the surface PAR sensor. At some point, it only worked intermittently, and upon closer investigation, it turned out that the connector on the sensor itself was broken beyond repair. Since we were not able to fix the sensor, most casts do not include any surface PAR data.

Detailed overview of ship CTD configuration and Dship logs

Table 5.2: Sensor configuration (conf1) of the Polarstern CTD/Rosette system.

Sensor	Primary	Secondary
SBE3 Temperature sensor	sn #1338	sn #1374
	sw #5842	sw #5844
SBE4 Conductivity sensor	sn #3173	sn #3590
	sw #5865	sw #5879
SBE43 Oxygen sensor	sn #1834	sn #0467
	sw #5883	sw #5880
SBE9+ Pressure sensor	sn #0321	-
	sw #3214	
Turner Cyclops Rhodamine Fluorometer	sn #216K00137	-
	sw #7118	
Altimeter	sn 47768	-
	sw #5900	
WET Labs C-Star Transmissometer	sn #1198	-
	sw #4126	
Satlantics SUNA Nitrate sensor	sn #1318	-
	sw #4998	
WET Labs ECO-AFL/FL Chl-a Fluorometer	sn #1853	-
	sw #4125	
Biospherical/Licor PAR/Irradiance sensor	sn #70257	-
	sw #5920	

WET Labs ECO CDOM CDOM Fluorometer	sn #4531	-
	sw #5911	
Biospherical/Licor Surface PAR	Sn #20349	-
	Sw #5921	
SBE35 High Precision Thermometer	Sn #0077	-
	Sw #6345	

Table 5.3: Sensor configuration (conf2) of the Polarstern CTD/Rosette system. Changed sensors are highlighted in red.

Sensor	Primary	Secondary
SBE3 Temperature sensor	sn #1338	sn #1374
	sw #5842	sw #5844
SBE4 Conductivity sensor	sn #3173	sn #3590
	sw #5865	sw #5879
SBE43 Oxygen sensor	sn #1834	sn #0467
	sw #5883	sw #5880
SBE9+ Pressure sensor	**sn #0935**	-
	tbd	
Turner Cyclops Rhodamine Fluorometer	**sn #216K00138**	-
	tbd	
Altimeter	sn 47768	-
	sw #5900	
WET Labs C-Star Transmissometer	sn #1198	-
	sw #4126	
Satlantics SUNA Nitrate sensor	sn #1318	-
	sw #4998	
WET Labs ECO-AFL/FL Chl-a Fluorometer	sn #1853	-
	sw #4125	
Biospherical/Licor PAR/Irradiance sensor	sn #70257	-
	sw #5920	
WET Labs ECO CDOM CDOM Fluorometer	sn #4531	-
	sw #5911	
Biospherical/Licor Surface PAR	Sn #20349	-
	Sw #5921	
SBE35 High Precision Thermometer	Sn #0077	-
	Sw #6345	

Table 5.4: Overview of ship CTD casts. Deep casts are indicated in bold, and were run without the SUNA nitrate sensor (depth rating 2000m).

Configuration 1 dship entry	Date	SUNA	Configuration 2 dship entry	Date	SUNA
PS122-5_59-149	20200829T16:00	n	**PS122-5_63-111**	20200928T10:18	n
PS122-5_59-138	20200819T12:17	n	**PS122-5_63-110**	20200928T09:53	n
PS122-5_59-72	20200818T06:23	y	**PS122-5_63-100**	20200927T19:43	n

PS122-5_59-62	20200817T14:21	y	**PS122-5_63-53**	20200925T09:08	n
			PS122-5_63-35	20200924T13:03	n
			PS122-5_62-91	20200917T06:56	n
(SBE9+ and rhodamine sensor exchange on 19/20 August 2020)			PS122-5_62-88	20200917T04:14	y
			PS122-5_62-66	20200916T04:08	y
			PS122-5_62-38	20200915T06:06	y
			PS122-5_62-4	20200914T04:16	n
			PS122-5_61-211	20200913T08:16	y
			PS122-5_61-189	20200912T04:03	y
			PS122-5_61-161	20200911T05:45	n
			PS122-5_61-159	20200911T03:58	y
			PS122-5_61-128	20200910T09:30	y
			PS122-5_60-89	20200904T04:02	y
			PS122-5_60-69	20200903T05:49	n
			PS122-5_60-67	20200903T03:57	y
			PS122-5_59-363	20200830T09:05	y
			PS122-5_59-357	20200829T04:39	y
			PS122-5_59-306	20200827T06:18	n
			PS122-5_59-305	20200827T04:23	y
			PS122-5_59-274	20200826T05:18	n
			PS122-5_59-272		y

The different configurations used are summarized in tables 5.2 and 5.3.

Deep CTD casts were carried out to ~10 m above the seafloor. The echosounder started to receive an echo at ~40 m above the seafloor. The actual depth was calculated using the echosounder and the computation was really accurate.

The water budget plan for the ship-based water samplings was prepared during leg 5 by team ECO, i.e., the team requesting the largest amount of seawater from the Polarstern CTD. Team OCEAN required water samples for salinity calibrations, as well as water samples for CFC/SF6, helium, tritium, and density.

It was Team OCEAN's responsibility to prepare and operate the CTD/Rosette system.

In total, 28 CTD casts were carried out from Polarstern, 13 of which were deep casts (see Table 5.4). Raw CTD data was processed following standard procedures (based on the SBE Data Processing software and automized by using Manage CTD). Data was copied to the MCS.

Salinometer measurements

During Leg 5 a total of 50 salinity samples were measured for calibration of the conductivity sensors on the CTD (Table 5.5). All the samples were taken from Niskin bottles fired at 1000 m and below, in order to provide as stable measurements as possible. In addition, replicates were sampled from each bottle, again to provide as little heterogeneity as possible. After flushing each sample bottle 3 times with the sea water from the Niskin bottle, the water was collected and the rubber lid attached carefully, as to not touch the inside of the lid nor the bottle. The bottles were then secured with an aluminium cap so that the rubber lid does not pop off and cause evaporation. In order to conserve Standard Sea Water (SSW) bottles, the samples were then stored until 10-20 samples had been collected. The day before the

samples were to be measured, they were placed in a water bath at 30 ˚C for 1 hour and then the rubber lid was punctured with a needle so that the samples would be degassed. Before the samples were measured, a standardization was made with SSW in order to calibrate the salinometer. The sample bottles were then vigorously shaken in order to homogenize the water inside and overcome any eventual stratification and then they were measured. After the samples had been measured the SSW was measured again to see if there was any difference between the SSW measurements.

Table 5.5. Overview of salinometry measurements. The columns show 1: associated CTD cast for each salinity sample, 2: the date of the cast and 3: the depth at which the salinity sample is taken from.

DShip entry	Date	Depth [m]
PS122-5_59-62	2020-08-17	1000
PS122-5_59-62	2020-08-17	1000
PS122-5_59-72	2020-08-18	1000
PS122-5_59-72	2020-08-18	1000
PS122-5_59-149	2020-08-19	4211
PS122-5_59-149	2020-08-19	4211
PS122-5_59-149	2020-08-19	3000
PS122-5_59-149	2020-08-19	3000
PS122-5_59-149	2020-08-19	2500
PS122-5_59-149	2020-08-19	2500
PS122-5_59-274	2020-08-26	3000
PS122-4_59-274	2020-08-26	3000
PS122-5_59-306	2020-08-27	4000
PS122-5_59-306	2020-08-27	4000
PS122-5_59-306	2020-08-27	2500
PS122-5_59-306	2020-08-27	2500
PS122-5_59-306	2020-08-27	2000
PS122-5_59-306	2020-08-27	2000
PS122-5_60-69	2020-09-03	4000
PS122-5_60-69	2020-09-03	4000
PS122-5_60-69	2020-09-03	2500
PS122-5_60-69	2020-09-03	2500
PS122-5_60-69	2020-09-03	2000
PS122-5_60-69	2020-09-03	2000
PS122-5_60-89	2020-09-04	2000
PS122-5_60-89	2020-09-04	2000
PS122-5_61-161	2020-09-11	4000
PS122-5_61-161	2020-09-11	4000
PS122-5_61-161	2020-09-11	2500
PS122-5_61-161	2020-09-11	2500
PS122-5_61-161	2020-09-11	2000
PS122-5_61-161	2020-09-11	2000
PS122-5_61-189	2020-09-12	2000
PS122-5_61-189	2020-09-12	2000
PS122-5_61-211	2020-09-13	2000

PS122-5_61-211	2020-09-13	2000
PS122-5_62-4	2020-09-14	4000
PS122-5_62-4	2020-09-14	4000
PS122-5_62-4	2020-09-14	2500
PS122-5_62-4	2020-09-14	2500
PS122-5_62-4	2020-09-14	2000
PS122-5_62-4	2020-09-14	2000
PS122-5_62-66	2020-09-16	2000
PS122-5_62-66	2020-09-16	2000
PS122-5_62-91	2020-09-17	4000
PS122-5_62-91	2020-09-17	4000
PS122-5_62-91	2020-09-17	2500
PS122-5_62-91	2020-09-17	2500
PS122-5_62-91	2020-09-17	2000
PS122-5_62-91	2020-09-17	2000

Sampling for CFC/SF6, Helium/Neon, and Tritium

During MOSAiC Leg 5 we collected 136 samples in total from the Polarstern CTD. All the laboratory installations for the sealing of the probes, thermostat, molecular sieve and gas cylinder, was already set up by leg 4 and worked fine for the entire leg 5. Our first water sampling station was a shallow cast during the transit to the floe on the 17th of August from Polarstern, followed by a second one, just two days of transit later at the Northpole. During this cast (PS122.5/59_149) the connection to the CTD was lost during the upcast at about 1100m (see section about the rhodamine sensor issue), therefore we couldn't collect any CFC and Helium samples from the upper water layers for this station.

After the arrival at the new floe the CFC/SF6 and Helium/Neon sampling was done once a week, according to the sampling strategy, beginning with station 59_306. Metal accessories for the CFC/SF6 ampoules were examined, cleaned and then stored in a bucket with fresh water after every cast. Helium/Neon probes were filled into labeled copper tubes and then sealed according to the instructions by the Handbook. The plastic tubes for filling the copper tubes were afterwards stored in a bucket with salt water until the next week. Tritium water samples were filled into labeled plastic bottles every second week. The cleaning of the heating spiral for the nitrogen was also done every second week, one day ahead of sampling.

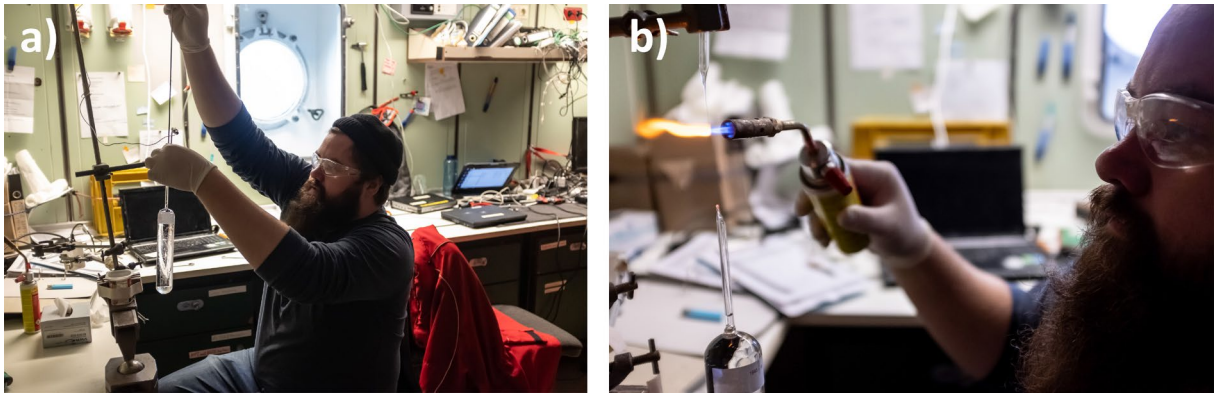


Figure 5.4: CFC sampling in Ocean Lab

Table 5.6 CTD stations with performing sampling during MOSAiC Leg 5

Station number	Date	Coordinates	CFC/SF6	He/Ne	Tr
59_62	17.08.2020	88˚17.940'N / 34˚38.980'W	×	×	×
59_149	19.08.2020	89˚59.735'N / Northpole	×	-	-
59_306	27.08.2020	87˚56.531'N / 107˚16.780'E	×	×	×
60_69	03.09.2020	88˚33.658'N / 119˚36.749'E	×	×	-
61_161	11.09.2020	88˚44.263'N / 104˚37.906'E	×	×	×
62_91	17.09.2020	89˚01.495'N / 108˚09.991'E	×	×	-

Table 5.7. Amount of samples collected during MOSAiC Leg 5

Sample	Amount of samples	Number of stations
CFC/SF6	78	
He/Ne	39	6
Tr	19	

In the end, we didn't have any complications with the laboratory installations, or the sampling in general, except for a few broken ampoules. For leg 5, the loss rate of CFC ampules is 9%, most of them due to a too tight bottle neck and a few probably during transport on the ship.

All collected samples will be sent to home institution for further processing. The samples will be analyzed with mass-spectrometer according to the priority list on the Oceanography Department of the University of Bremen. Snow samples for tritium probes should be done every second week according to the sampling strategy. No snow samples were taken during Leg 5.

Vessel-mounted Acoustic Doppler Current Profiler

Polarstern is equipped with a vessel-mounted Acoustic Doppler Current Profiler (VMADCP) to monitor underway ocean currents. The Ocean Surveyor instrument sends and receives sound near 150 kHz (beam angle 30 degree) below the ship's hull from which to estimate vertical profiles of horizontal ocean velocity. Velocity vectors are measured relative to the moving ship whose velocity vector must be removed in order to measure water currents. To estimate the ship's velocity over ground, the vessel's GPS system was used. Furthermore, pitch, roll, and heading data are converted from the NMEA string. Current speed data were collected in beam coordinates to apply corrections during post processing.

During leg 5 we used the same configuration for the VMADCP as used during MOSAiC leg 4. The instrument was configured in narrowband mode and set up to use 4 m bin size covering a range from 15 m to about 240 m (latter depending mainly on the backscatter signals during the time of the drift). The software VmDas (Teledyne RD Instruments) was used to set the ADCP's operating parameters and to record the data. We used a long-term averaged interval of 20 min and a short-term averaged interval of 5 min. The Ocean Surveyor data conversion was done using Matlab routines (osheader.m, osdatasip.m, osrefine.m) last changed by Gerd Krahmann in 2015 (OSSI19).

The VMADCP was operated continuously during Leg 5 of MOSAiC. The post-processing will be done using the SADCP software developed at GEOMAR Helmholtz Centre for Ocean Research Kiel with minor changes implemented at AWI.

T-POP deployment (PI: C. Heuze)

The T-POP is a football-sized autonomous temperature instrument that sits at the bottom of the ocean for a pre-set time, taking measurements every hour. It then automatically burns its anchoring link to float back to the surface and send its data by satellite. These sensors are part of the project "*Why is the deep Arctic Ocean Warming? (WAOW)*" of the University of Gothenburg. The aim is to quantify for the first time the high-frequency, seasonal, and interannual variability of the deep Arctic Ocean temperature. Team OCEAN had deployed four T-POPs (out of a total of ~25) in leg 5 (Table 5.8). Preparation was done by one person and deployment by two persons.

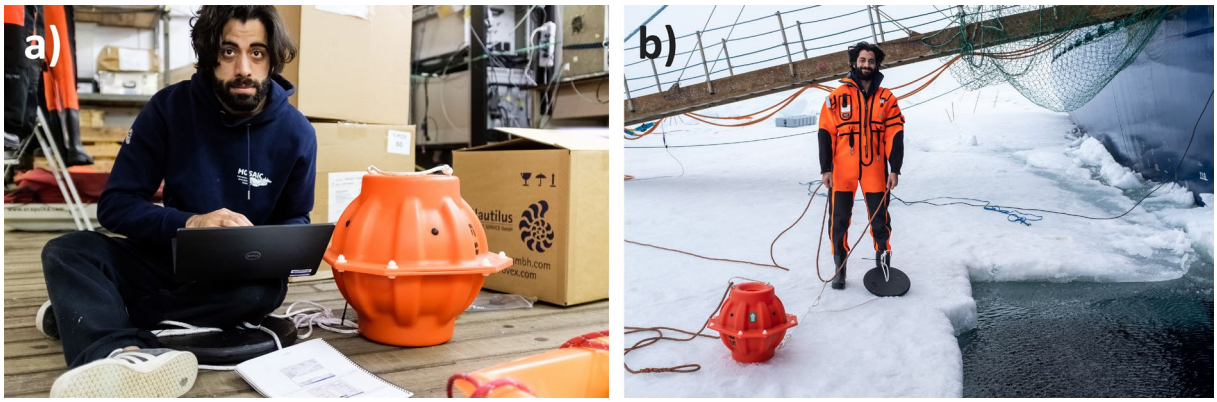


Figure 5.5: Preparation (a) and deployment of a T-POP in the CTD hydrohole (b).

Table 5.8. Overview of T-POP deployment

Dship-action	Timestamp	Latitude (deg)	Longitude (deg)
PS122/5_59-148	2020-08-19 15:40	89.992765	132.236841
PS122/5_59-285	2020-08-26 09:20	87.8377	105.002651
PS122/5_60-72	2020-09-03 09:49	88.585873	120.029879
PS122/5_61-165	2020-09-11 09:40	88.741973	104.215916

Work on the MOSAiC floe during the Leg 5 ice camp (Central Observatory)

Map of Ocean sites

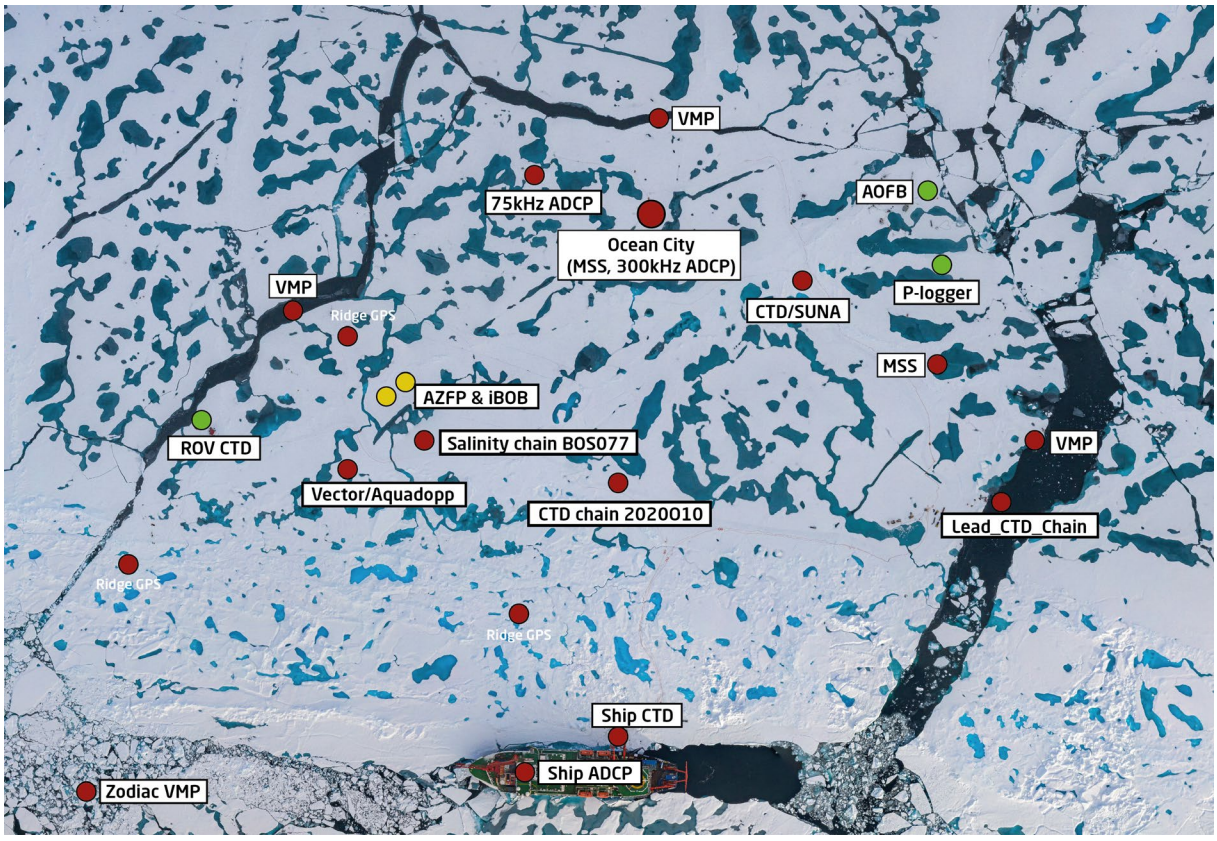


Figure 5.6: Map of ice camp and indication of sites relevant to the work of Team OCEAN. In red the main installations from team Ocean and in Blue installations that were deployed in collaboration with other teams.

Ocean City (OC) – devices, power supply, and final dismantling

Ocean City in leg 5 was set up light as the duration of the camp was short (about 4 weeks). We decided to not reinstall the weatherhaven and to not run the Ocean City CTD. We drilled a hole of about 1m x 0.8m to accommodate both the MSS and the 300kHz ADCP. It was located in an area of level ice, about 1.30 m ice thickness and about 300 m away from the ship. The first location chosen was about 350 m away from the ship, but due to a crack in the logistic area Polarstern had to relocate closer to Ocean City (about 300 m away). To protect the electronics from rain/snow and to protect from the wind, an Eskimo pop-up tent was set up. We could have accommodated a heater in the tent but as the temperature did not drop very low during our leg, we chose rather to not heat the tent and bring the MSS every night on board.

The first couple of weeks were still in the melting season so no hole maintenance was needed. In the last two weeks, the freezing started and some hole maintenance was needed at the surface. Edge maintenance was never needed.

Figure 5.7: Location of Ocean City during the Leg 5 ice camp

During the entire duration of leg 5, work in the OC tent was possible every day.

Power to Ocean City was supplied via one of the main power lines from Polarstern. The overall power distribution was set up as follows: 3 main power lines were running from the starboard side of Polarstern to the main power hub in the log area. From there power was distributed to the different “cities” inside the Central Observatory with one power line running to the Ocean City power hub. During our leg power was continuously supplied without major interruptions. The power was cut three times only for a couple of hours each: twice because of the presence of a polar bear on the camp, and once because of power cut on board.

Microstructure measurements

<u>Meltpond close to Ocean City site</u>

The first day (22nd August), because of a dynamic floe with crack developing next to the ship, we did not start setting up the camp. Instead, we found a meltpond that went through next to the edge, and did some MSS profiling there. The same meltpond was used for VMP profiling the next day (23rd August), before a lead opened in the central observatory next to remote sensing.

<u>Microstructure profiling at Ocean City</u>

During MOSAiC Leg 5, the microstructure turbulence profiler MSS 90L 091 was used to perform measurements of microstructure temperature, salinity, velocity shear, oxygen, and chlorophyll-a concentrations.

Profiling was performed in Ocean City. Because the tent where we operated the MSS was not heated, we always took the microstructure profiler back on board Polarstern overnight. We followed the procedure used in all the different legs during the deployment of the

microstructure profiler. We did at least 3 profiles during one station. Observations cover a depth range between 1 and 420 meters. The mean vertical sinking velocity was around 0.5 m/s.

Intensive Observation Period (IOP)

Two Intensive Observations periods were conducted at the floe, with continuous sampling for 36h of MSS. Team ECO also sampled continuously in the same period at Eco Lodge that was installed next to Ocean City. Both events were associated with a high wind event. The first one took place 06-07 September 2020 (Dship:60-248), and the second one 14-15 September 2020 (Dship: 61-159). During both events, we tried to also run the nitrate profiler as much as possible to get in the end nitrate fluxes. Unfortunately during the first IOP the SUNA was not working as it ran out of batteries. More information about these intensive observation periods can be found in the corresponding cross-cutting section.

Microstructure profiling during transit stations

Three ice stations were performed during the transit on the way back. During 2 of these stations we deployed the MSS from a lead at about 400 m away from the ship. We did not deploy it during the last station as the MSS winch was not working anymore.

MSS issues and troubleshooting

On the 29th of August, the MSS stopped communicating and the deck unit lost power while we were pulling the profiler up. We brought the winch, the deck unit and the instrument back to the ship to try to troubleshoot it. We found that the cable had internal damage at about 100m from the termination. We therefore cut the cable and redid the termination. Hence, for the rest of the ice camp, we ran the MSS with about 330m of cable.

From the end of Leg 4 onwards, the MSS091 had issues with the tilt and oxygen sensors. After correspondence with the Leg 4 team, we decided to not troubleshoot these issues right away because the sensors were not critical to our program and we did not want to risk further damage to the instrument. However, on 09 September, we decided to partially open the instrument to take a look at the faulty components. We couldn't find any obvious issues with the tilt sensor, and did not undertake any further steps to fix it. We then investigated all components of the optical oxygen sensor, and after a cleaning of the sensor head with the fiber optic part, the sensor started working again. For reasons unknown to us, the sensor stopped working again a few days later and we were not able to fix this issue.

On the 15th of September, the MSS stopped transmitting data on the way up again. After troubleshooting the entire setup, no damage could be found on either the cable or the instrument. The setup was working during further bench tests. However, when trying again to operate it on the ice, we again found that the instrument lost power as soon as the winch was operated. We ran the instrument by hand, which partly worked, but the cable got twisted and the instrument was sometimes not free falling. As a consequence, for the next ice station we replaced the entire winch cable and connectors on both ends, and a bench test was again ok. However, during the next ice station, the system still did not work properly, and we did not have any more time to fix this issue. It is likely that the friction rings within the winch motor might have a problem, which needs to be sorted out by the manufacturer.

We encountered a few more minor problems with the MSS software, the GPS and MSS USB cables (being rusty) and the USB ports of the 2 main PCs (also not being in a good shape any more). Given the numerous issues with the present system, we recommend a complete maintenance before further usage.

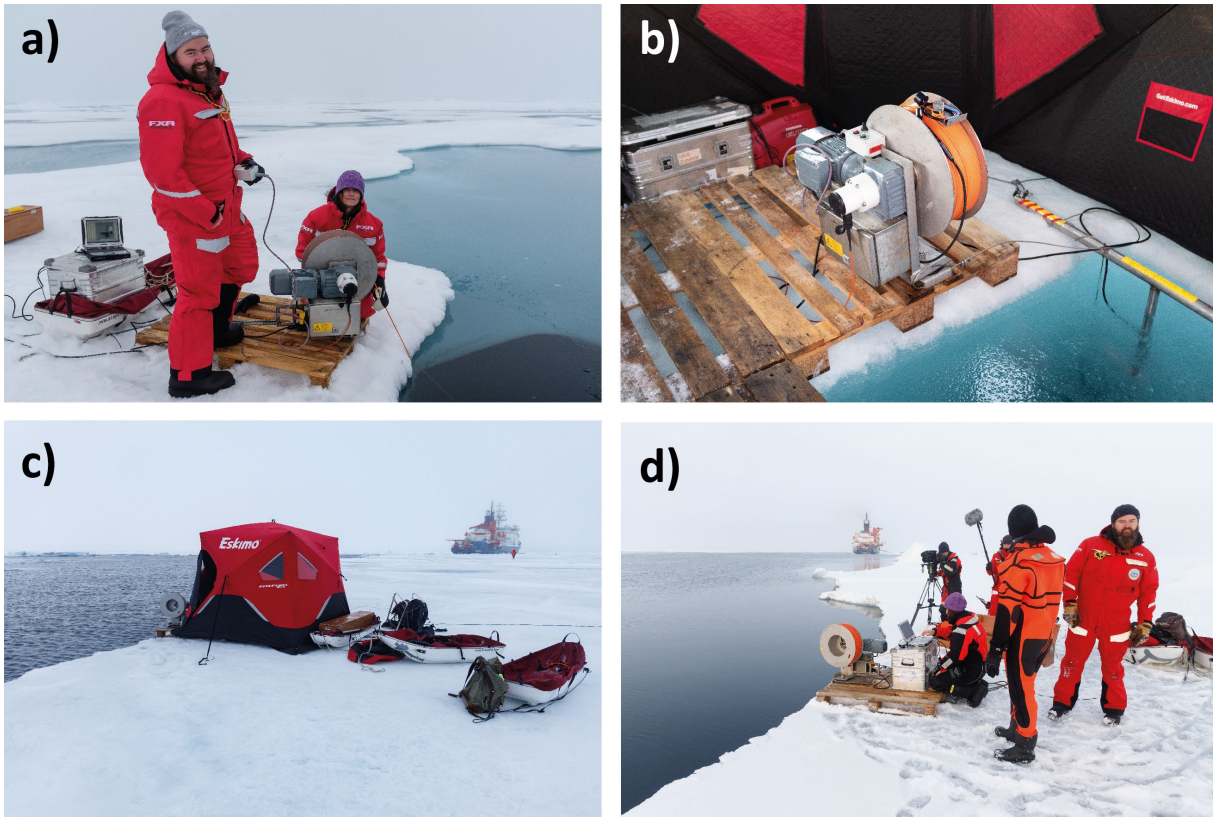


Figure 5.8: Microstructure profiling setup in meltpond (a), Ocean City (b) and during two transit ice stations (c,d).

Table 5.9: Overview of MSS casts during Leg 5

Date	Time start	Time end	Profiles	Depth	Location	Dship
20200822	12:06	15:41	8	400	Melt pond	PS122/5_59-201
20200825	08:34	12:11	11	400	Ocean city	PS122/5_59-282
20200826	10:52	12:04	4	400	Ocean City	PS122/5_59-299
20200828	06:52	08:21	5		Ocean City	PS122/5_59-383
20200829	06:54	11:48	8		Ocean City	PS122/5_59-384
20200831	10:13	14:04	7		Ocean City	PS122/5_60-40
20200901	04:41	07:40	9		Ocean City	PS122/5_60-41
20200902	04:37	11:28	13		Ocean City	PS122/5_60-87
20200903	04:51	11:20	14		Ocean City	PS122/5_60-88
20200904	05:03	16:24	10		Ocean City	PS122/5_60-246
20200905	04:37	13:59	22		Ocean City	PS122/5_60-247
20200906	09:43		43		Ocean City	PS122/5_60-248
20200907		18:21	55		Ocean City	PS122/5_60-248
20200908	09:06	11:56	10		Ocean City	PS122/5_61-112
20200909	04:54	11:27	13		Ocean City	PS122/5_61-113
20200910	05:00	06:15	3		Ocean City	PS122/5_61-182
20200911	05:27	11:47	13		Ocean City	PS122/5_61-183
20200912	04:51	05:43	4		Ocean City	PS122/5_61-247
20200913	10:51	11:54	5		Ocean City	PS122/5_61-248
20200914	04:56		57		Ocean City	PS122/5_61-159
20200915		09:27	26		Ocean City	PS122/5_62-159

20200917	07:50	08:11	2	Ocean City	PS122/5_62-160
20200918	08:49	09:40	3	Ocean City	PS122/5_62-161
20200924	07:00	10:00	7	Transit/Open Lead	PS122/5_63-36
20200926	06:00	10:00	6	Transit/Open Lead	PS122/5_63-81
Total			358		

Current profiler at Ocean City

Following up on the measurements installed during leg 4, a 300 kHz ADCP was mounted temporarily in the Ocean City hydrohole in order to record data of currents and turbulence in the mixed layer concurrently (Figure 5.9). The device was mounted in a steel frame that kept the heading of the ADCP fixed relative to the heading of the floe. The ADCP gathered reliable data in the upper 50 m and was deployed in the hydrohole nearly the entire time. Further gaps in the time series were caused by gaps in the power supply and during times when we changed the memory cards (once every second week). We miss about 15h of data on the 14th of September as the memory card was full.

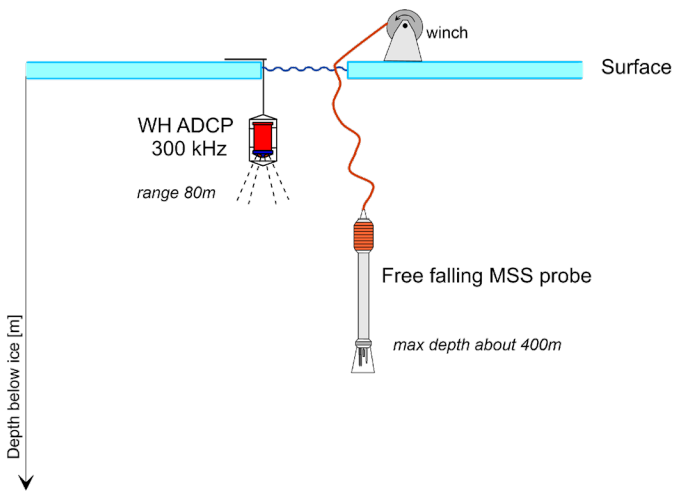


Figure 5.9: Left: Sketch of concurrent measurements from the MSS profiler and ADCP in Ocean City ice hole.

Microstructure profiling with VMP250 Upriser

In total, we collected 113 profiles with VMP250 Upriser during 21 stations (Table 5.10) as a part of the AROMA project from University of Bergen. The aim with using the uprising vertical microstructure profiler was to record dissipation rates of turbulent kinetic energy in the upper 80 m up to the ice-water interface in order to resolve the under-ice boundary layer and to better quantify the ocean heat fluxes in the upper water column.

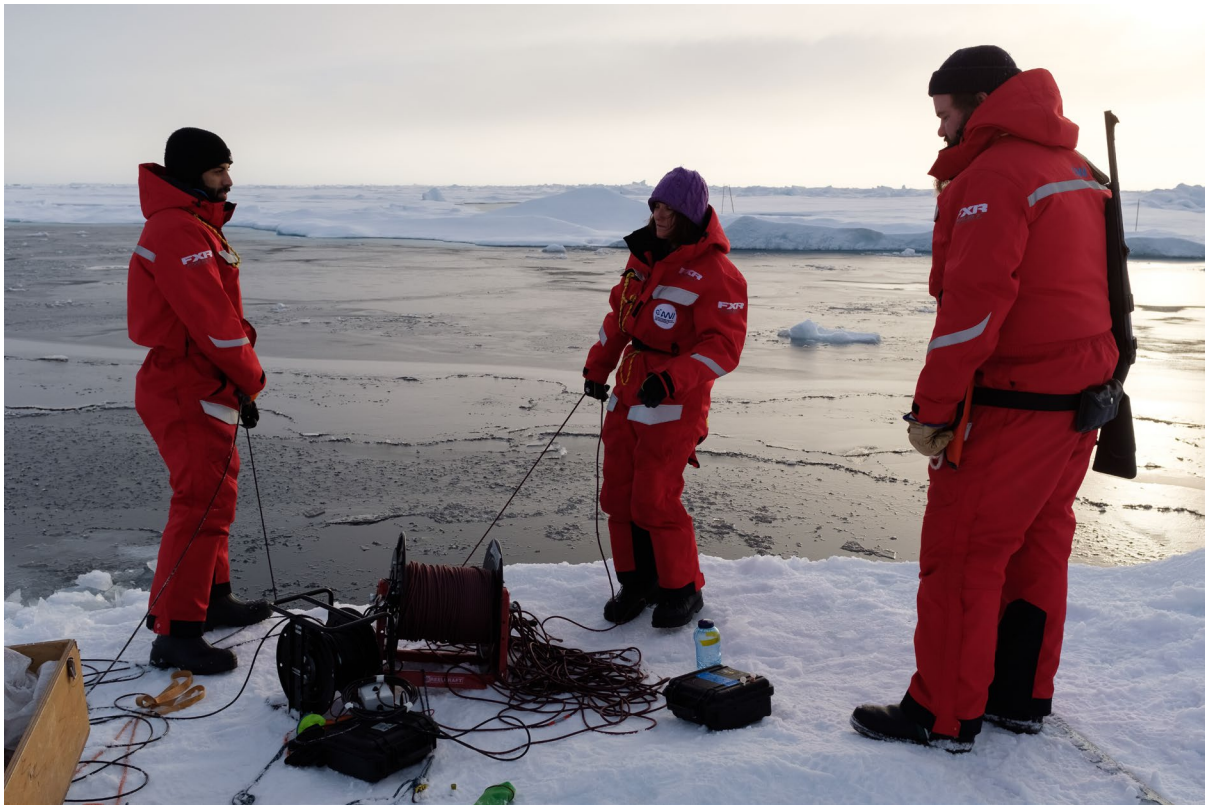


Figure 5.10: VMP profiling in a refreezing lead

Following the recommendations from leg4, we did not deploy the VMP from ocean city as the ADCP300 in the hydrohole was a danger for the sensors of the VMP. We deployed it in different leads, from ice, from a zodiac (twice) and from a catamaran (once). We ran the VMP when the drift was not too fast (less than 0.6 knots). We ran it with 4 brushes leading to a rising speed of about 0.6m/s. During each deployment, we lowered the instrument to about 80m depth and waited at least 5 minutes after lowering the VMP and before releasing it to rise under the ice surface in order to avoid an artificially increased turbulence signal generated by the device itself. We aim for at least 3 good casts per set. We got only a few entanglement resulting in a high ratio of good profiles.

Unfortunately, sensors broke in the previous legs and we did not have any microconductivity sensor left at the beginning of leg 5. Also, we ran out of temperature and shear sensor relatively quickly, so most of the measurements were performed with only one shear sensor. On the 29.08.2020 after the replacement of both shear sensors, one cavity where the sensors are located got flooded as a sensor was loose. In the evening, we opened all the probe holders and changed all the o-rings that were quite worned out.

The deployment of the VMP was part of the cross-cutting activity of lead sampling, performed intensively with EOC and BGC during leg 5 (see special section for more details).

Table 5.10. VMP250 Upriser stations during MOSAiC Leg 5.

Station number	Date	Coordinates	Max. depth, m	Number of profiles	Location
59-245	23.08.2020	87°45.072N 105°48.425E	80	7	Ocean Meltpond
59-275	25.08.2020	87°46.794N 104°34.028E	80	7	RS Lead
59-325	27.08.2020	87°56.675	80	7	RS Lead

		107°27.261E			
59-380	28.08.2020	88°01.507N 108°40.599E	80	5	RS Lead
59-381	29.08.2020	88°06.296N 109°27.428E	80	7	RS Lead
59-382	30.08.2020	88°13.529N 112°06.113E	80	6	RS Lead
60-36	31.08.2020	88°17.528N 114°05.914E	80	2	RS Lead
60-37	01.09.2020	88°20.960N 115°23.932E	80	7	RS Lead
60-85	02.09.2020	88°26.040N 117°34.250E	80	6	ROV Lead
60-218	04.09.2020	88°42.868N 120°49.603E	80	6	ROV Lead
60-219	05.09.2020	88°45.019N 119°27.647E	80	5	ROV Lead
60-220	06.09.2020	88°44.493N 118°15.382E	80	5	OC Lead
61-24	07.09.2020	88°42.273N 111°58.292E	80	6	OC Lead
60-179	08.09.2020	88°40.778N 112°57.343E	80	5	OC Lead
60-180	09.09.2020	88°43.677N 112°05.888E	80	4	OC Lead
60-181	11.09.2020	88°44.125N 104°41.314E	80	5	OC Lead
60-245	12.09.2020	88°46.293N 101°20.940E	80	6	OC Lead
60-246	13.09.2020	88°51.569N 97°20.661E	80	3	OC Lead
60-110	15.09.2020	89°03.912N 107°48.929E	80	6	Ship Lead
60-112	16.09.2020	89°05.430N 108°49.784E	80	3	Ship Lead
60-113	17.09.2020	89°01.017N 107°43.262E	80	5	Ship Lead

UiB ADCP Longranger mooring

The UiB 75kHz ADCP was deployed on 26 August 2020 at a distance of about 50 m from Ocean City, with power supply and data connection using the Ocean City power hub. The ADCP was deployed in between meltponds, on an ice thickness of about 1.30m. A glasfiber cable ensured continuous data downloads from the 75 kHz ADCP on board Polarstern. The ADCP was deployed using a snow machine. During the deployment, one strap was left on the frame of the ADCP. This strap allowed us to recover the ADCP using also a snow

machine. To ease the recovery, we maintained the hole open during the entire duration of the camp. The ADCP was deployed using a similar setup as during leg1 (RDI75_single_ping.txt).

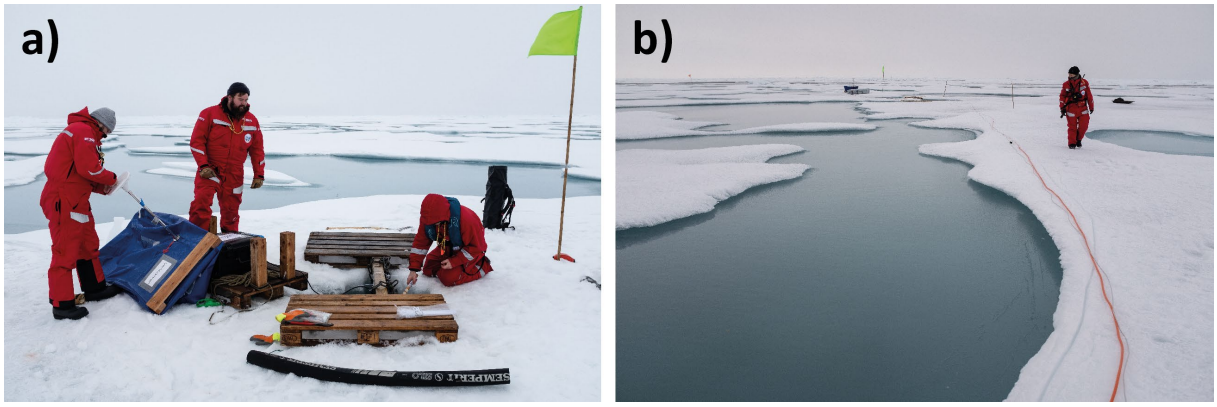


Figure 5.11: a) Installation of UiB Longranger ADCP. b) View of ADCP location from Ocean City.

Deployment of Vector EC instrument and Aquadopp at ridge site

In collaboration with the University of Hokkaido, Tokyo (Y. Kawaguchi), a turbulence system consisting of a Nortek Vector Eddy covariance system and a Nortek Aquadopp ADCP were deployed close to the main ridge on 28 August 2020 (9:45 UTC). A slave fast T and DO sensor was also connected to the Nortek Vector Eddy covariance instrument. Both instruments were set up on two different tripods in the same hole (see picture). The hole was maintained open to ease recovery. Buoyancy was attached to both tripods.

Data were retrieved on 3 occasions during the drift. After the first download of the data, we noticed that the fast T and DO sensor did not collect data, so we try to change the configuration file. After 2 attempts, it was still not working and to our knowledge no data was collected from this instrument. Both instruments were recovered on 19 September.

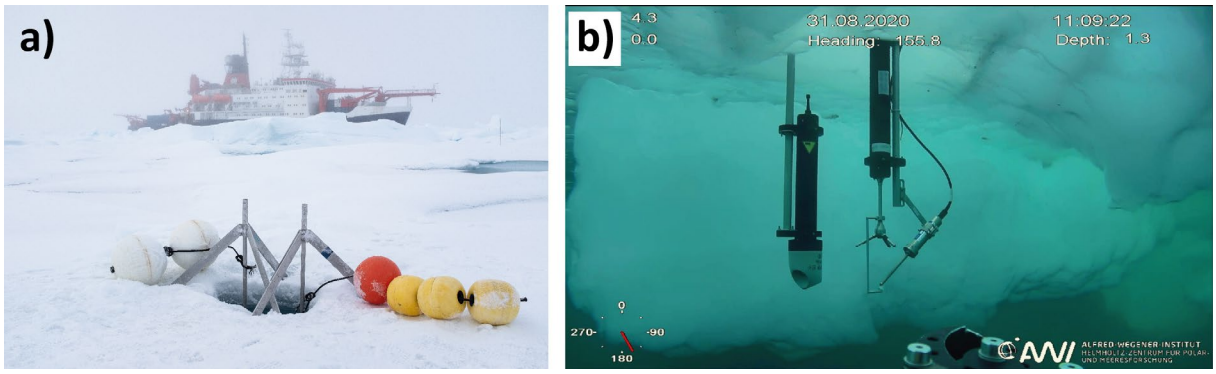


Figure 5.12: Above (a) and ROV under-ice picture (b) of Vector EC (left in pictures) and Aquadopp (right) deployment close to main ridge.

In order to determine ridge dynamics as a complement to the current turbulence measurements, 3 Marlin Yug Iridium IceST/20 GPS tracker buoys were deployed in a triangle around the Vector EC/Aquadopp systems, at a distance of about 80-90 m. Two were placed in the main ridge, and one close to the main buoy site (see map).

Figure 5.13: Deployment of the 3 MY GPS buoys as part of ridge dynamics triangle: a) GPS_MY_5460, b) GPS_MY_5610, c) GPS_MY_5620)

Table 5.11: GPS buoy triangle around EC/Aquadopp system

Shortname	IMEI	Deployment time	Location	Dship
GPS_MY_5460	300234061165460	02.09.2020 12:10	Ridge close to ROV	PS122/5_58-70
GPS_MY_5610	300234061165610	02.09.2020 12:00	Buoy site	PS122/5_58-69
GPS_MY_5620	300234061165620	02.09.2020 11:45	Middle of ridge	PS122/5_58-68

Lead CTD chain deployment

In order to characterize the properties of the upper water column within a freezing lead, 4 SBE37IMP microcats were installed on a rope attached to a floatation, and placed at the edge of the newly formed lead appr. 100 m from the Remote Sensing site on 31 August 2020 (8:30 UTC). The instruments were placed at depths of 1, 2, 4 and 8 m, and configured to record data every 60 seconds. This so-called “Lead CTD chain” had to be relocated on 06 September 2020 (11:30 UTC) to avoid the loss of the instruments because the lead was subsequently closing and danger of ridge formation was imminent. The new location was right next to the Remote Sensing site, appr. 100 m from the old location, and the lead width was 30 m (with a 2 m wide opening in the middle). The pontoon was recovered on 19 September.

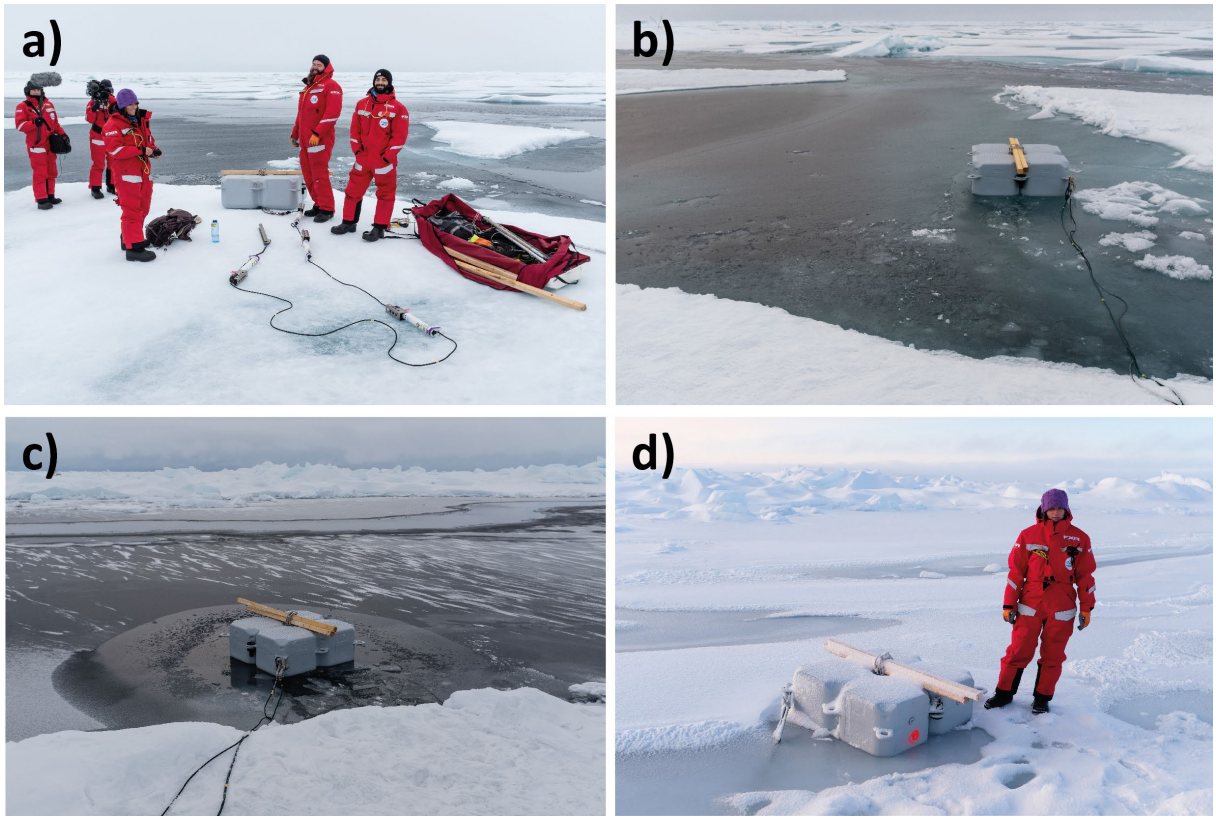


Figure 5.14: Initial deployment of CTD chain (4 x SBE37IMP) on 31 August 2020 (a) and condition of the site on 03 September 2020 (b). The lead kept closing until the instruments were relocated to a new lead site right next to the Remote Sensing site on 06 September 2020 (c). The instruments were recovered on 19 September 2020 (d).

Table 5.12: Components of lead CTD chain (Shortname lead_CTD_chain, Dship action log PS122/58-153)

Instrument	Depth	Serial No	Pressure sensor depth rating
SBE37IMP	1 m	37-21100	100 m
SBE37IMP	2 m	37-21103	100 m
SBE37IMP	4 m	37-21104	100 m
SBE37IMP	8 m	37-21084	1000 m

Nitrate profiling system close to Ocean City and nutrient sampling

In order to complement the turbulence measurements obtained by the microstructure profiling in Ocean City, we set up a measurement platform consisting of an RBR Concerto CTD (Shortname ctd_rbr_60547) set to a measurement frequency of 2 Hz, along with a SUNA optical nitrate sensor (Shortname SIO_SUNA_1) equipped with an external battery pack. The configuration of the SUNA was the same as the one on the ship CTD. The instruments were attached to a sensor frame with additional floatation, attached to a 100 m Kevlar rope and running through a tripod anchored to the sea ice. The frame was opportunistically lowered to 100 m depth, and subsequently pulled up again whenever there was time and personnel available in parallel to any MSS casts. The platform was installed on the main road close to the Met City junction, appr. 100 m from Ocean City. Whenever the instruments were not being profiled, they were fixed within the mixed layer, at a depth of appr. 15-20 m. Dship action log ID is PS122-5_58-124. In order to calibrate the sensors, water samples for nutrients were collected 3 times (Dhsip ID: PS122/5_60-298 on

01.09.2020; PS122/5_60-299 on 05.09.2020; PS122/5_59-502 on 29.08.2020). SUNA did not record between 05.09.2020 and 09.09.2020 due to power failure (empty batteries).

Table 5.13: Nitrate profiler overview

Instrument	Shortname	Serial No	Deployment	Profiles
RBR Concerto CTD	ctd_rbr_60547	60547	02.09.2020 9:00 UTC	153
SUNA Deep nitrate sensor	SIO_SUNA_1	732	02.09.2020 9:00 UTC	90

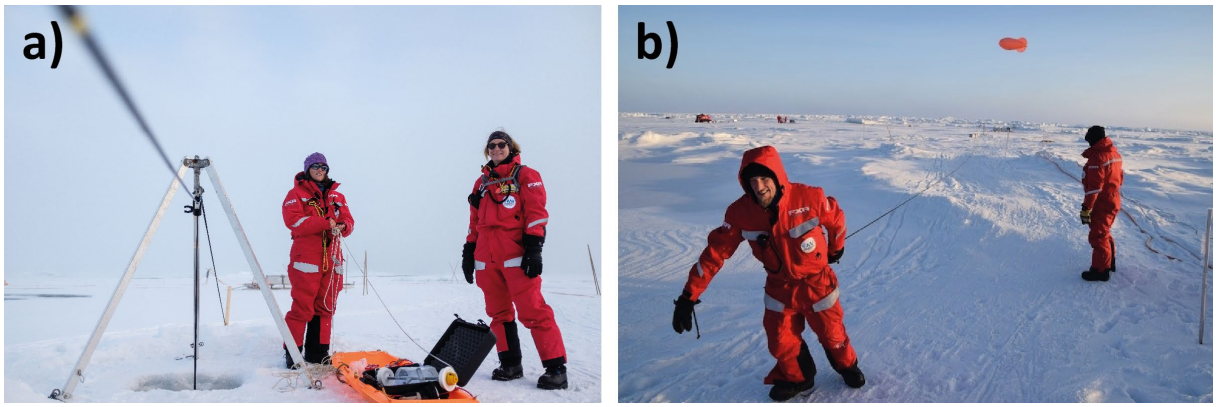


Figure 5.15: Nitrate profiling system setup (a) and operation (b). The sled in a) comprises components for the in-situ nutrient sampling.

Deployment of iridium CTD chain buoy 2020O10

An iridium CTD chain buoy (shortname: 2020O10, Dship action log PS122/5_58-94) consisting of 5 SBE37IMP microcats operated on a 100 m long inductive modem tether (Pacific Gyre, California, US) was deployed close to the logistics area on the main road between the Remote Sensing site and ROV Oasis on 28 August 2020 (10:45 UTC). The CTDs were installed at 10, 25, 50, 75 and 100 m along the inductive modem tether. The distance to both the ship and Ocean City was ~150 m. The internal recording interval of the CTDs was configured to 2 minutes, and the transmission interval of the iridium surface unit was set to 10 minutes. Ice thickness was 1.55 m. Due to its iridium data transmission capabilities, the buoy remained on the ice floe after Polarstern had left, providing the evolution of water column properties of the central Arctic Ocean even beyond the end of the MOSAiC campaign.

Table 5.14: Components of buoy 2020O10 (Manufacturer ID AWI-SVP5S-0001, IMEI 300234068066320, Shortname 2020O10, Dship action log PS122/5_58-94)

Instrument	Depth	Serial No	Pressure sensor depth rating
SBE37IMP	10 m	37-21089	100 m
SBE37IMP	20 m	37-21090	100 m
SBE37IMP	50 m	37-21091	100 m
SBE37IMP	75 m	37-21092	100 m
SBE37IMP	100 m	37-21082	1000 m

Figure 5.16: CTD chain buoy 2020O10

Deployment of BOS077 salinity chain

A salinity chain prototype (manufactured by Bruncin, Zagreb, Croatia) consisting of 3 Solumetrix BKIN50 conductivity cells installed on a 45 m long cable was deployed on the main road between the coring triangle and the buoy site on 28 August 2020 (12:00 UTC). The sensors were attached at depths of 10, 25 and 45 m. The instrument was also equipped with a GPS receiver, internal humidity & temperature sensors, as well as an atmospheric pressure sensor. Data of all sensors was recorded hourly. The instrument (shortname: BOS077, Dship action log PS122/5_58-154) was retrieved on 19 September 2020, prior to leaving the camp. The main purpose of this deployment was a field test, and a comparison to standard instruments from RBR and Seabird is planned. The Solumetrix conductivity cells are more affordable compared to these other sensors, and the potential of this new development needs to be assessed.

AZFP and iBOB buoy deployment

On 12 September 2020 (6:45 UTC), a buoy equipped with an Acoustic Zooplankton Fish Profiler (ASL, Halifax, Canada) and a suite of other sensors (see Table 5.15) was co-installed with a second buoy (see below) on level FYI (ice thickness: 1.3 m) close to the main buoy site. Both buoys were transported to the site via helicopter sling load.

The buoy transmits its data via iridium, and stayed behind on the ice floe even beyond the Polarstern drift to continuously record a suite of parameters at a regular interval. The buoy is powered by alkaline batteries complemented by a second, solar-rechargeable power supply.

Measurement intervals for most parameters were every 10 min or hourly for summer and winter, respectively. AZFP intervals were 20 minutes or every 2 hours for summer and winter, respectively. Webcam images are transmitted every 6 hours (except during polar night).

Table 5.15: AZFP buoy sensor overview

Parameter	Sensor Model
GPS position	Garmin 18x
Atmospheric pressure	Bosch B280
Air temperature	Honeywell
AZFP parameters	ASL AZFP
Chl-a fluorescence	Turner Cyclops
Salinity (under ice)	Solumetrix BKIN50
Incoming PAR	Apogee
Inner buoy temperature, humidity	Bruncin
Battery voltage/current, CPU load	Bruncin
Camera (air)	Bruncin
Camera (underwater)	Bruncin

The AZFP buoy was co-deployed with an ice-tethered bio-optical buoy (iBOB) equipped with a large suite of sensors measuring complementary parameters (see Table 5.16). The iBOB was deployed at a distance of 10 m from the AZFP buoy. Ice thickness was around 1.5 m, and was variable at that particular location (some rafted floes were observed underneath). The Solumetrix BKIN50 conductivity cell was installed very close to the ice/water interface. A Seabird SBE37SIP CTD, an Aanderaa oxygen optode and a Wetlabs Eco Triplet-W were installed on a short tether appr. 1 m, 1.6 m and 1.8 m below the ice bottom, respectively. An L-arm carrying a TriOS RAMSES ACC-VIS spectral radiometer with inclination/pressure sensors was mounted appr. 2 m below the ice bottom. A TriOS RAMSES ACC-VIS to measure the incoming irradiance as a reference was mounted on top of the glass dome.

A set of 7 ablation stakes was drilled into the nearby sea ice in the field of view of both cameras as a reference for surface ablation in the next summer season.

Table 5.16: Ice-Tethered Bio-Optical Buoy (iBOB) sensor overview

Parameter	Sensor Model
GPS position	Garmin 18x
Atmospheric pressure	Bosch B280
Air temperature	Honeywell
Spectral irradiance (air: up)	TriOS RAMSES ACC-VIS
Spectral irradiance, tilt, pressure (under ice: up)	TriOS RAMSES ACC-VIS with inclination/pressure
700nm backscatter	Wetlabs Eco Triplet-W
Chl-a fluorescence	Wetlabs Eco Triplet-W
CDOM fluorescence	Wetlabs Eco Triplet-W
Dissolved oxygen	Aanderaa 4330SW
Salinity (under ice) at 2m	Solumetrix BKIN50
Seawater temperature, salinity, pressure	Seabird SBE 37 CTD
Inner buoy temperature, humidity	Bruncin
Battery voltage/current, CPU load	Bruncin
Camera (air)	Bruncin
Camera (underwater)	

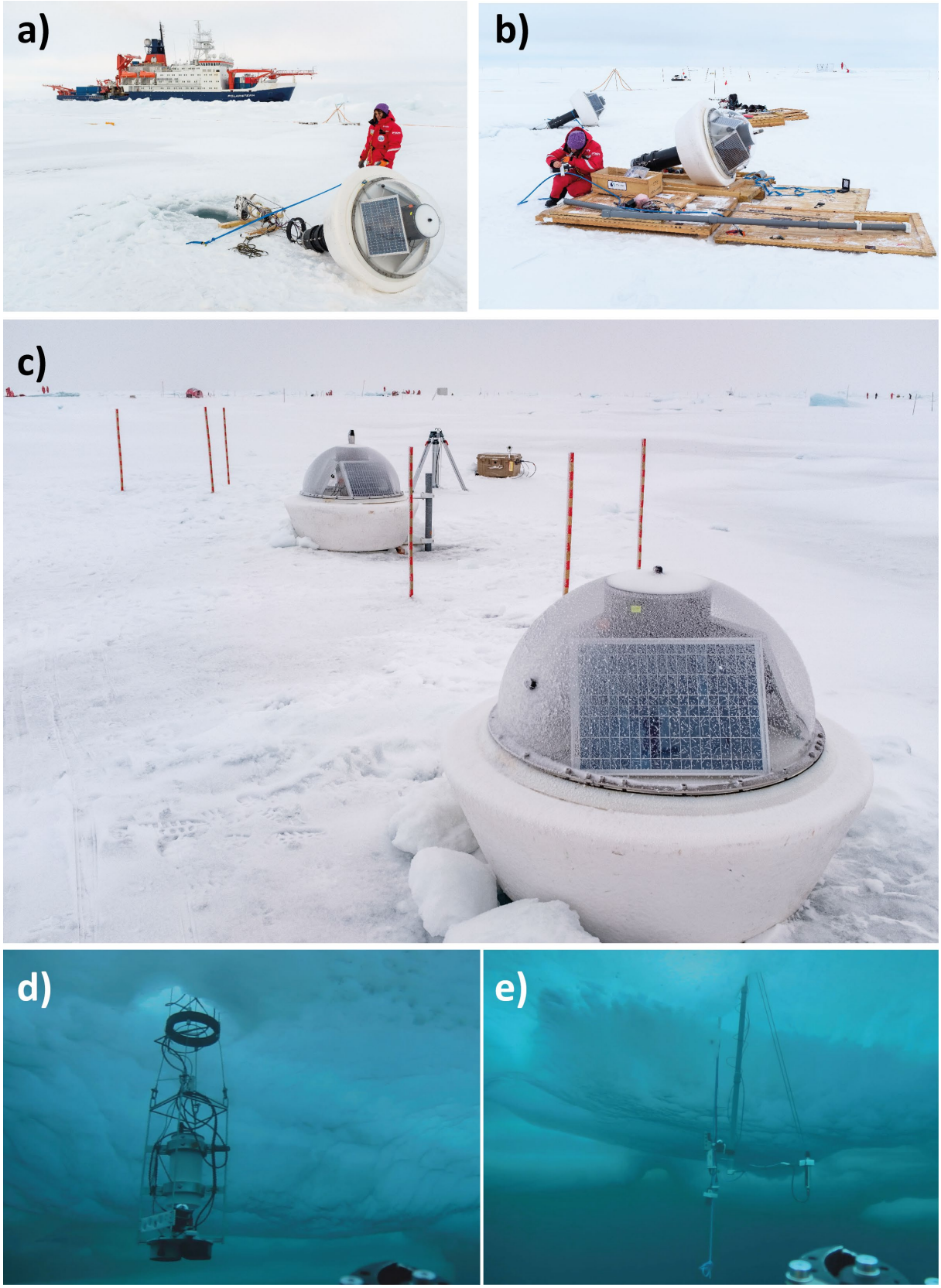


Figure 5.17: Deployment of AZFP (a) and iBOB (b), final installation including stakes and IMB 2020M23 (c), AZFP underwater unit (d) and iBOB underwater components (e).

AOFB deployment in MetCity

During the period after MOSAiC Leg 4, Polarstern recovered many critical instruments remaining in the distributed network. The NPS AOFB deployed at L2 was recovered and brought on board to be utilized at the new MOSAiC floe. Before re-deployment, the instrument was inspected and repaired on board by M. Gallagher. The ADCP was found flooded, likely at the initial L2 deployment, and was removed before redeployment. The vertical carriage was found corroded and was disassembled, cleaned, and re-assembled. The upwards-facing radiometer was found cracked and was sealed with epoxy. The AOFB was re-deployed roughly 20 meters ship-side of the 10m tower at Leg 5 met city on August 30th at 11:00 UTC. It was reported that the flux package was operational and taking data but was unable to travel in the vertical. Several attempts were made to remove and repair the AOFB but were unsuccessful. The AOFB remains permanently installed at the Leg 5 met city location and will report fluxes via iridium at a stationary depth of approximately 1.5 meters.

Figure 5.18: Deployment of the AOFB

T/p sensor deployment in Fibertown

On 26 August 2020, an RBRduet bathythermograph (shortname: rbr_duet_td_85201) was co-deployed with a Silixa XT-DTS ruggedised distributed temperature sensor for measuring the ocean temperatures along an optical fibre cable (shortname: S_XT_SN19076). See Team ATMOS chapter for details on the latter instrument. The RBRduet was attached to the bottom of the glass fibre cable in order to determine the influence of ocean currents to the alignment of the cable in the water. The RBRduet was configured to measure pressure and temperature at 1s intervals. The instrument was retrieved together with the Silixa unit on 18 September 2020.

Operation of a small ("fishing rod") CTD at different locations on the MOSAiC floe

During MOSAiC Leg 5, we used a SST 48M CTD (by Sea&Sun Technology) for 3 main tasks: (1) complement the ship CTD when it was not running because the hydrohole could not be used (2) measure the hydrographic properties of the freshwater lens observed early on in Leg 5, and (3) investigation of ocean circulation during lead events. We used the sensor with serial number 1459.

Table 5.17. Overview of fishing rod CTD deployments.

Location	Deployment date	DShip entry
Ocean City	2020/08/24	PS122-5_59-254
RS Lead	2020/08/24	PS122-5_59-255
RS Lead	2020/08/25	PS122-5_59-277

RS Lead	2020/08/31	PS122-5_60-38
RS Lead	2020/09/01	PS122-5_60-39
ROV Lead	2020/09/02	PS122-5_60-86
ROV Lead	2020/09/04	PS122-5_60-249
Ocean City Lead	2020/09/05	PS122-5_60-250
Ocean City Lead	2020/09/06	PS122-5_60-251
Ocean City Lead	2020/09/07	PS122-5_61-115
Ocean City Lead	2020/09/08	PS122-5_61-276
Ocean City Lead	2020/09/09	PS122-5_61-277

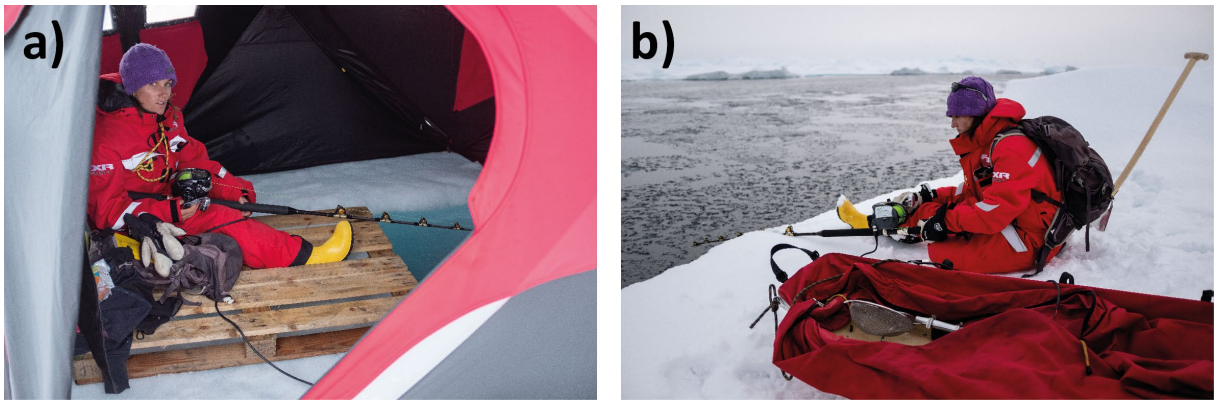


Figure 5.19. a) Fishing rod CTD deployment in Ocean City. b) Deployment in lead.

The deployment procedure is described in cruise report of Leg 2. One buoyancy ring was attached to the CTD. We chose the continuous mode of the recording with ca. 1 second time interval. The speed of the fishing line was about 0.5 - 0.7 m/s.

Preliminary results

RBRduet 85201 Fibertown

Figure 5.20 shows the preliminary results of depth (converted from pressure readings) and seawater temperature obtained from the RBRduet T/p logger that was attached to the bottom of the Fibertown glass fibre cable. Data was successfully recorded throughout the entire deployment duration between 26 August and 18 September 2020. The data shown here were processed using the RBR Ruskin software.

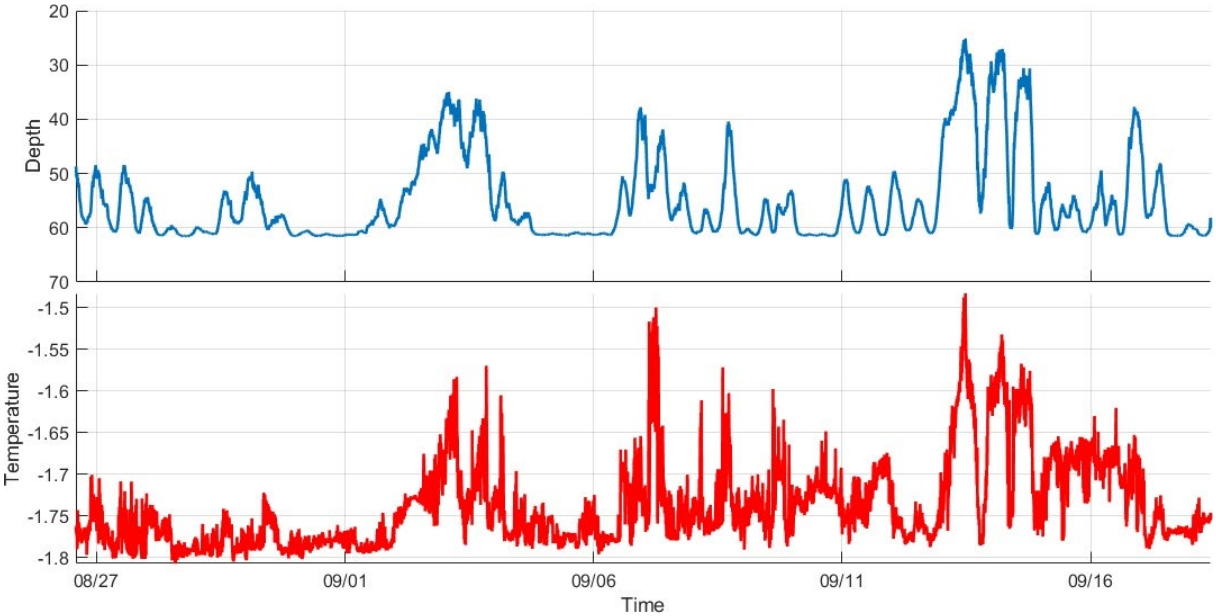


Figure 5.20 depth and temperature from the RBR duet at Fibertown

CTD chain buoy 2020O10

Figure 5.21 shows the preliminary results of instrument pressure, seawater temperature and salinity at 10 minute intervals obtained from the 5 Seabird SBE37IMP CTDs that were attached via an inductive modem link to the CTD chain buoy 2020O10. The data shown here are an excerpt only covering the period from deployment of the buoy to the recovery of the ice camp. The buoy was left behind and will continue to report data via iridium satellite, hopefully providing a valuable ocean properties dataset far beyond the Leg 5 drift camp.

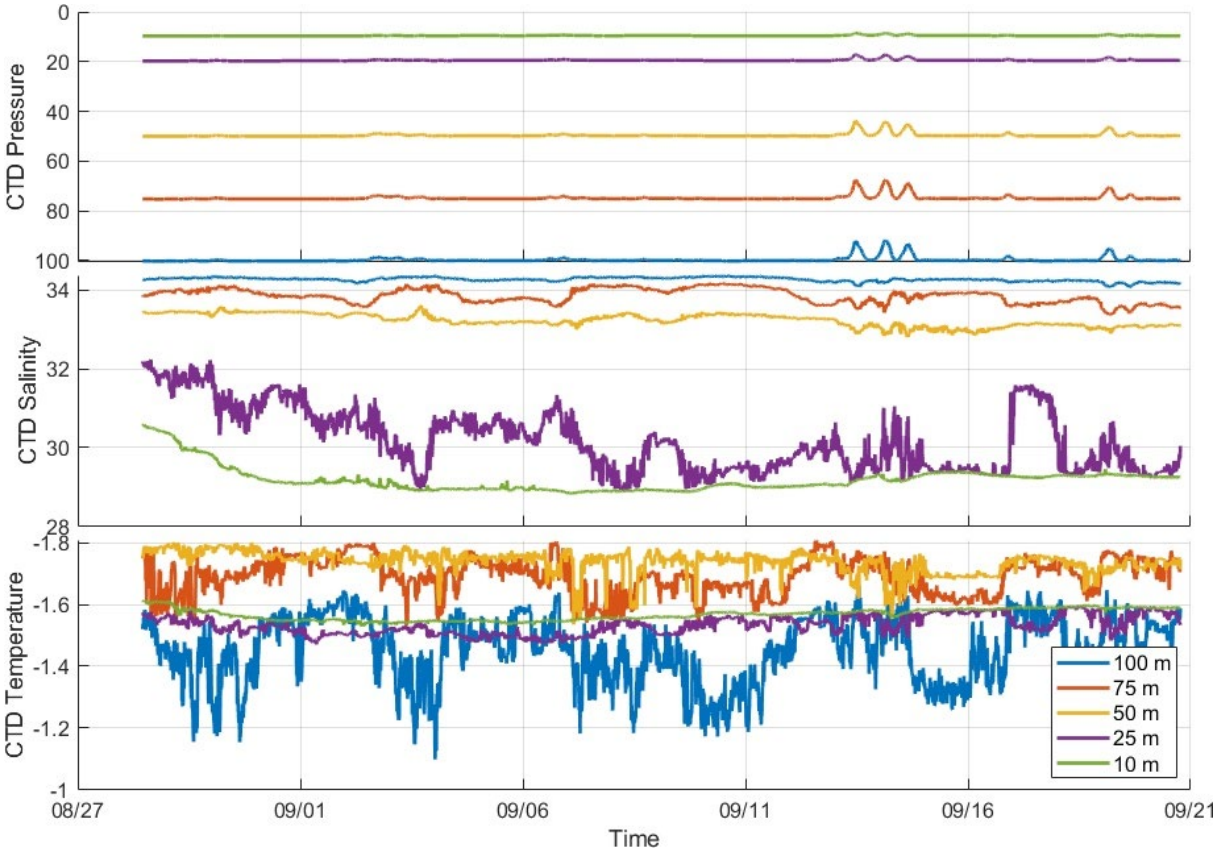


Figure 5.21: CTD pressure, salinity and temperature (10 min interval) of 5 SBE37IMP microcats mounted on buoy 2020O10 deployed in the central observatory. The plot only shows the data for the duration of the ice camp.

RBR Concerto 60547 CTD on Nitrate Profiler

Figure 5.22 shows the preliminary results obtained from the RBR concerto CTD that was co-installed with a SUNA nitrate sensor between Ocean City and Met City. The horizontal line represents the data when the instruments remained at a fixed depth, but continued to record data. The vertical lines represent the 140+ profiles between 0 and 100 m that were taken on an opportunistic basis, mostly in conjunction with MSS profiling in Ocean City, and in particular during the two 36h intensive sampling periods. The SUNA data requires more extensive processing and is not shown here. Unfortunately, no SUNA data was recorded between 05 and 09 September 2020 (including the first 36h intensive sampling period) due to a power failure of the external battery pack.

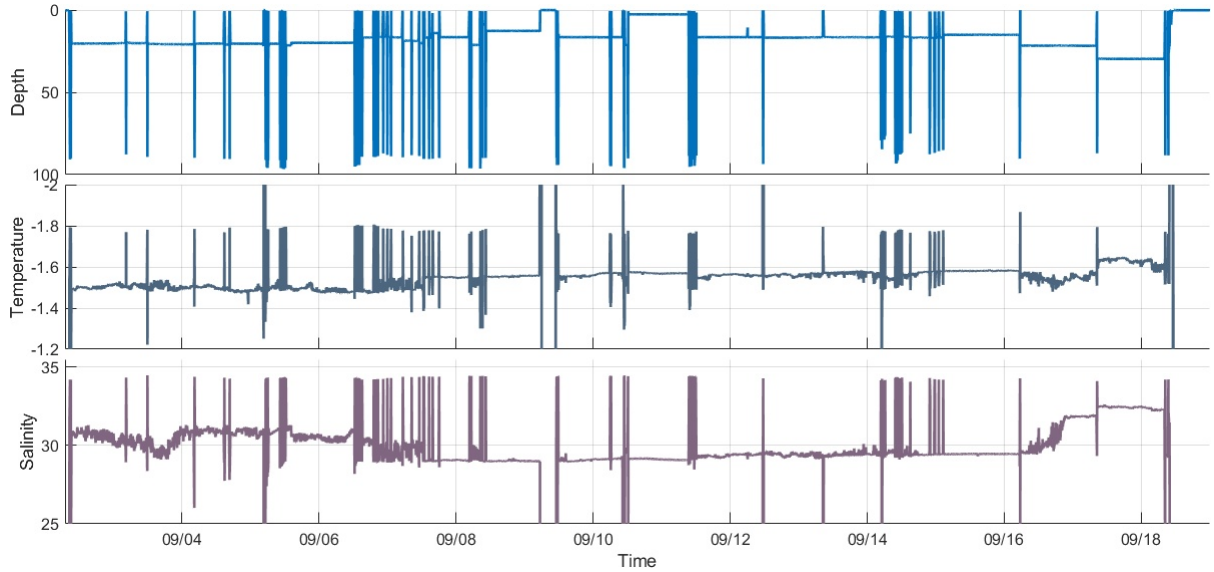


Figure 5.22: Raw data from the RBR concerto on the Nitrate profiler. Each vertical bar corresponds to one profile down to 100 m.

XCTDs during transit

Figure 5.23 shows temperature and salinity data from all 18 XCTD casts obtained during the transit to the ice camp (13 profiles) and back home (5 profiles). The data was converted using the MK150 software, and partially cleaned for bad salinity data.

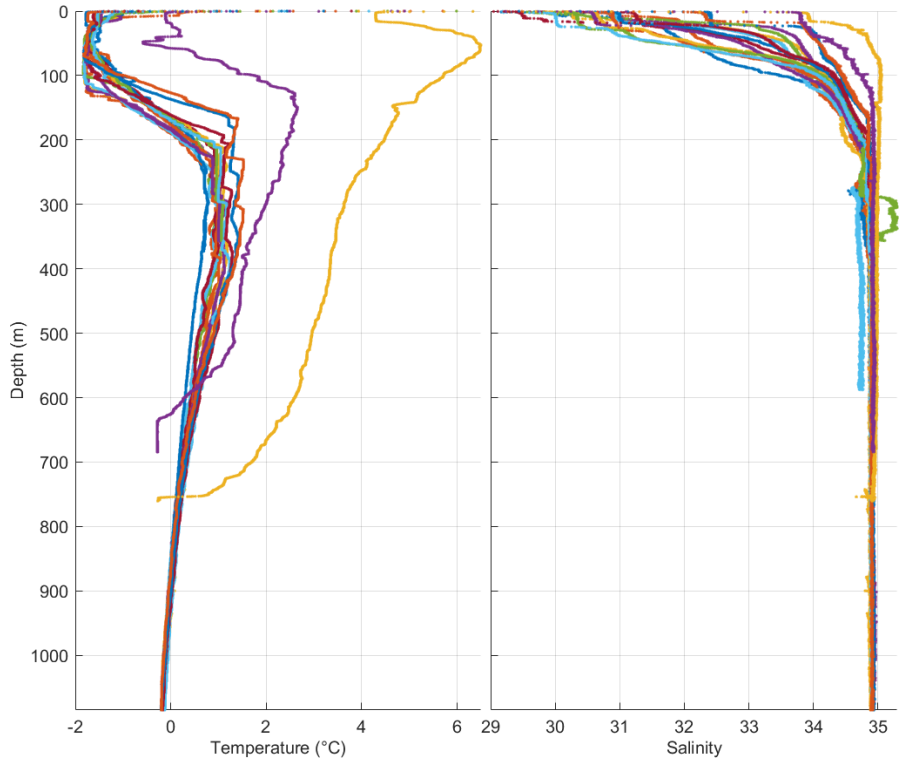


Figure 5.23: First overview of temperature and salinity from the xCTDs deployed during both transits.

Ship ADCP

Figure 5.24 shows preliminary current data (daily average) obtained from the ship (or vessel-mounted) ADCP for the duration of the Leg 5 ice camp.

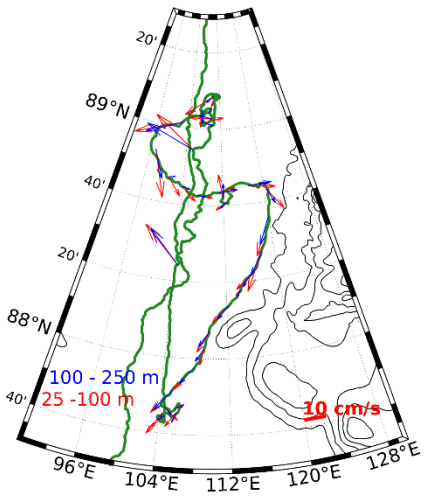


Figure 5.24: Daily averaged current deduced from the sADCP.

MSS data

Figure 5.25 shows preliminary results of conservative temperature, absolute salinity, density and turbulence derived from the MSS microstructure data obtained during the Leg 5 drift.

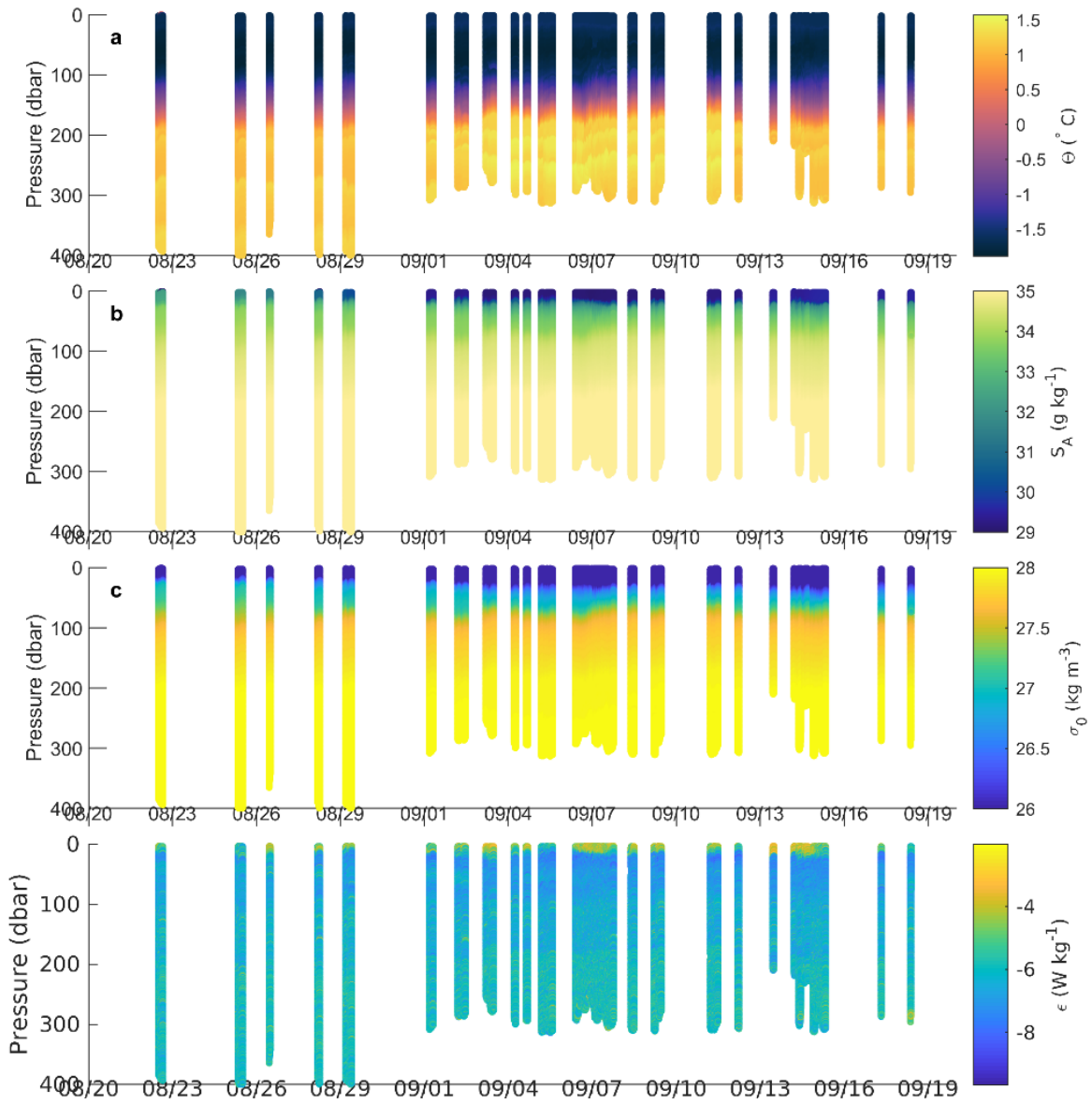


Figure 5.25: Overview of the MSS data during the duration of the camp

VMP data

Figure 5.26 shows preliminary results of turbulence data obtained by the VMP upriser that was operated in different leads during the Leg 5 ice camp.

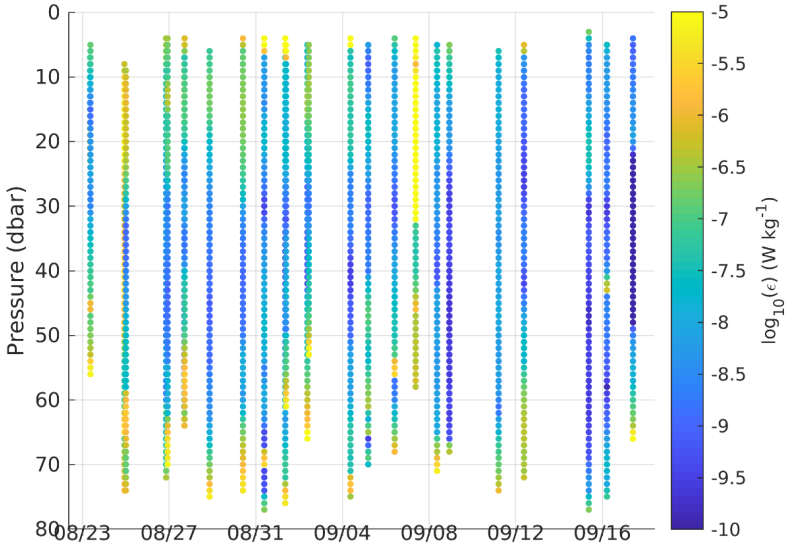
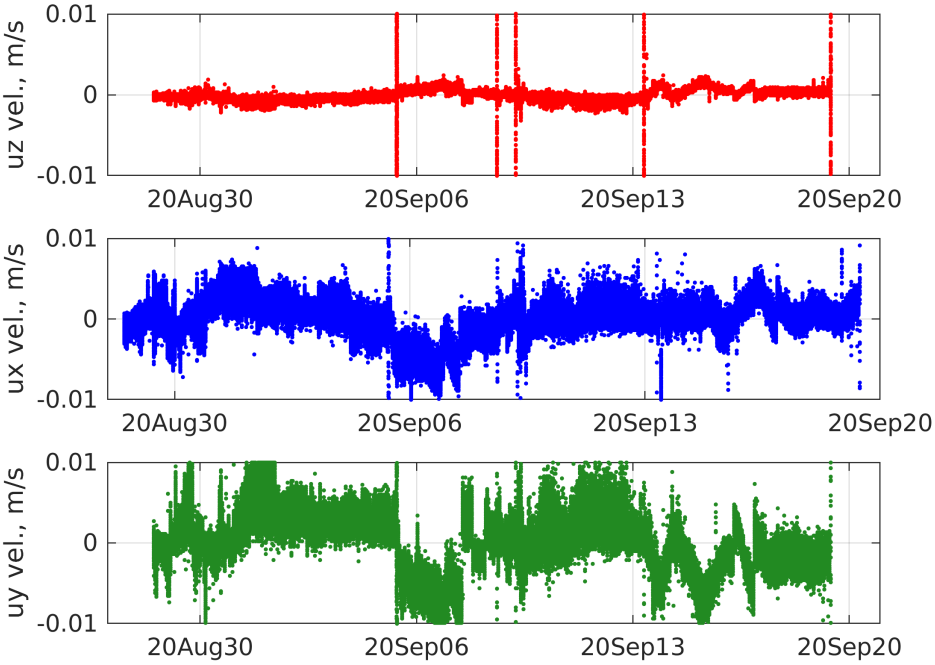


Figure 5.26: Overview of the VMP data during the duration of the camp

Vector data

Figure 5.27: Overview of the data from the Vector deployed near the ridge.



Fishing rod CTD

Figure 5.28 shows preliminary results of absolute salinity and conservative temperature obtained from the fishing-rod CTD that was operated in different locations (mostly in leads) during the Leg 5 drift.

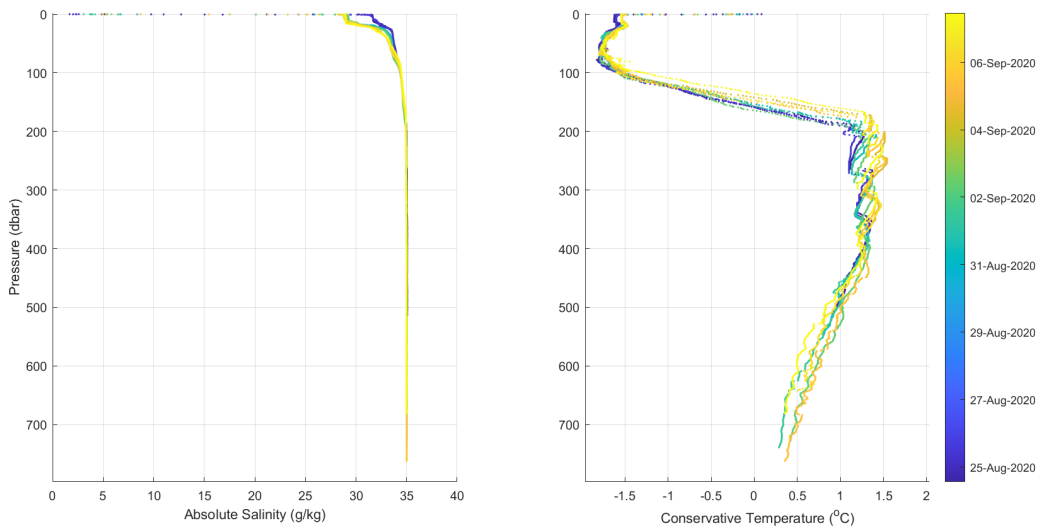


Figure 5.28: Salinity (left) and temperature (right) from the fishing rod CTD

Ship CTD

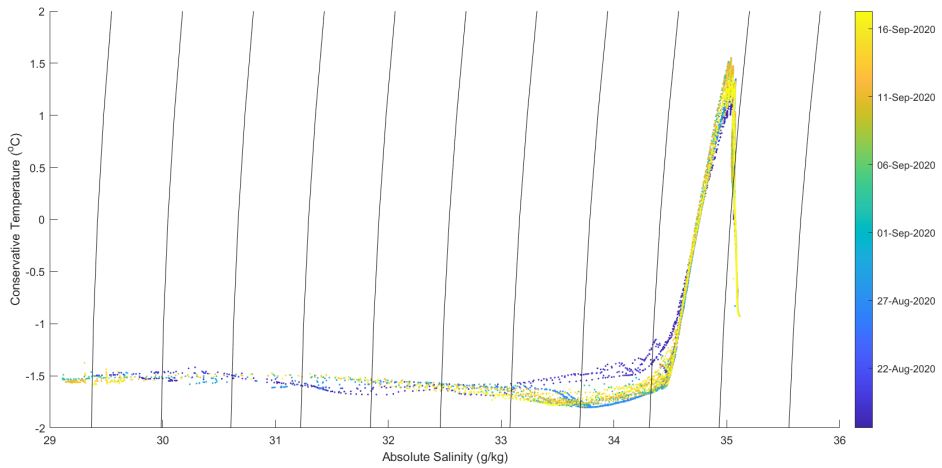


Figure 5.29: T-S diagram of the ship CTD data

Data management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX).

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