Arctic Bay May/June 2019 Data Report

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Field Day 1 (May 27, 2019):

Drivers: Nigel Kigutikajuk and Levi Kalluk

10:40: Left Arctic Bay in 2 qamutiks (SMART Qamutik and Personnel/Equipment Qamutik)

12:15: Passed crack #1

12:40: Passed crack #2

12:52: Reached crack #3, decided not to cross. Started travelling west into Admiralty Inlet along crack.

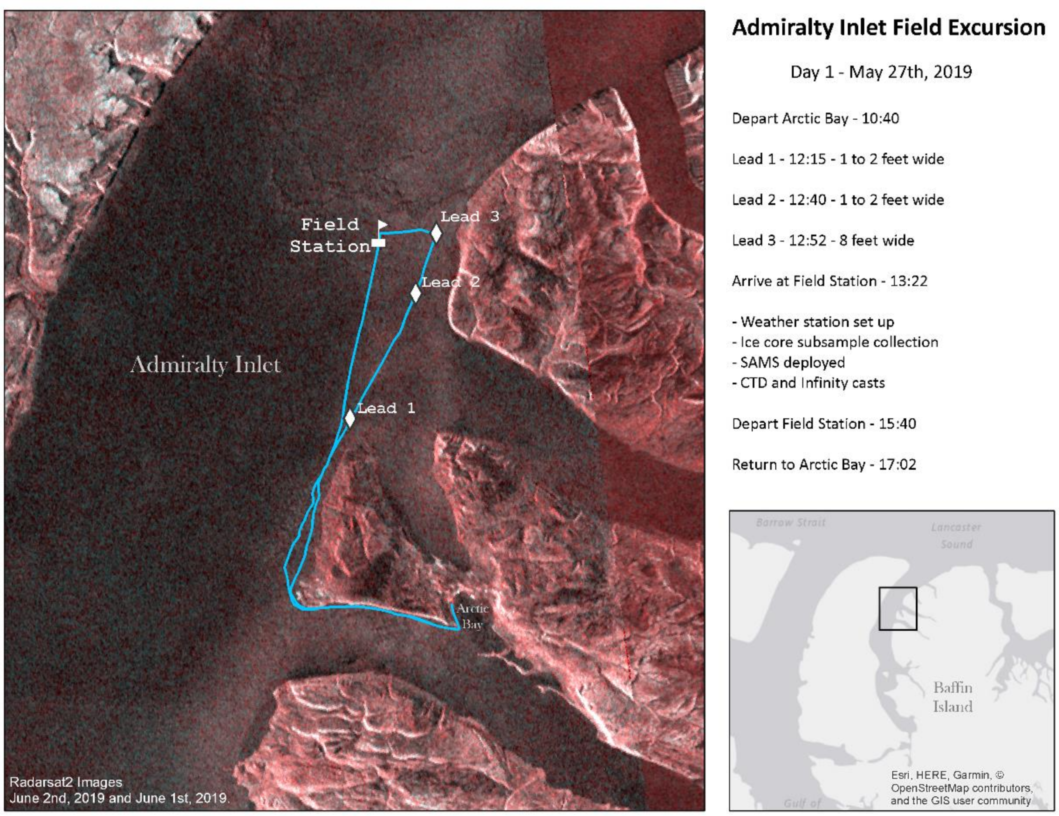
13:22: Decided on a location for field site. Measured ice thickness, installed weather station and SAMS, took sea ice core and samples

14:45-15:00: CTD cast in core hole

15:10-15:24: Infinity profile in core hole

15:40: Left field site for Arctic Bay

17:02: Arrived back in Arctic Bay



Field Day 2:

Drivers: Nigel Kigutikajuk and Gideon Allurut

10:44: Left Arctic Bay with 2 snow mobiles and 1 qamutik

13:15: Arrived at shore south of crack #3

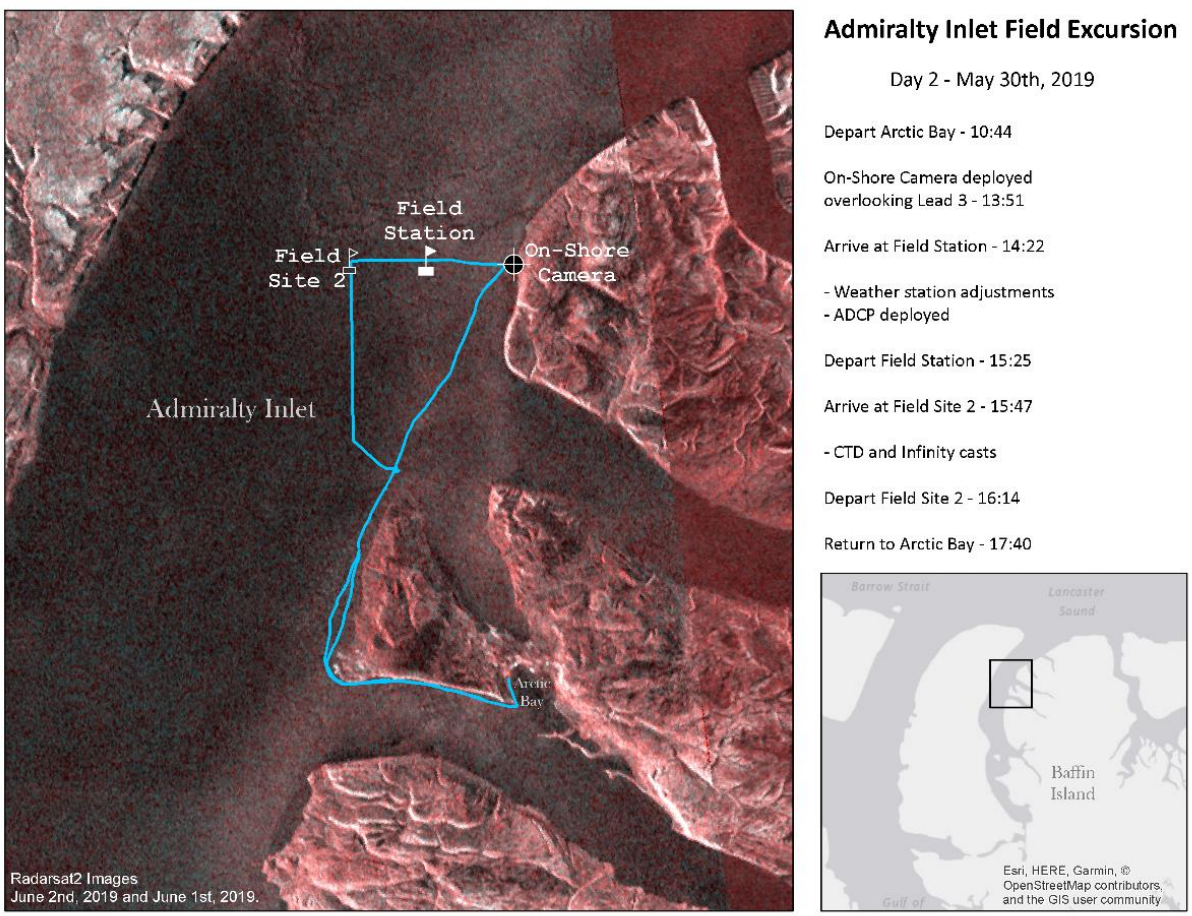
13:51: Deployed camera #1 on shore facing crack and Inlet (west)

14:22: Arrived at main field site. Adjusted temperature sensor and electronics case on weather station pole, deployed ADCP

15:47-16:10: Travelled west of field site, found seal hole for CTD cast and Infinity profile

16:14: Left seal hole for Arctic Bay

17:40: Arrived back in Arctic Bay



Data:

The following sections describe the relevant information related to data collection/instrument deployment during our two field days on the ice in Admiralty Inlet. The raw data can be found on the WIRL server in '*/tank/ice/projects/ArcticBay2019/Data/*' in the appropriately named folder for each data type. The names of the raw data files are included in this document below each section header. Additional information can be found in the field books also located on the server in the ArcticBay2019 project folder.

Weather Station:

Raw Data: 'cryologger_aws_arctic_bay_2019.csv'

On May 27, Calder set up weather station at the field site with help from Nigel and Levi. Two anemometers and one temperature/humidity sensor were installed. Measurements of sensors from top of ice from top to bottom on the pole: anemometer 1: 252cm, electronic box: 170cm, temperature/humidity sensor: 150cm, anemometer 2: 90cm. The anemometers were oriented facing due east as the NS wind was the wind direction that we were most interested in and we wanted to reduce the effects from the pole in that direction. Data is transmitted via iridium every hour on the hour and the real-time data can be viewed at cryologger.org/arctic-bay-data/.

Figure 1. Weather station, SAMS, and ADCP configuration at field site after deployment

To collect measurements, the Cryologger sampled the temperature, humidity, wind speed and direction and battery voltage every 5 minutes and saved this information to the microSD card. At the end of every hour, the samples were then averaged and either transmitted, or stored for later transmission. At each 5-minute interval, the wind speed was measured over the course of 3 seconds by counting the revolutions of the anemometer cups, then calculated according to the formula provided by the manufacturer. (Information provided by Adam Garbo)

The wind direction needed to be converted to meteorological coordinates, where 0° is defined as a wind coming from the north, and by convention the wind direction increases clockwise from there. To make this conversion, the wind direction was offset by adding 90° then subtracting 180°. A summary of the data collected is shown in the figure below.

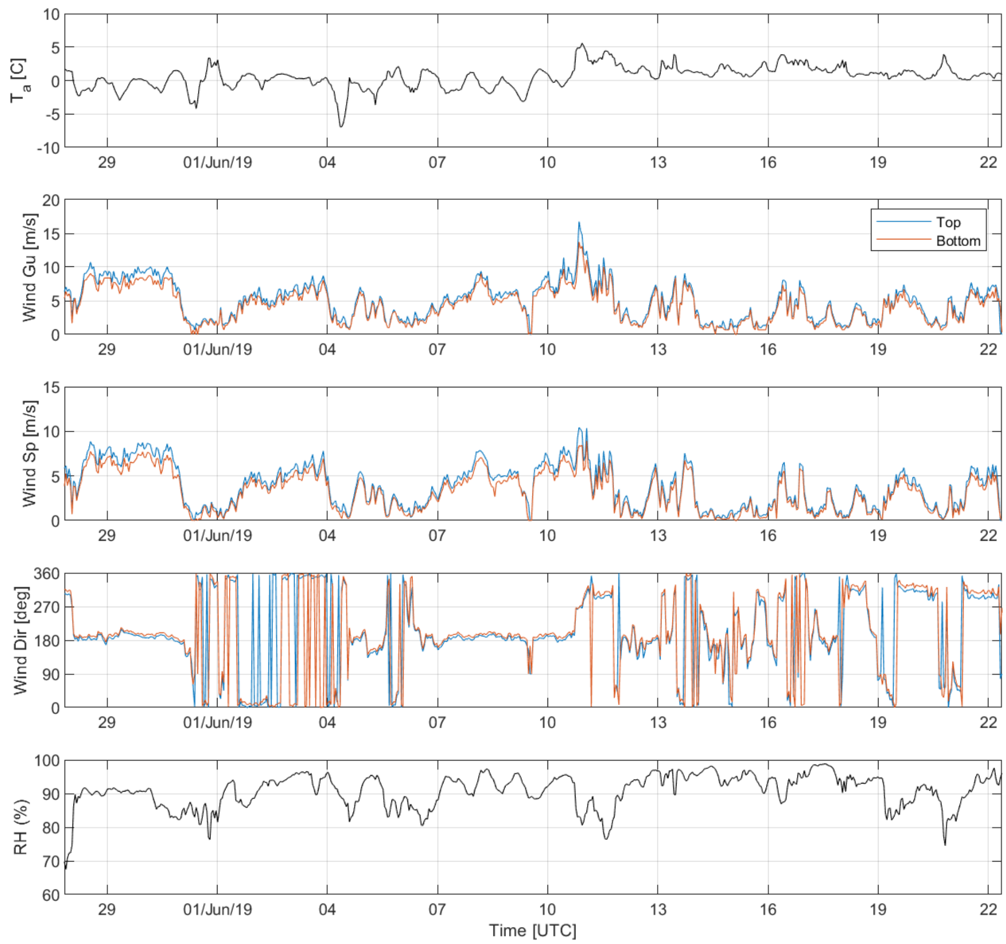


Figure 2. Weather Station data was collected at the field site on the ice from May 27 to June 22 when it was recovered.

SAMS:

Raw Data: 'gca0101gps_2019-07-08_16-05-30_GPS.csv',' gca0101st_2019-07-08_16-05-42_stat.csv',' gca0101td_2019-07-08_16-05-08_temp.csv'

On May 27, while Calder was setting up the weather station, Greg used Kovacs auger to drill small hole in ice and measured ice thickness. This hole was used for the SAMS thermistor chain. The node separation is 2cm, and the top node of the thermistor chain was right at the upper ice surface (air-snow interface at node 1), and the ice thickness at the time of deployment was about 160cm (ice-water interface would be around node 80). Another hole was drilled halfway through the ice about 1m north from the thermistor chain for the support pole. The SAMS electronics case was placed about 1m east from the thermistor chain.

Figure 3. SAMS configuration in the field during deployment

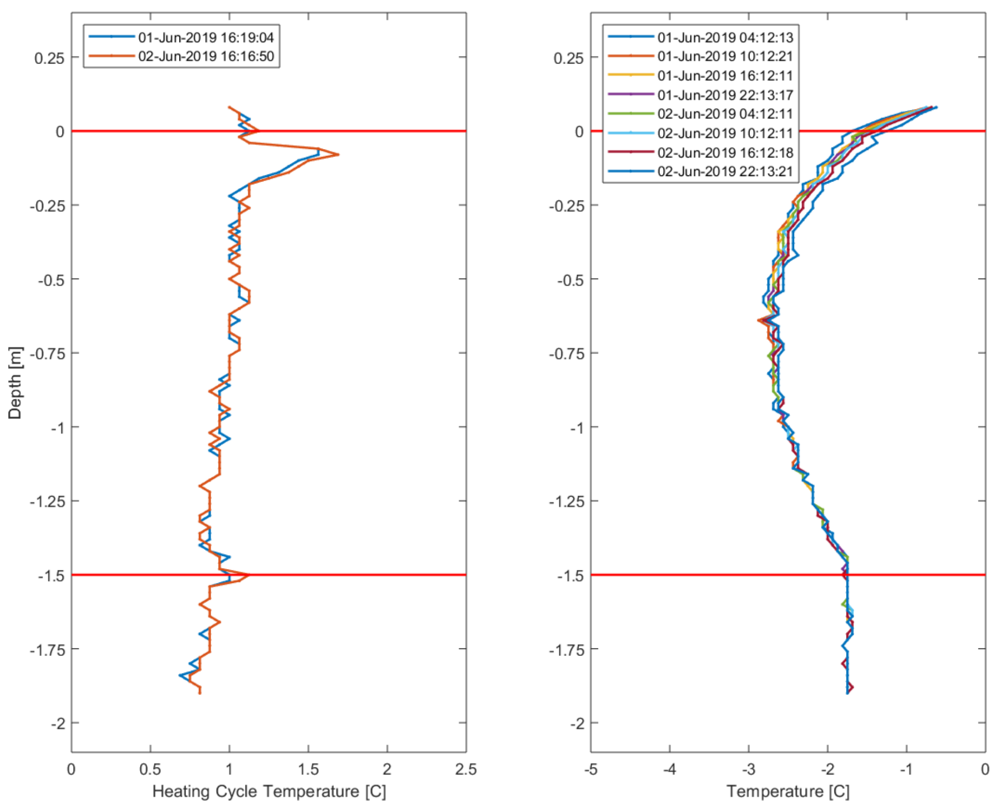


Figure 4. Example SAMS heating cycle data (left) and temperature profile (right) on June 1-2, 2019.

Sea Ice Core:

Raw Data: 'AB0527_IceCoreData.csv', 'YSI_icecoredata_0528.csv'

On May 27, after the SAMS was set up, Greg used the Kovacs corer to take a core sample of the sea ice. One core was taken in two parts using the corer, with a total thickness 170cm. Ada used a hand drill to drill holes into the core at 10cm intervals, and small thermometers were used to measure the ice temperature at each depth. The ice core was then cut into 5cm blocks at 15cm intervals using a handsaw and put into small round Ziplock containers to be brought back to Arctic Bay and melted to measure salinity.

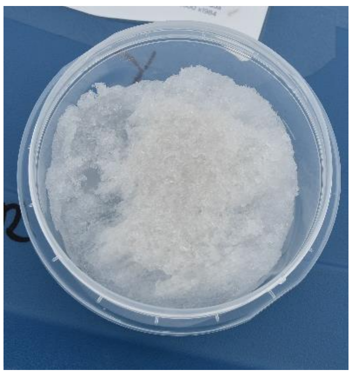


Figure 5. Sea ice core (top) and top view of 5cm ice core section (left)

Back in Arctic Bay, once the core samples had melted, Ada and Calder measured the salinity of each sample by pouring each sample into a plastic cylinder, taking a salinity measurement using both the Idronaut and the YSI salinometer, then removing the sample from the cylinder and shaking out the cylinder between samples (without rinsing). The YSI salinity values needed to be calibrated using a conductivity standard back at Carleton.

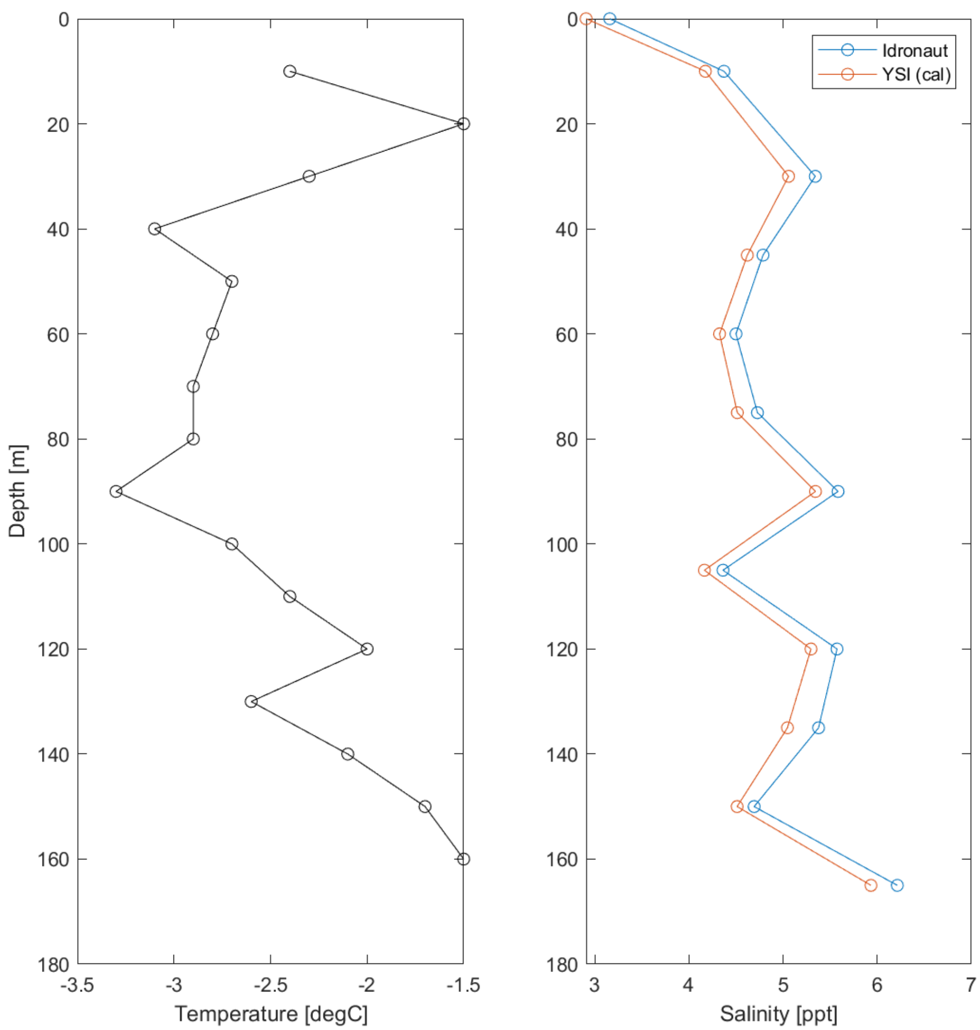


Figure 6. Sea ice core temperature (left) and salinity (right) profiles from May 27

CTD Casts:

May 27:

Raw Data: 'AB_idronaut_052719_1.txt', 'AB_RBR018837_20190527_1.hex'

After the sea ice core was taken using the corer and the core samples collected, the core hole was used to conduct CTD casts. Both the Idronaut and the RBR were used to collect profiles to confirm the operation of both instruments since there had previously been issues with data collection from the Idronaut. The Idronaut and RBR were connected in series, with the Idronaut on the bottom and the RBR on the top connected by rope and a carabiner at the end cap of the RBR. The rope connecting the Idronaut to the RBR was about 105cm, leaving about 60cm between the top of the Idronaut and the bottom of the RBR sensor. The RBR was then connected to a 500m rope reel. The depth of the water was about 450m.

At 14:45 the instruments were lowered into the water to about 300m. The depth was marked on the rope by some tape. The instruments reached their maximum depth around 14:56 and were out of the water by about 15:00.

Both instruments worked well and had fairly reasonable agreement (Figure 7). There was a larger discrepancy between the salinity measurements of the different instruments than expected, but this difference was attributed to the fact that the RBR hadn't been calibrated since 2016, whereas the Idronaut had just come back from the manufacturer for calibration. There is a potential issue with the pressure sensor on the Idronaut. This needs to be looked into in more detail, but perhaps may be corrected in post-processing.

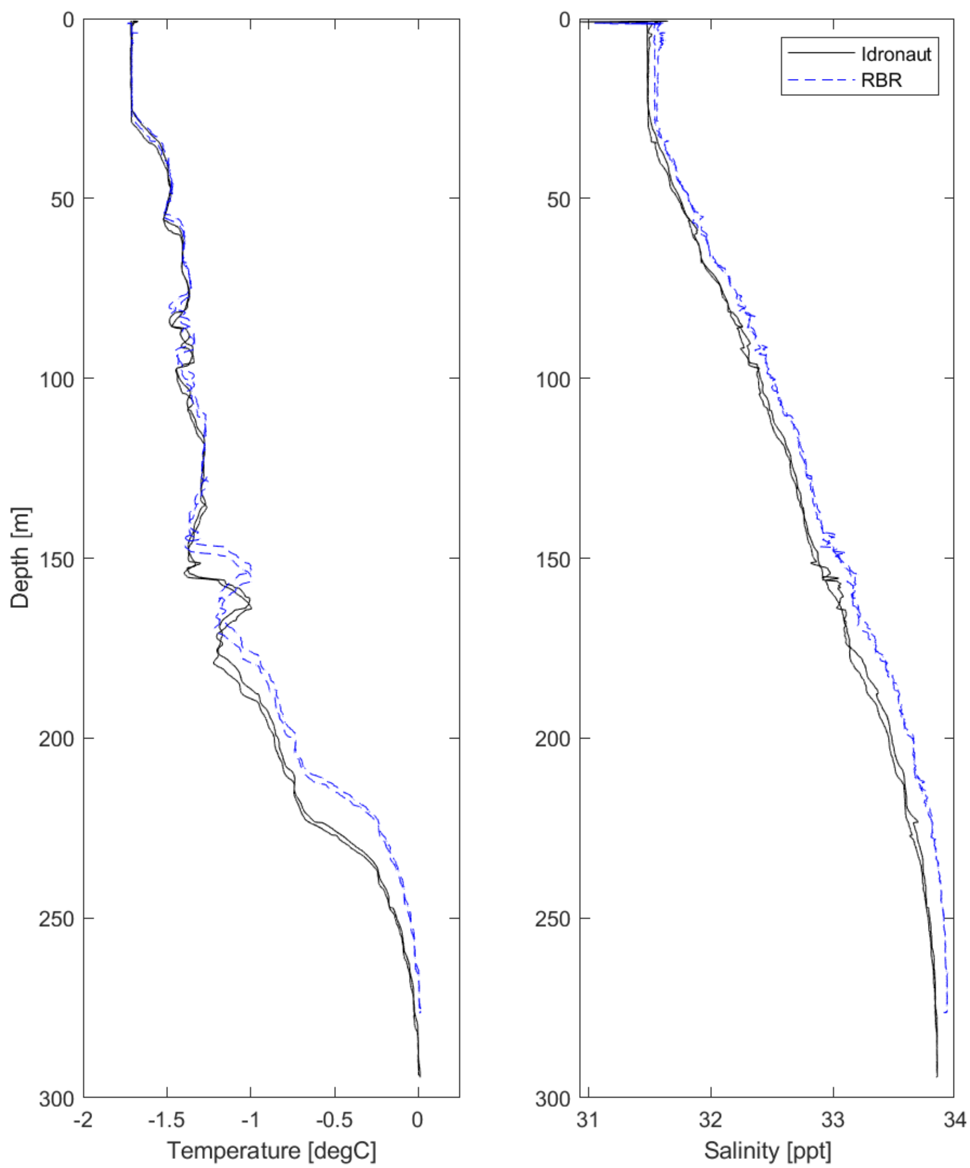


Figure 7. Temperature and salinity profiles from RBR and Idronaut on May 27 from core hole CTD cast

May 30:

Raw Data: 'AB_idronaut_053019_1.txt'

After completing everything at the main field site, another location to do a CTD cast and Infinity profile was sought out further west into Admiralty Inlet to look for spatial variability in water properties throughout the Inlet. A 1m seal breathing hole was found by Nigel and Gideon (the seal was thought to have been nearby!) and was decided to be at a suitable location to do water property measurements. This site was 5.4km from the main field site, and about 600m depth.

Ada and Calder set-up the CTDs in the same arrangement as previously, with the Idronaut on the bottom and the RBR on top. The CTDs were put into the water at 15:53 and lowered to about 350m. The instruments reached maximum depth around 16:01 at 350m and were out of the water by about 16:10.

When data was downloaded at the end of the day, it was found that the RBR memory was empty. It was uncertain whether there was a problem with the RBR, or if the deployment time was set wrong. Fortunately, the Idronaut did collect data, and similar features were found at this site as the previous site (Figure 8).

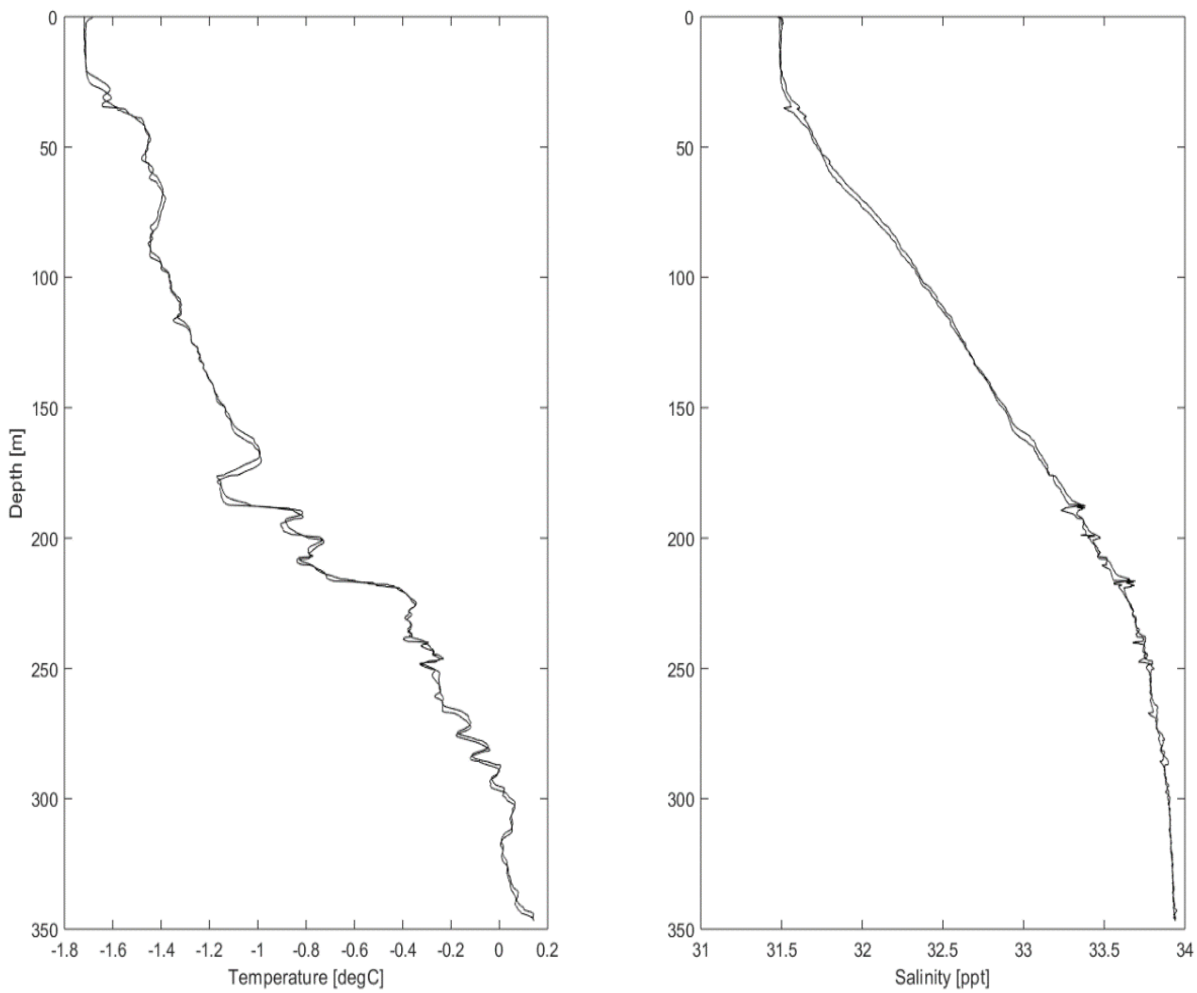


Figure 8. Idronaut CTD Cast (temperature and salinity) May 30 (seal hole), both up and down cast

Infinity Profiles:

May 27:

Raw Data: '20190527_1200_AEM-USB_1144_210947.raw'

After the CTD casts were finished in the core hole, Greg lowered the Infinity into the core hole to take a current profile under the ice using a rope with the depths marked at 1m intervals using a sewn-on piece of fabric. The Infinity was held at each depth for about 2 minutes, and velocities were averaged over this time interval at each depth in post-processing to determine the current profile. A summary of the times and depths of the profile points are shown in Table 1.

Table 1. Time and depths of Infinity profile taken May 27 in core hole

Time (EDT)	Depth (m)
15:10-15:12	2
15:12-15:14	3
15:14-15:16	4
15:16-15:18	5
15:18-15:20	7
15:20-15:22	10
15:22-15:24	15

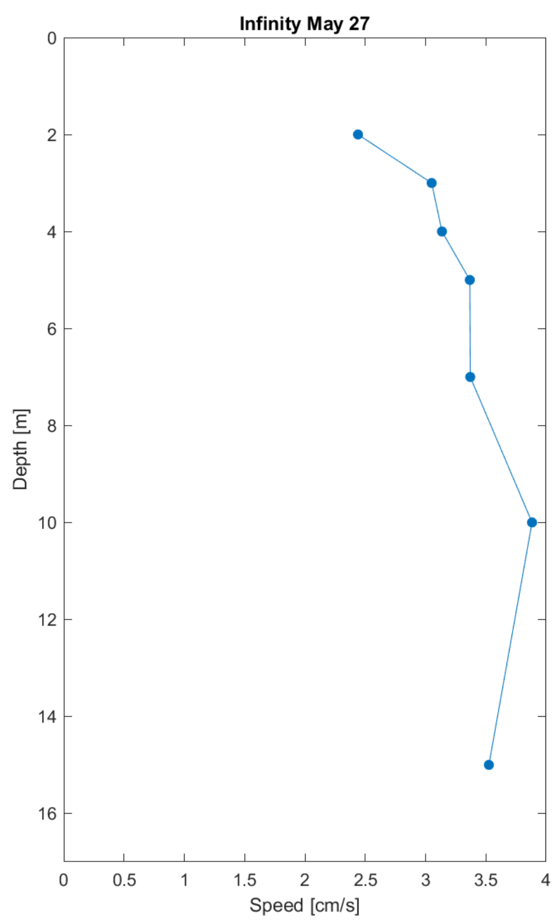


Figure 9. Infinity current profile from May 27 (current magnitude plotted)

May 30:

Raw Data: '20190530_1100_AEM-USB_1144_131028.raw'

While the CTD casts were being taken in the seal hole, Greg lowered the Infinity into the seal hole to take a current profile under the ice using the method used previously. A summary of the times and depths of the profile points are shown in Table 2Table 1.

Table 2. Time and depths of Infinity profile taken May 30 in seal hole

Time (EDT)	Depth (m)
15:55-15:57	2
15:57-15:59	3
15:59-16:01	4
16:01-16:03	5
16:03-16:05	7
16:05-16:07	10
16:07-16:09	15

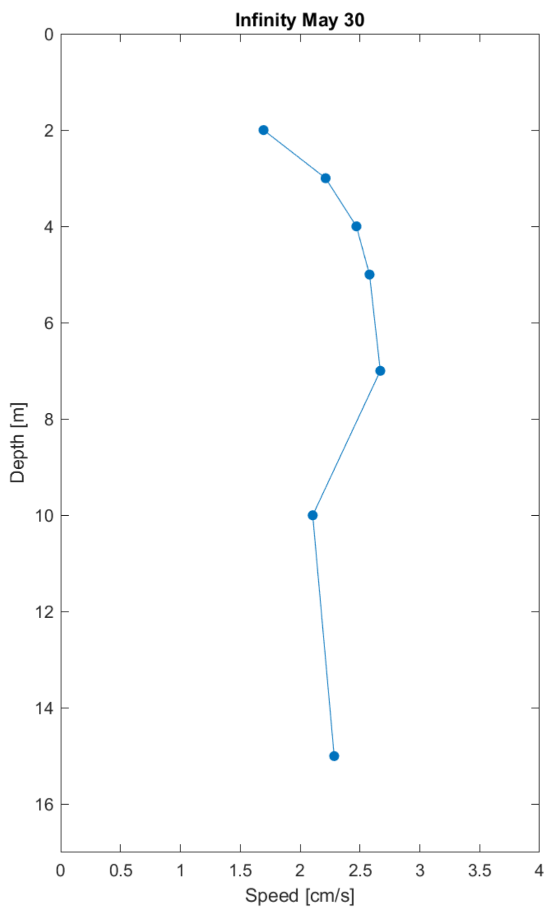


Figure 10. Infinity current profile from May 30 (current magnitude plotted)

ADCP:

Raw Data: 'ADCP_AB19_data.csv'

On May 30 at the main field site the extension for the 4' auger thought to have been left behind after the last field day was looked for in the snow to no avail. Snow was shovelled to form a 2x2m square and the 4' auger was used to create a partial hole for the ADCP, and the corer was used to complete the hole.

Ada placed the ADCP in the pipe apparatus, and the 3 hose clamps gripping the ADCP to the pipe were tightened as much as possible by Ada and Greg to prevent loss of the instrument through the pipe. A wooden rod with two white wooden feet was placed in the 3rd hole from the top of the pipe to prevent the pipe from falling through the hole and to keep the bottom of the ADCP at approximately right at the underside of the ice. A buoy was attached to another hole in the pipe using some webbing for extra security in case of the pipe and feet melting out.

The ADCP inside the pipe apparatus was carefully lowered into the hole in the ice, the apparatus was slightly positively buoyant, so it was held down to allow water to fill a hole in the pipe drilled specifically for this purpose. The area was covered with snow to prevent early melt-out.

Figure 11. Photo of ADCP configuration at deployment.

Table 3. ADCP Deployment Settings

Profile Interval	900s (15 minutes)
Number of Cells	25
Blanking Distance	0.4 m
Cell Size	1.00 m
Average interval	60 s
Compass update rate	900 s
Speed of sound	1436 m/s
Coordinate System	XYZ

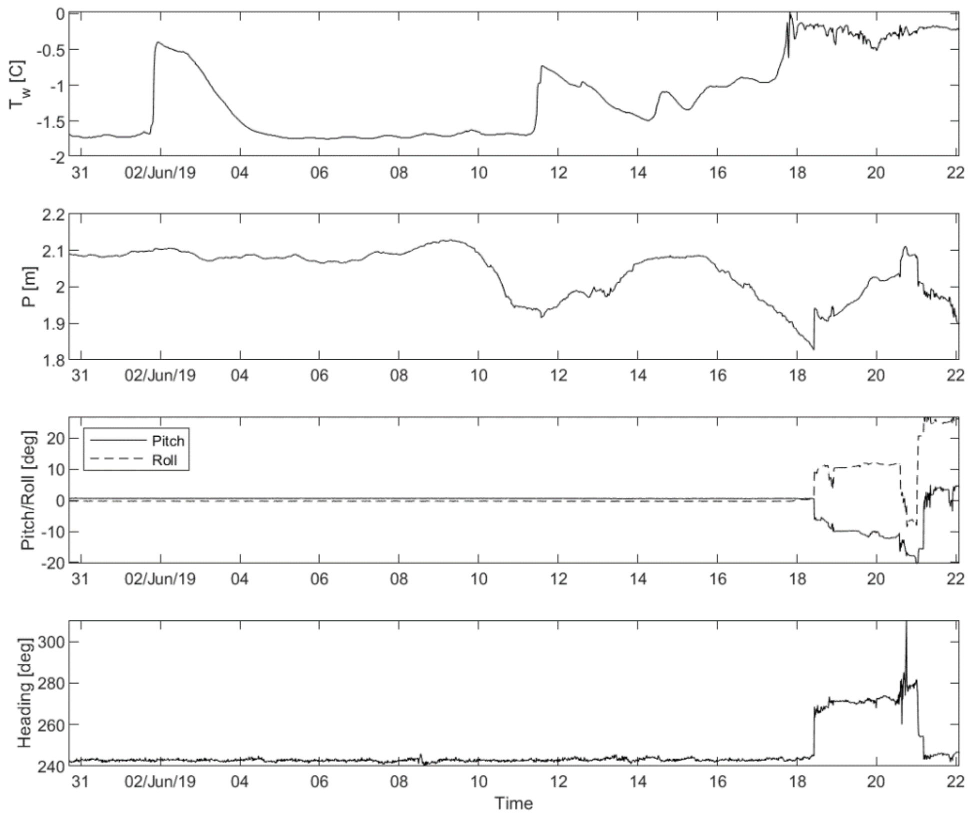


Figure 12. ADCP Ancillary Data May 30-June 22, 2019

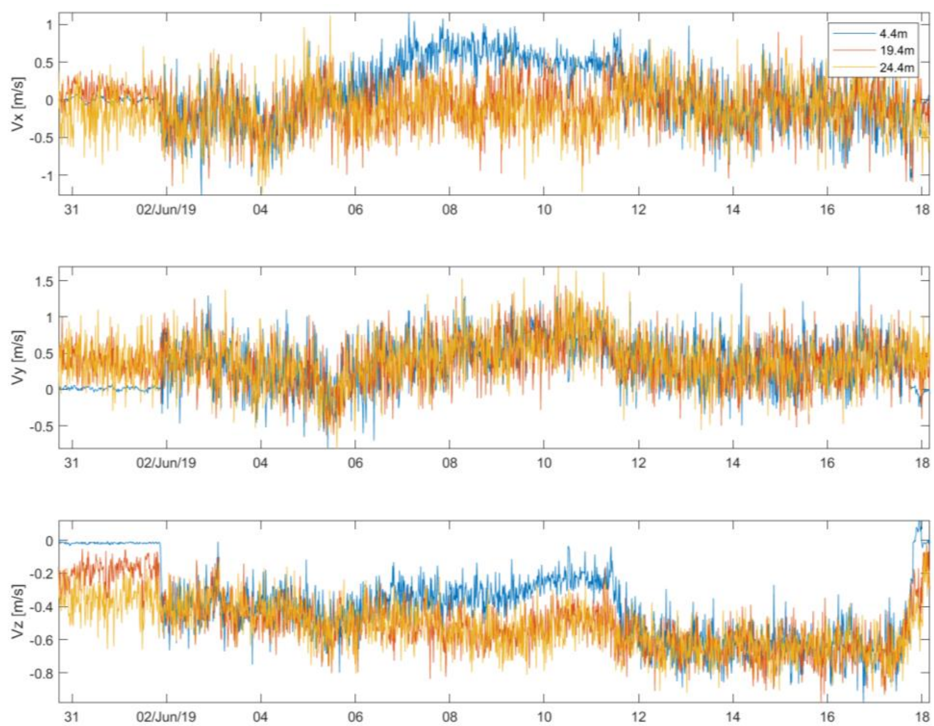


Figure 13. ADCP velocity data at 4.4m, 19.4m, and 24.4m depth. Vx is the NS velocity component, Vy is the EW component (W is positive), and Vz is the UD component

Cameras:

On May 30 one of the two cameras was deployed on the eastern shore of Admiralty Inlet between Strathcona Sound and Baillarge Bay in a place called '*sujartalik'.* Accessing the shore was difficult due to the large cracks in the ice in the tidal zone, but the team found a way with the guidance of Nigel and Gideon. The camera was placed at about 250m from the shore at 15m elevation facing west towards the large crack encountered on the first field day, and stabilized using rocks from around the shore. Niore and Mishak thought that ice south of this crack would move south and rot away in Admiralty Inlet, while ice north of this crack would drift out into Lancaster Sound.

This camera will continue taking photos until the ice has completely broken up, after which it will be recovered by Nigel Kigutikajuk and stored in the Arctic Bay Adventures office until shipment back to Carleton can occur.

Figure 14. Photo of camera (bottom-left) orientation on shore facing Admiralty Inlet

The second camera was lent to the QIA for placement on the southern corner at the mouth of Elwin Inlet looking north towards Lancaster Sound during break-up.

Instrument Recovery

Figure 15. Photo of field site during recovery (photo by Nigel Kigutikajuk)

Nigel Kigutikajuk and his son went to the field site on June 21-22 to recover all the instruments on the ice.

The weather station was originally planned to be carefully brought to shore to the time-lapse camera site at *sujartalik* and stabilized by rocks on the shore to continue collecting data throughout the summer. This was found to be impossible, as the shore lead was impossible to cross at the time of recovery, so the instrument was brought back to Arctic Bay and is currently stored at the Arctic Bay Adventures office and will be redeployed next year.

The ADCP was recovered on June 22 in the early morning. The hole was significantly melted out. The ADCP will be removed from the pipe and placed back in its case for shipment back to Carleton by Trevor Bell. Until shipment the ADCP and accessories were stored in the Arctic Bay Adventures office in Arctic Bay.

The SAMS thermistor chain was unfortunately cut during the recovery trying to get the chain out of the hole. The case and remaining part of the chain were recovered and put in storage in the Arctic Bay Adventures office. A new chain will be brought up during next year's field season and the instrument is planned to be redeployed.