

# NGA LTER & Gulf Watch Alaska Cruise NUQ2020-03S

Northern Gulf of Alaska Freshwater Pathways Cruise  
28 July to 7 August 2020

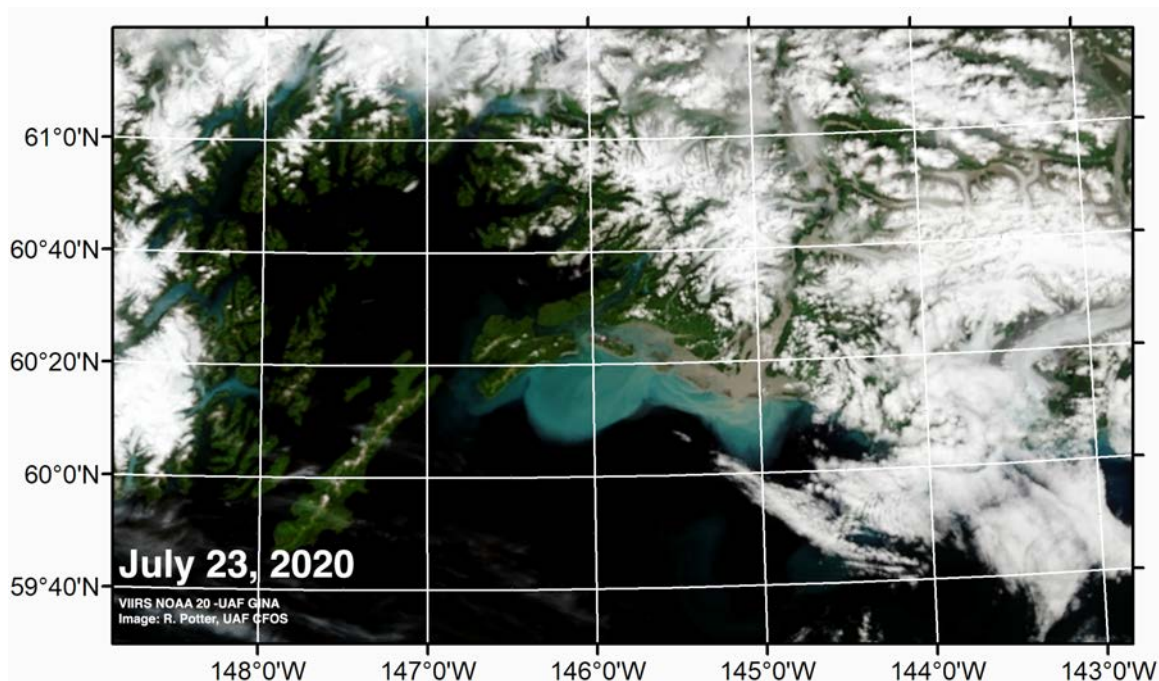
**Funding Sources:** NSF

**Science Personnel:** Hank Statscewich, hank.stats@alaska.edu  
Isaac Reister, isreister@alaska.edu  
College of Fisheries and Ocean Sciences  
University of Alaska Fairbanks  
Fairbanks, AK 99775  
Phone: 907-474-7245

Vessel Crew: Capt. Brian Mulally, Simin Boroumand

## Synopsis and Objectives:

The scientific purpose of this research is to map the nearshore fresh water system of the Northern Gulf of Alaska. Weather permitting, we will work offshore of the Copper River delta, towing an undulating CTD in and out of the frontal systems between the fresh river water and the salty waters offshore. Inclement weather will re-direct operations into Prince William Sound. This cruise will attempt to re-occupy transects covered by R/V Sikuliaq in early July 2019 and the R/V Nanuq in July/August 2020, seeking information on the temporal evolution of the fresh water distribution and freshwater pathways.



**Figure 1:** Satellite image from the NOAA VIIRS platform from July 23, 2020 showed the Copper River sediment laden plume fairly well confined nearshore at the river delta and then spreading offshore on the Eastern end of Hinchinbrook Island.

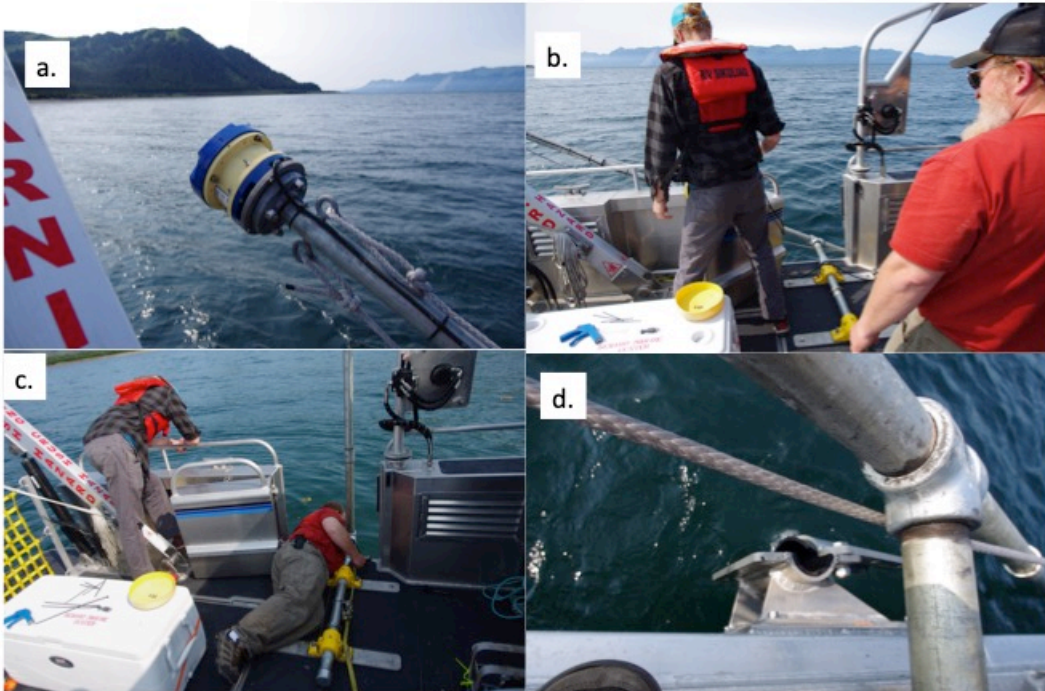
## Cruise Narrative:



**Figure 2:** The RV Nanuq at the dock in Seward, AK prior to sailing to Prince William Sound.

### Tuesday July 28, 2020:

We finalize all deck securing operations and last minute provisioning and depart Seward small boat harbor at 11 am. Once outside small boat harbor, we turn on the newly installed Thermosalinograph (TSG) system and transit through Resurrection Bay. At one point while making coffee and heating up cinnamon buns (use of coffee pot and microwave) we trip a breaker which seems to cause a reset of the UPS which powers the Nanuq Data Server and the TSG. After a short reboot and troubleshooting of the UDP GPS feed, which required a second reboot, the TSG is up and running. Smooth seas across the Gulf make for a three-hour transit to Hanning Bay where we begin the assembly of the pole-mount ADCP. The assembly is straightforward but time consuming due to the need to work over the side of the vessel. We recommend bringing a 3/16" allen head rachet adapter for future missions requiring the ADCP. Once the ADCP was secured to the pole mount we started a box pattern in Hanning Bay to calibrate the ADCP compass. Several lessons learned from this experience are that water depths need to be greater than 10 m and ship speed must be greater than 2 m/s. After several hours of running the box pattern, we obtained a mean amplitude correction of 0.99 and a phase correction of  $-4.8^{\circ}$  (standard deviation of 0.55). Prior to anchoring for the evening, we tilted the pole mount upwards and secured the ADCP in the recovery position.



**Figure 3:** The 300 kHz RDI Workhorse ADCP secured to the port rail of the RV Nanuq prior to deployment (panel a). The pole mount brackets and port dive door are left open during transits (panel b). Pivoting the pole mount into place prior to securing the vertical mast into place (panel c). The clam shell bracket holds the vertical mast securely to the vessel and guy lines affixed both forward and aft of the bracket provide for extra security (panel d).

### Wednesday July 29:

Departed Hanning Bay under heavy fog at 0700, headed for Hinchinbrook Entrance. Slow transit to Port Etches where we deploy the pole mount ADCP and make 6 kts headway to just offshore of Cape Hinchinbrook for a Gulf of Alaska ACROBAT tow. ACROBAT deployment was smooth, flight characteristics are optimal with yo's between the surface and 50 m. Spoke too soon, with 3 nm to go on our last transect, we experienced a ton of spikiness from the ACROBAT pressure sensor located in the motor module. We recovered the instrument and headed to English Bay in Port Etches to anchor for the night. We removed the motor module and inspected the pressure can for leaks, no obvious signs. Went to sleep but was woken up at 2:30 am with an anchor drag alarm.

### Thursday July 30:

Recalibrated to pressure sensor on Seasciences motor module s/n 158 and decided to take advantage of the good weather by running offshore to Middleton Island. Once at Middleton Island we rotated the ADCP into its deployed position, we started to mobilize to deploy the ACROBAT and just before starting the ACROBAT winch, Simin thought she smelled burning electronics. We rapidly stopped all operations and began to troubleshoot the source. Brian lifted the engine hatch cover while we readied the fire extinguisher. While in the engine room, Brian realized that the generator was not running, he had surmised that we may have drifted through a patch of kelp and debris on the surface that clogged the sea water intake and caused the generator to burn up its impellor, causing the acrid smell. He took apart the sea water intake, and while he was at it also cleaned out the TSG intake pump, both were completely clogged with kelp. After the mechanical issues, we deployed the ACROBAT and towed back towards the Copper River Delta. After about three very clean yo's, we started seeing pressure spikes from the ACROBAT motor module sensor. We

switched from autopilot mode to manual mode and flew the sled by using the factcat ctd pressure sensor for about an hour and as the seas came down Isaac realized that there were fewer pressure spikes so he switched to autopilot. This worked for several more hours and then the pressure spikiness started again, making autopilot impossible. At one point in the tow, the sled had a near vertical flight angle and no amount of up or down wing command was able to gain control of the vehicle. We initiated a recovery and just as the sled came up close to the stern, an extremely large jelly fish was the culprit, it covered the nose and both wings! A blast of the engine prop wash rectified the situation and we continued the tow using manual flight control. At one point in the evening, we were checking on our estimated ETA for the end of the line and Simin stated that had 12 more nm to go and we would likely be finishing up at 9:30 pm. I checked my watch to confirm and it also showed a time of 7:30 pm. A discussion ensued whereby the position of the sun seemed to be a bit lower than 7:30 pm so we checked some additional clocks onboard and realized that both garmin devices were showing an incorrect local time, it was actually 9:30 pm local time. Since we would not be at the end of the line until 11:30 pm and darkness was rapidly approaching, we determined that the safest course of action would be to retrieve the ACROBAT and use the remaining light of the day to navigate through Hinchinbrook Entrance and reach safe anchor within English Bay or Port Etches. Once we dropped the anchor and started to shut down electronics, we heard a discordant noise from the port engine, Brian thought this was coming from the hydraulic pump. Upon further inspection, he saw that the pump belts that attach to the hydraulic clutch were coated in rubber and some metal shards were badly worn. We now know that the source of the smell was the clutch being burned up but we are not sure why this occurred.



**Figure 4:** The Acrobat tow sled with Seabird FastCat CTD and WetLabs three channel Ecopuck.

#### **Friday July 30:**

Woke up in English Bay and headed for Cordova for fuel and to arrange for the hydraulic pump repairs. Once in Cordova, Isaac and I unspooled the cable on the Acrobat winch and respooled a backup cable we brought. Only after spooling the cable back on did we realize that this new cable had a short in it, between the white and orange twisted pair

of 22 ga wires. We tried to diagnose the source of the short by cutting off the tow end of the cable and reterminating it, sadly this did not fix the issue. We spent much of the day awaiting word from the hydraulic shop on the status of the repair but by 6 pm we assumed we would be spending the night in the cordova small boat harbor. By about 10 pm, we realized that the short was likely at the spot where the cable enters the winch drum, there is a sharp bend there that puts a bunch of stress on the cable.

### **Saturday August 1:**

We removed the backup cable and put the original cable back on but we moved all of the wire grips so they would not put any additional pressure on the cable in the same location. Brian was able to install the repaired hydraulic pump and all mechanical systems were functioning properly. We left the boat harbor at 3 pm and stopped at shoreside petroleum for fuel prior to departing Cordova and heading to Port Gravina to scout out the region for future glider deployments. We anchored up in St. Matthews Bay in order to tackle the Orca and Hinchinbrook lines in the morning.

### **Sunday August 2:**

Left St. Matthews Bay for Knowles head in rain and fog. The winds were forecast to pick up out of the East and the seas in Orca Inlet seemed to be in the 3-4' range. The Seal Rocks buoy outside of Hinchinbrook Entrance reported seas of 9'. These factors made us rethink our strategy for the day as we did not want to be caught in heavy seas with both the ADCP and ACROBAT deployed without relatively calm waters for retrieval. We headed across the sound to inside the sill in College Fjord. Deployed the Acrobat and observed several yo's to 30 m on autopilot with no issues, we stepped the autopilot down to 40 m and at the apex on the turn (presumably at the point of max tension in the cable) we observed a spike in pressure from the motor module and lost all control of the Acrobat wings. We slowed the vessel and initiated a recovery. Isaac and I tested the tow cable and observed a short in the twisted wire pair that supplies Acrobat flight data back to the flight control system, we isolated those two wires and swapped the signal to two other wires that did not show a short. We redeployed the Acrobat and quickly observed the same behavior in the Acrobat (pressure spikes and loss of wing control). We decided that it was beyond us to repair this cable any further so we reached out to Pete Shipton to ask if he would deliver the brand new cable to Whittier so that we could swap it out with the problem cable. We made our way to Whittier and refueled at the Shoreside Petroleum and tied up at the boat launch. Pete showed up at about 7:45 pm, we installed three yale grips at 75, 150 and 225 m and installed the new cable on the winch drum. We proceeded to Shotgun Bay and dropped the anchor for the night. At some point we had another anchor alarm in the middle of the night but it turned out to be a non-issue.



**Figure 5:** Deploying the Acrobat tow sled with the A-Frame fully extended over the stern of the RV Nanuq.

#### **Monday August 2:**

We departed from Shotgun Bay after a hearty breakfast of pancakes and bacon. The rolling seas in Passage Canal were 3-4' and with a stiff east wind, I had my doubts as to the workability of the day. As we rounded Perry Passage, the winds seemed to abate and the seas calmed down to a point where deploying the ADCP and Acrobat seemed reasonable. The Acrobat towed flawlessly with its new cable, we tested the yale grips at 150 and 225 m, the latter hookup allowed the Acrobat to undulate between 55 m deep and the surface. We towed our way down Perry Passage and into Knight Island Passage. We stopped the tow just north of Drier Bay and dropped anchor inside Port Audrey.

#### **Tuesday August 4:**

Left Port Audrey and picked up our three shrimp pots on the way out, they were full of shrimp. Headed out of drier bay and into Knight Island Passage to resume the tow from the day prior. We towed to the end of KIP, down Montague Strait (towards the Gulf) and across the strait to MacCleod Harbor where we recovered the towfish and the adcp. Once all our gear was aboard we steamed to the 3 nm mile limit and pumped our blackwater. After this task we steamed back up Montague Strait to anchor in Stockdale Harbor.

#### **Wednesday August 5:**

We awoke to bright blue skies and light winds. In a last ditch effort to complete the Middleton Island Line we decided to forego the plan and nose out into the Gulf with hopes of making the run to the Copper River Delta if conditions warranted. Once in the Gulf large swells in the 4-6' range were rolling in from the SE. We continued on our easterly trajectory but as the winds picked up we decided that our margins for error were too tight, that with the ADCP and Acrobat in the water we would have limited ability to recover the equipment in the large swells. The Cape Clear buoy was already reporting winds gusting to 25 kts and significant wave height in the 6 foot range. About halfway to the Copper River Delta, Brian expressed his concerns and we all agreed, there was no reason to push the equipment or the

safety of the crew. We returned to PWS and completed the Hinchinbrook and Orca inlet lines and then returned to Cordova for water (we were empty) and dropped the anchor just outside the small boat harbor.

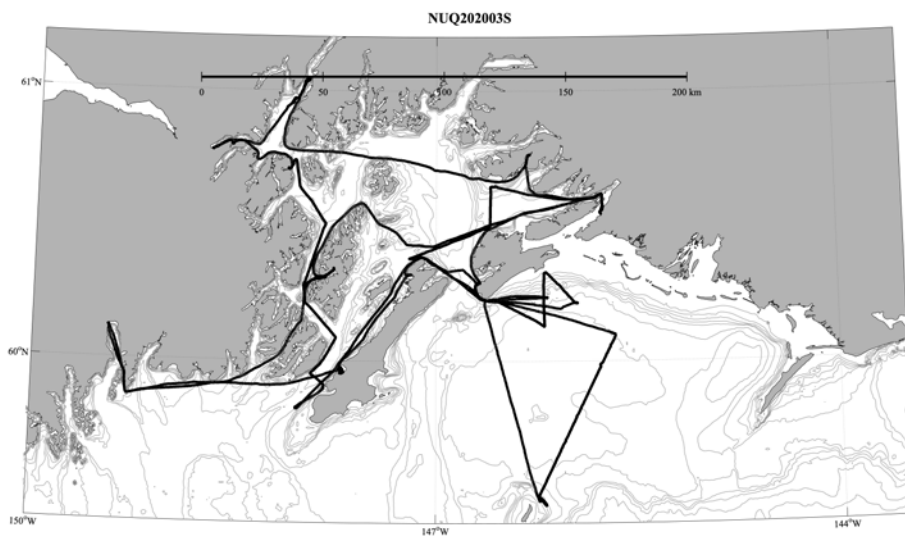
#### **Thursday August 6:**

After waiting for a spot at the fuel dock in Cordova, we topped off the Nanuq and began our transit back to Seward. While crossing Hinchinbrook Entrance, the predicted Easterly gale arrived and with it large waves originating from the Gulf of AK and the lengthy fetch afforded by Orca Inlet and the breadth of PWS. Operating the vessel under these conditions proved difficult and Brian announced that he was unable to keep the vessel on course for Montague Strait, instead he proposed altering our course so that we would be able to hide in the lee of Knight Island. After a few tense moments, we turned into Knight Island Passage and were able to escape the heavy seas. With the winds in the Gulf ramping up, we decided that the safest plan of action would be to stay one extra night on anchor in Port Audrey and let the low pressure system pass.

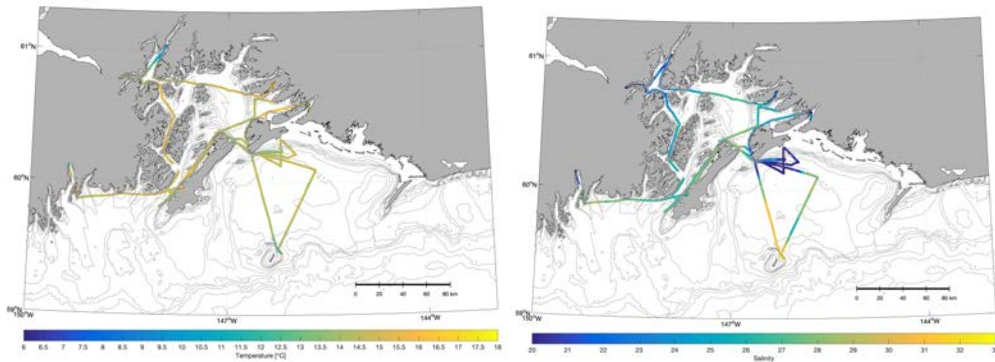
#### **Friday August 7:**

The winds howled overhead in Port Audrey overnight but our anchor held. We were able to receive updated weather reports from Ed DeCastro on my iridium InReach, which predicted the winds would be coming down at Cape Resurrection in the early afternoon. We left the anchorage at 11 am and made good time through Elrington Passage, across the Gulf and into Resurrection Bay in the early afternoon. We arrived at the Seward Small boat harbor at approximately 3:30 pm. Ed DeCastro met us at the dock and informed us that Pete Shipton intended to use the Nanuq the following day for CTD casts at the GAK1, RES2.5 and Thumb cove stations. We proceeded to offload all of our equipment, trash and personal gear from the vessel.

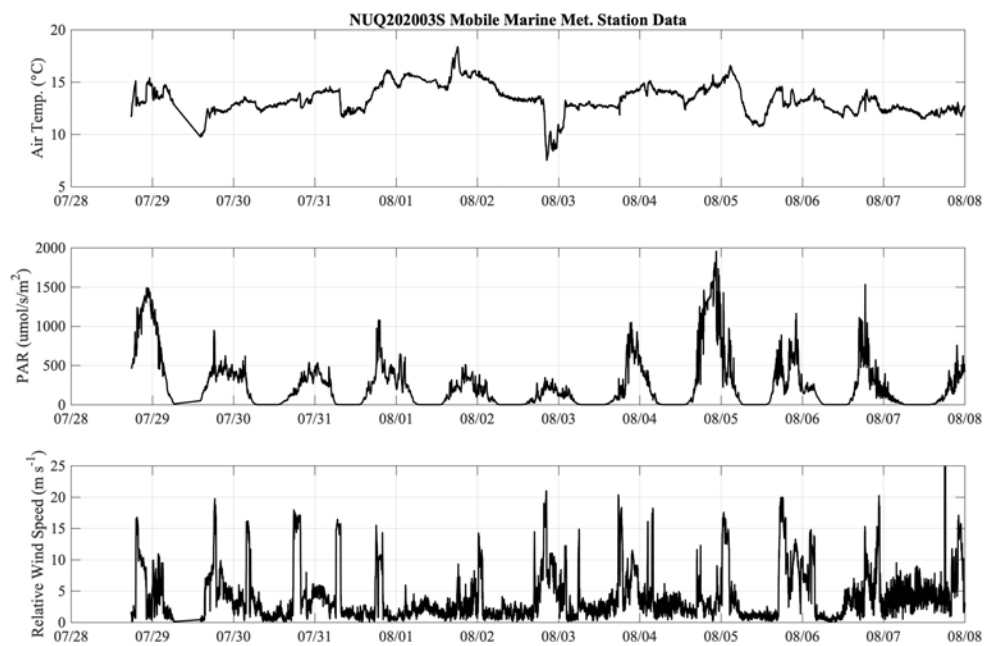
#### **Preliminary Science Plots:**



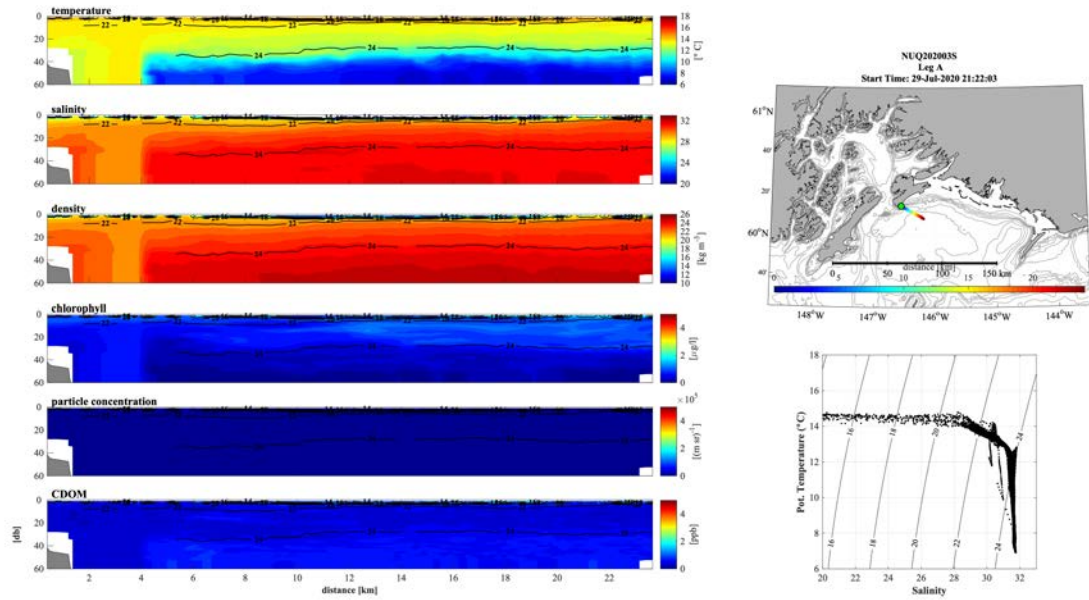
**Figure 6:** The vessel track from the NUQ202003S research cruise.



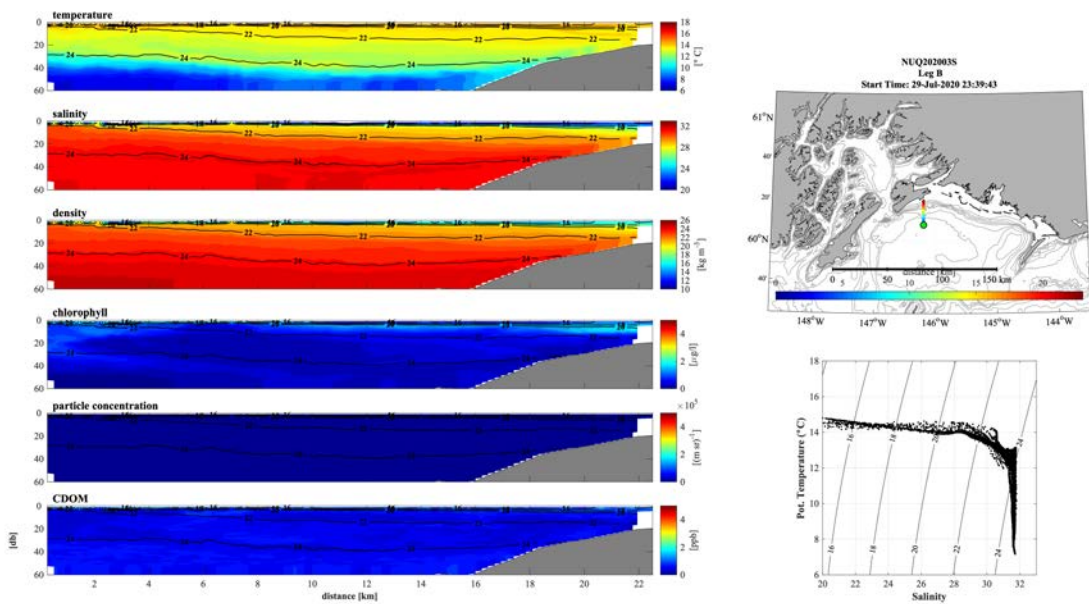
**Figure 7:** Sea surface temperature (left) and salinity (right) collected with the R/V Nanuq thermosalinograph.



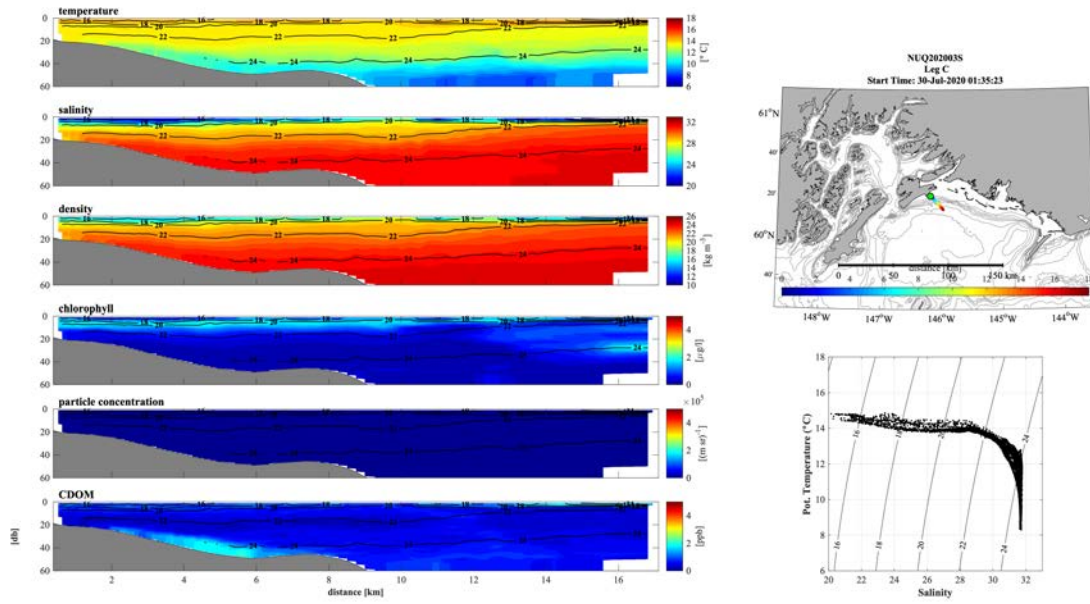
**Figure 8:** Air temperature (top), Photosynthetically Active Radiation (middle) and relative wind speed (bottom) from the mobile marine meteorological station mounted on the upper mast of the R/V Nanuq.



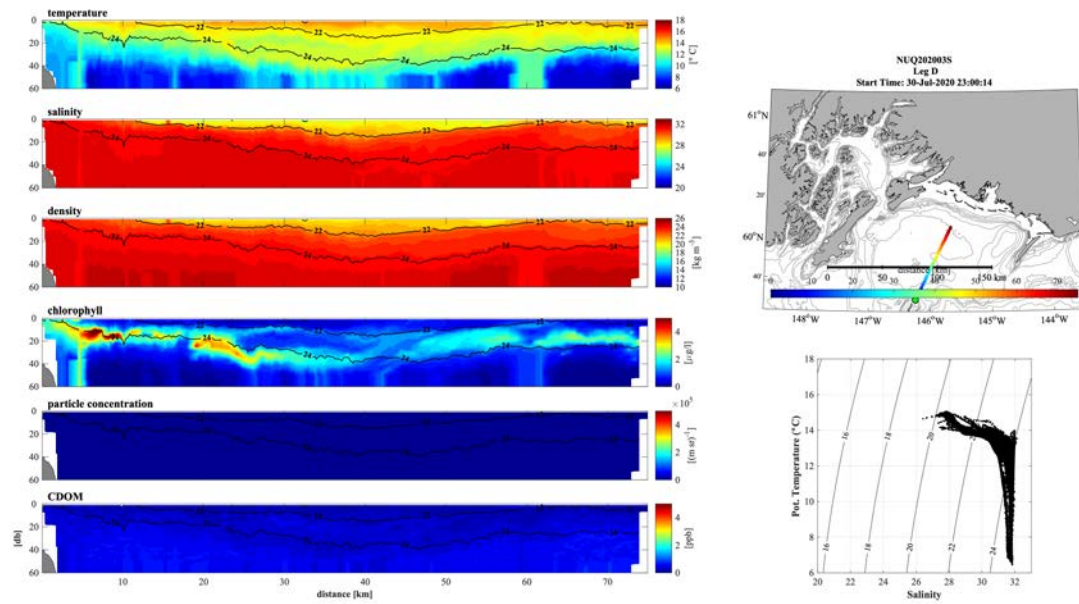
**Figure 9:** Acrobat Tow data for the A leg.



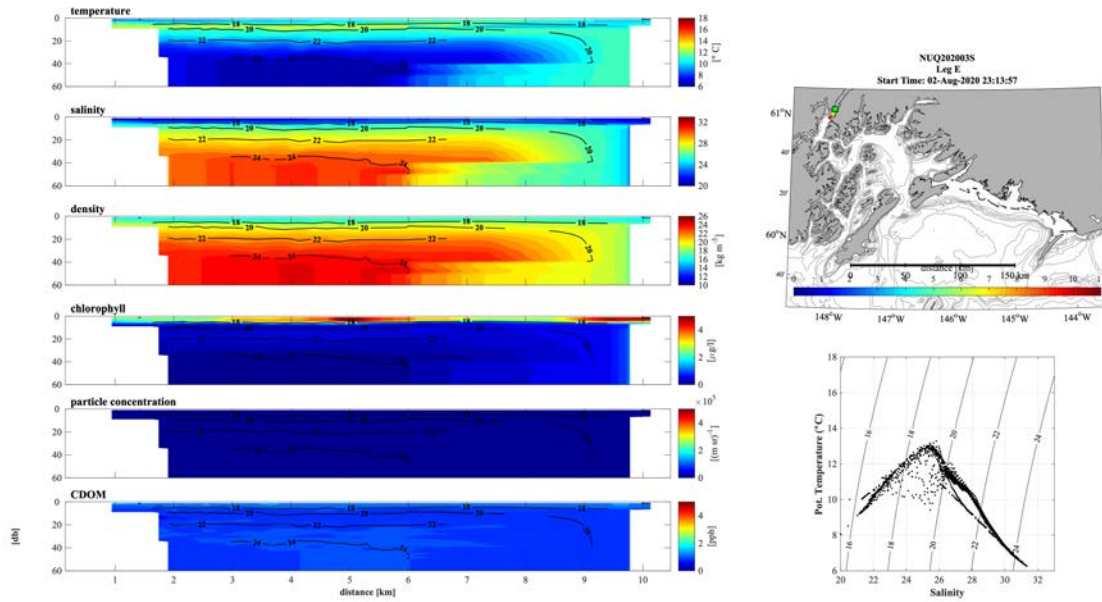
**Figure 10:** Acrobat Tow data for the B leg.



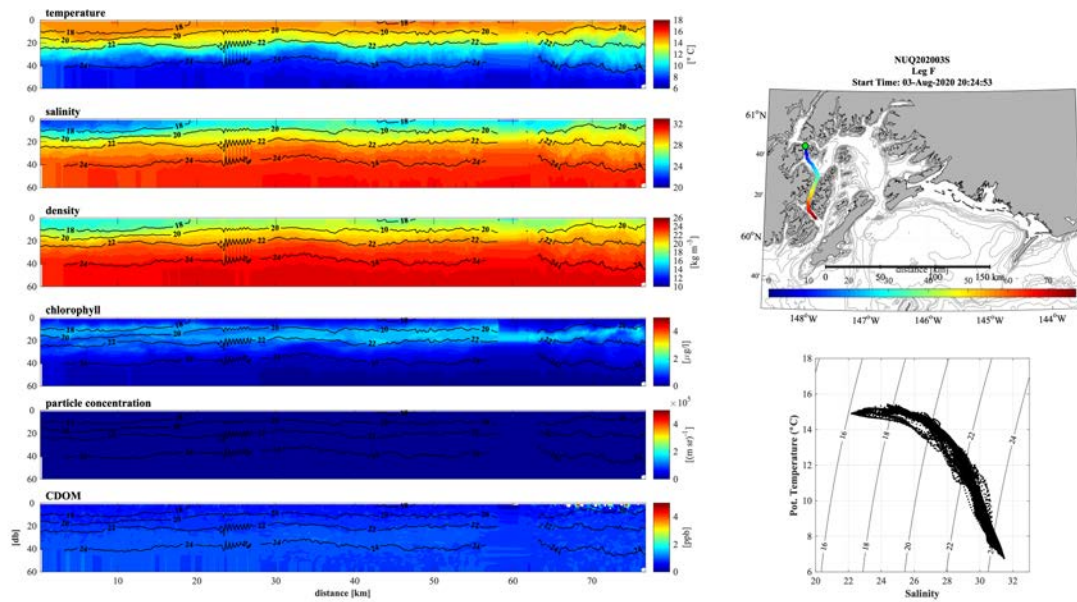
**Figure 11:** Acrobat Tow data for the C leg.



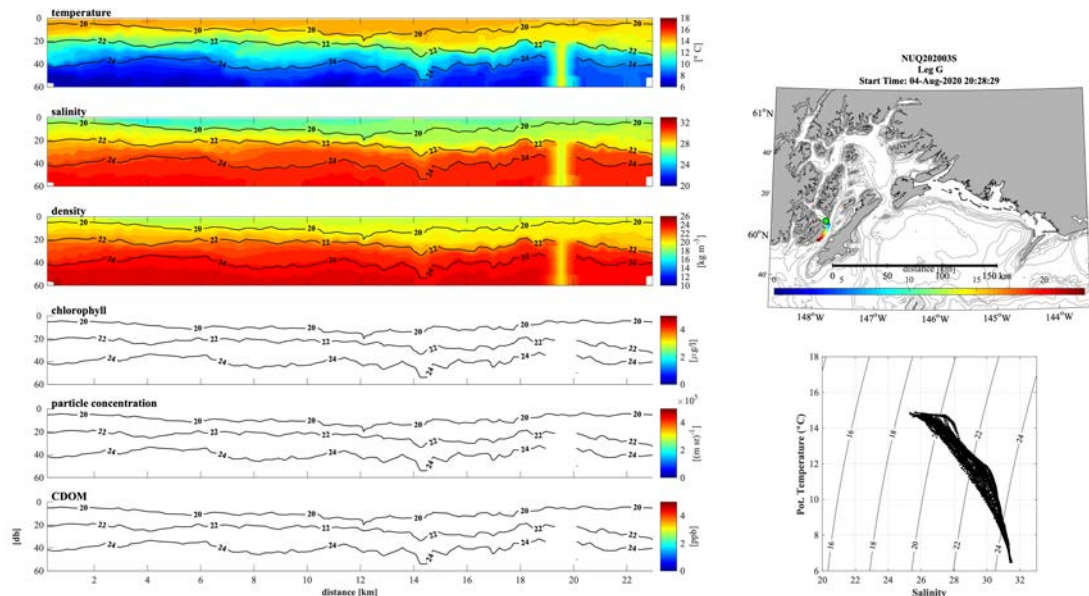
**Figure 12:** Acrobat Tow data for the Middleton Island or D leg.



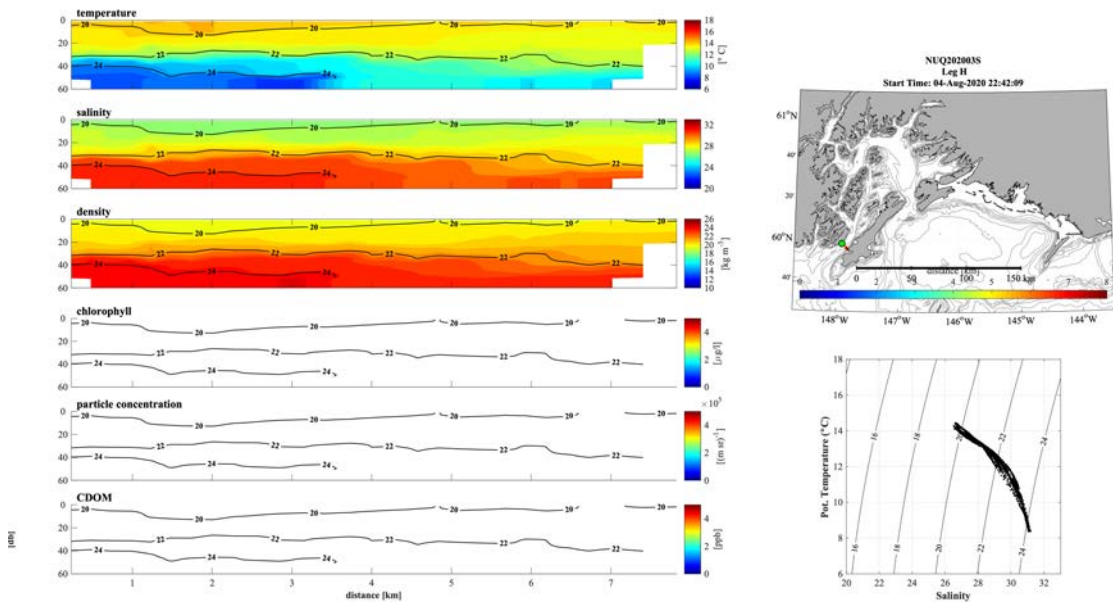
**Figure 13:** Acrobat Tow data for the E leg, this data was plagued with cable issues dictating an emergency trip to Whittier for a replacement cable.



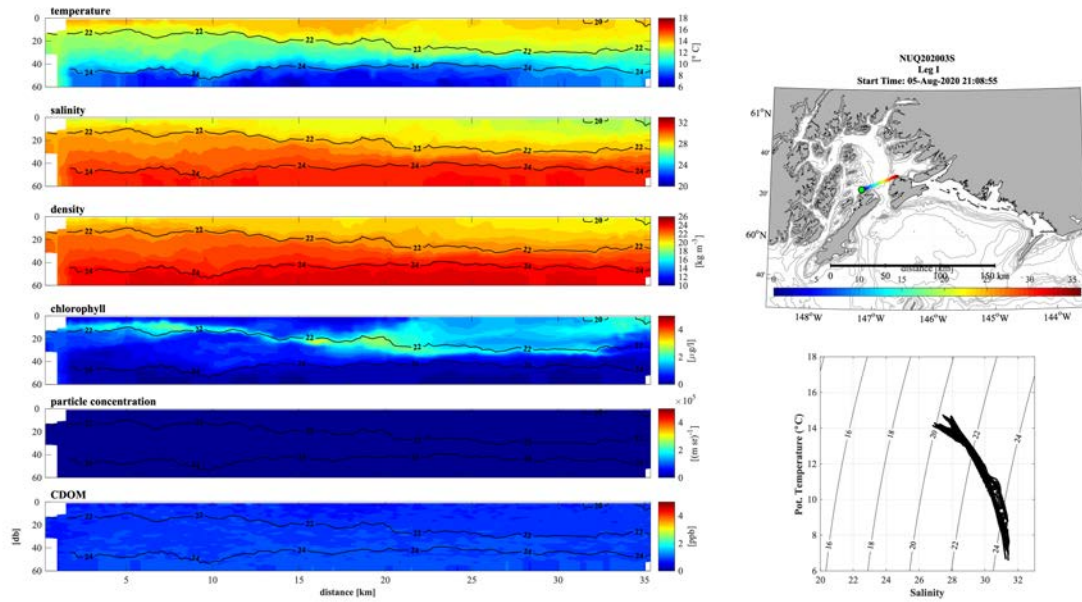
**Figure 14:** Acrobat Tow data for the F leg.



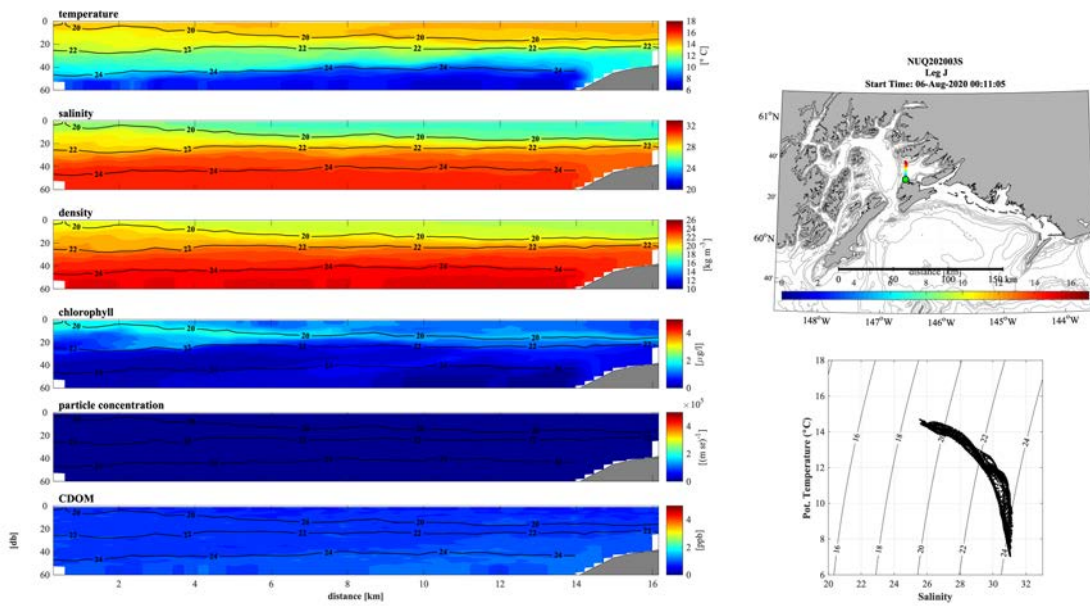
**Figure 15:** Acrobat Tow data for the G leg, we are still diagnosing the reason for the ECOpuck drop out in the next three tows completed on August 4.



**Figure 16:** Acrobat Tow data for the H leg across Montague Strait.



**Figure 17:** Acrobat Tow data for the I leg across Hinchinbrook Entrance.



**Figure 18:** Acrobat Tow data for the J leg across Orca Inlet.