Native Village of Mekoryuk
Survey Trip Report 2023

Arctic Coastal Geoscience Lab - University of Alaska Fairbanks

Field Work Sept 23-29, 2023

This report has been prepared by:

Aaron Woods, arwoods2@alaska.edu
Chris Maio, cvmaio@alaska.edu
Matthew Balazs, mbalazs@alaska.edu

The project titled, Meq unguvatkarput (water is our livelihood) - building community resilience for the future, is being funded through the National Science Foundation Navigating the New Arctic Program (Grant # 2220559) and directed by the University of Massachusetts, Amherst.

INTRODUCTION

Mekoryuk is located at the mouth of Shoal Bay on the north shore of Nunivak Island in the Bering Sea (Figure 1). Nunivak island lies 48 km (30 mi) west of the Alaska coast. According to the United States Census Bureau, the city has a total area of 7.4 square miles (19 km^2), of which, 7.4 square miles (19 km^2) of it is land and 0.14% is water. At the most recent 2020 Census, the Population was ~262 with a median age of 39, the 2010 census population was 191, down from 210 in 2000. The island's entire population lives in the north coast city of Mekoryuk.

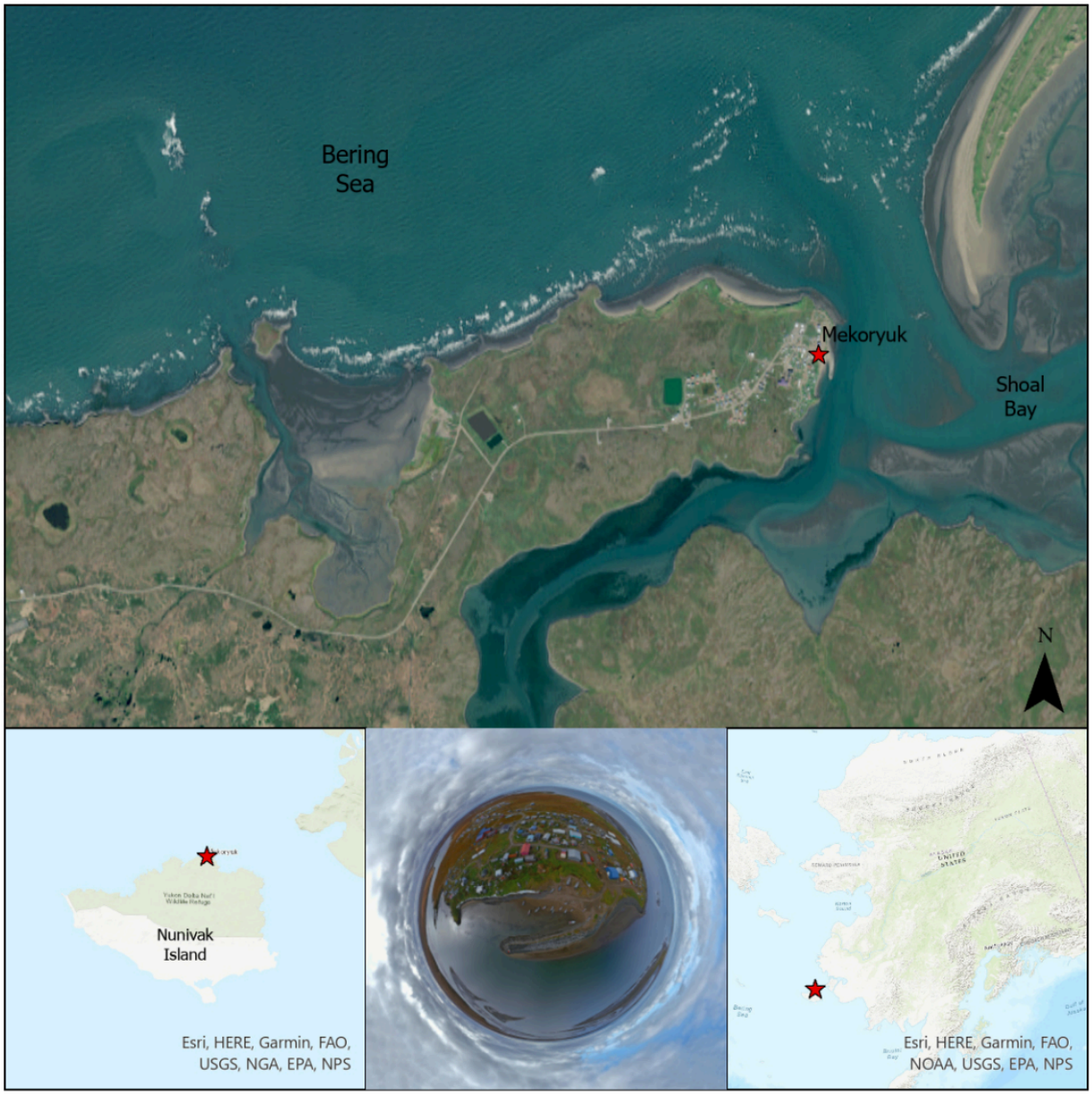


Figure 1 Mekoryuk Village location map with view of the community through a fisheye lens.

Draft Cultural History:

Nunivak Island has been inhabited for ~2,000 years by the Nuniwarmiut, or Nunivak Cup'ig people. The community's first contact with Europeans was in 1821 when explorers from the Russian-American Company arrived on their island. These Russians recorded ~400 people living in 16 villages on Nunivak Island. The island is 1,631.97 square miles (4,226,8 km^2) in area, making it the second largest island in the Bering Sea and eighth-largest in the United states.

In the mid-20th century, Mekoryuk became the only permanent population center on the island. Until the 1940s, the traditional lifestyle and traditional ceremonies and religious beliefs were practiced.

The 1950s and 1960s brought considerable change. Mekoryuk Airport was built in 1957. When the Territorial Guard was formed, men were sent to Fort Richardson near Anchorage for training. During this time, many families moved to Bethel during the winter to be near the high school, returning in the spring for fishing and sea mammal hunting. A high school was constructed in Mekoryuk in 1978. The Nuniwarmiut School has ~50 students preK-12 and is part of the Lower Kuskokwim School District and a hub for community events.

Previous Assessments of Coastal Flooding and Erosion Hazards

2023 State of Alaska, State Hazard Mitigtation Plan
https://ready.alaska.gov/Documents/Mitigation/SHMP/2023%20State%20of%20Alaska%20Hazard%20Mitigation%20Plan.pdf

A history of Human Settlement on Nunivak Island, Alaska: Insights from Recent Investigations at Nash Harbor Village. https://www.jstor.org/stable/40316565?seq=1

Effects of seasonality and variability of streamflow on nearshow coastal areas: final report
https://scholarworks.alaska.edu/handle/11122/1224

Recent and Historic Population Trends in Bering Sea and Aleutian Island Fishing Communities: Hubs and Spokes, Booms and Busts
https://www.academia.edu/download/32591816/download.pdf

SURVEY TRIP REPORT

Field Team Daily Log, Sept 23- Sept 29, 2023

9/23. Saturday - left the village of Kongiganak and traveled to Mekoryuk. This Was done via 2 flights, the first one left Kong at ~10:00 AM via Grant Aviation with 5 of the 6 team members and their personal gear. One person (Aaron) remained in Kong to monitor and travel with the team's gear on the next flight (via Ryan Aviation). The next flight left ~30 minutes later and the team reassembled at the Mekoryuk school where we stayed the first night. We had good weather upon arrival in Mekoryuk and began UAV flights immediately. Other team members went on an exploration hike led by Julie to discuss areas of interest for work. The initial UAV data was processed overnight to visualize the extent captured and to check data quality. The team stayed in the Nuniwarmiut School, sleeping in the classrooms, the first night in Mekoryuk.

9/24 Sunday: The team transitioned from the School to the Parsonage House (across from Red Church) at 3 in the afternoon with the help of the Nuniwarmiut School Principal, Peter Hawkins (he loaded our gear in his truck for transport around the corner to the new location). The weather was not as good for UAS flights so we opted to focus on collection of GPS data. Chris, Aaron and Patrick began collecting GPS data for Vegetation lines and beach profiles Sunday morning near the harbor. The water quality team began sample collection and organizing interviews for later in the week with community members.

9/25 Monday. Aaron captured additional UAS data to supplement areas not captured on 9/23. The research team presented to a combined group of the City Council and the Village Advisory group in the evening at the School to discuss project goals and shared some initial water sampling results for the school water system.

9/26 Tuesday: GPS data was collected (Julie, Aaron, Chris and Patrick) in the morning. Julie worked with Chris and Patrick in the afternoon collecting more profiles and GCP data while Aaron captured additional Drone imagery.

In the evening, the team attended a meeting held by CE2 Engineers who are working on a Design for Washeteria updates including a couple of Lift Pumps to send wastewater directly to the Wastewater stream vs the current Gravity feed system to the previous Wastewater Lift pump at the “old facility”. We learned a bit about the history of the water system and how the wastewater treatment pond had been moved previously.

9/27 Wednesday: The team visited the Laundromat early to get some laundry done and to see the system. Aaron was asked to present UAS information to students at the Nuniwarmiut School after lunch (12:40-2pm). The class enjoyed seeing the results of the UAS mapping and learning how UAS can be used for mapping. Chris, Aaron and Julie went out to the dump in the afternoon and did some core samples at the exposed bluff and we checked soil quality in an old lake bed near the Airfield. We found that once a hole was poked in the vegetation layer, the vegetating mat was able to move/undulate and was really a thick layer of vegetation floating on

a mucky/silty/wet soil layer. Caitlyn, Patrick and Tom visited a water source upriver and did some water samples and fishing (no fish were caught, but fun was had)

9/28 Thursday: Caitlyn and Tom were asked to present some information about water sampling and rain gauges at the school in the afternoon and they presented twice (a Middle school session and a High School session). Chris and I compiled data from UAS, field Cameras, and GPS to share with village partners. Aaron produced a couple of 8.5”x11” maps for Julie to show work progress in some initial trip reports.

9/29 Friday: We returned the 4wheelers and gear to the team CONEX box. The team had a 9:00 AM flight/charter scheduled for return to Bethel for connection with Alaska Airline Flights back to Anchorage and Fairbanks. Bessie provided the team with a lift to airstrip at about 8:30 and flights back to Fairbanks all went smoothly.

RESEARCH METHODS, ACTIVITIES, AND DATA

Topographic Surveys: All topographic data was collected using a Trimble R12 real-time kinematic Global Navigation Satellite System (RTK-GNSS) including a mobile rover unit and base station. The GPS base station was established Saturday, Sept 23rd on a bluff above the small boat harbor. The GPS was checked daily for battery level and operational status. The corrected coordinates are Easting 434,632.309, Northing 6,695,193.631 Elevation 11.036 m. The base station was set up on top of a sand dune located above the boat harbor (Figure 2). A total of 2,922 points were collected during the field work (Figure 3.)



Figure 2. Location of base station on sand dune fronting small boat harbor.

Cross-shore topographic profiles: 22 cross-shore topographic profiles were collected along the shoreline fronting the Mekoryuk village (Figure 3) Profile lines were started from inland high points and progressed in a generally perpendicular orientation toward the water lines with data captured every few meters via the RTK rover unit. Supporting terrestrial digital photos were captured of each profile line area showing terrain and vegetation conditions (Figure 4). GNSS data was later differentially corrected against RTK GNSS data from the temporary base station the team established above the community small boat harbor. Appendix A, Profile graphs were generated for each line with associated terrestrial and aerial imagery.

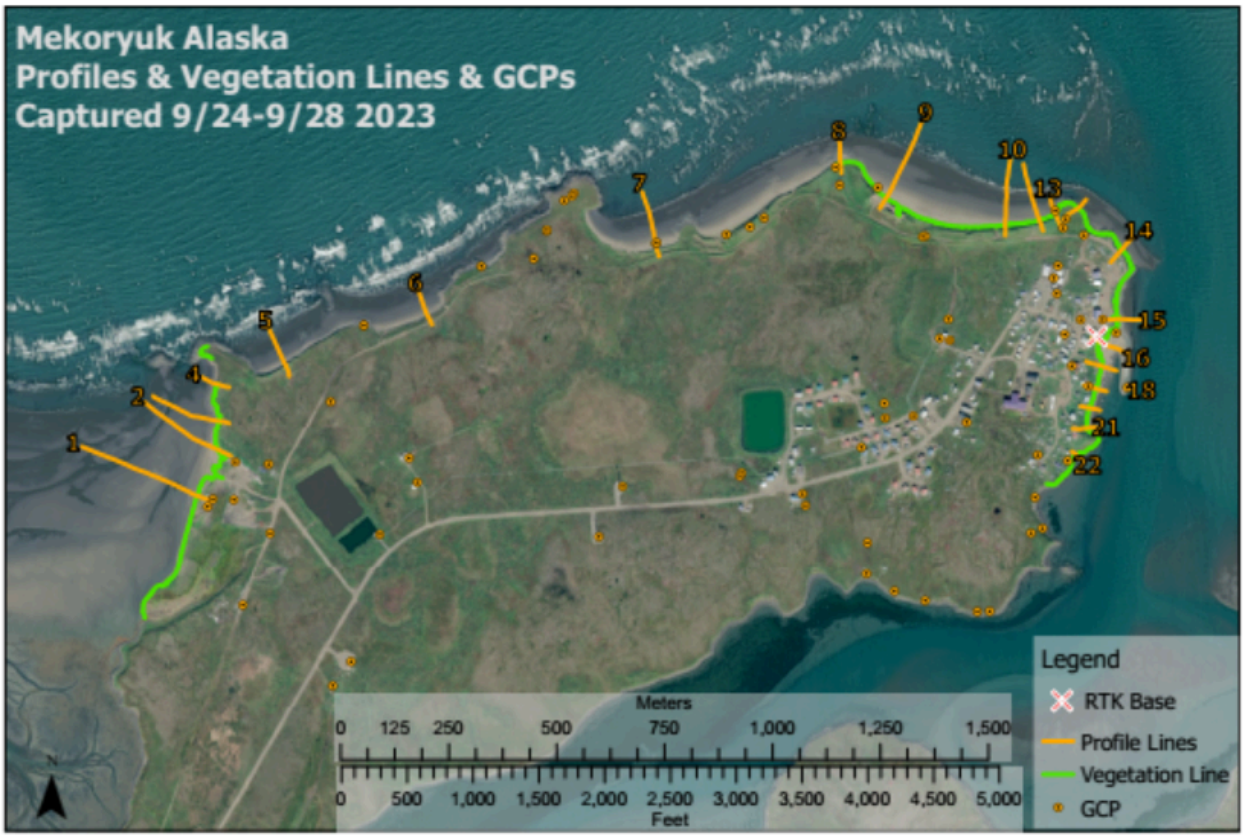


Figure 3 . Profile & Vegetation Lines and GCP points collected via RTK GNSS



Figure 4: GPS Data Collection with local project participants.

Shoreline Vegetation Line: The team walked and recorded ~2km of the existing vegetation line along the surrounding coastal/shore area (Figure 3). The RTK rover in *continuous topo mode* was carried along the vegetation line with points captured every meter as the team members traversed this coastal feature (Figure 5).



Figure 5: Shore Vegetation Line being recorded by RTK GNSS.

Ground Control Points: In conjunction with the Shoreline vegetation and Shoreline Profile data collection, the team collected 72 individual Ground Control Points (GCPs) using the RTK GNSS system (Figure 3) in support of accurate orthomosaic image creation/registration and validation, leveraging aerial imagery collected from an Autel Evo II RTK UAS system. Multiple flights were conducted over multiple afternoons as weather conditions permitted. Each flight was designed to capture nadir imagery with roughly 80% front and 75% side overlap from an altitude of ~300 ft above take off. In all 7,810 20mp images (Figure 6) were processed into a seamless orthomosaic covering X acres with a Ground Sampling Distance (average pixel size) of 2.50 cm or 0.98 inches or roughly 1 inch per pixel.

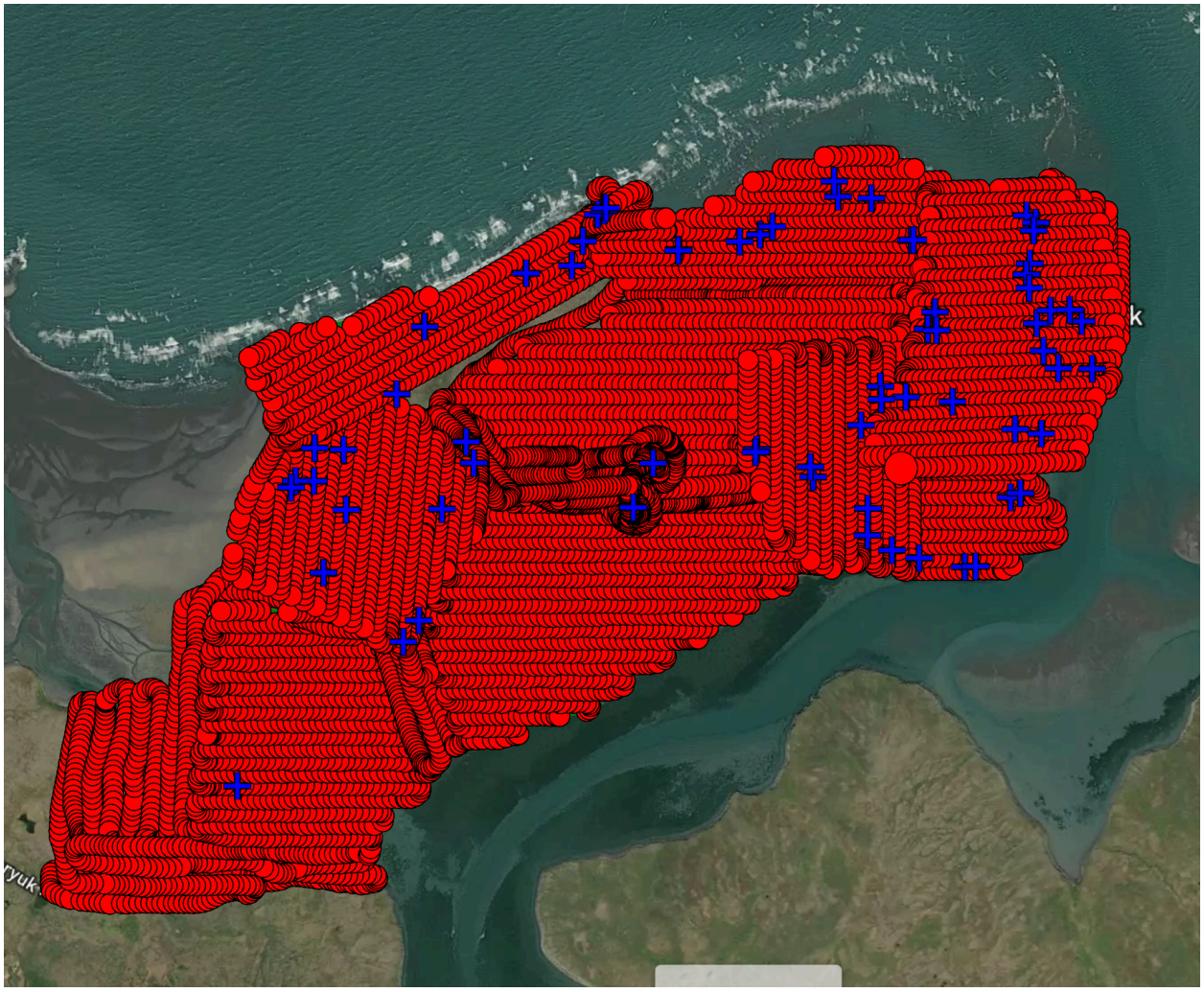


Figure 6 . Red dots indicate photo points captured by UAS. Blue crosses indicate GCP locations.

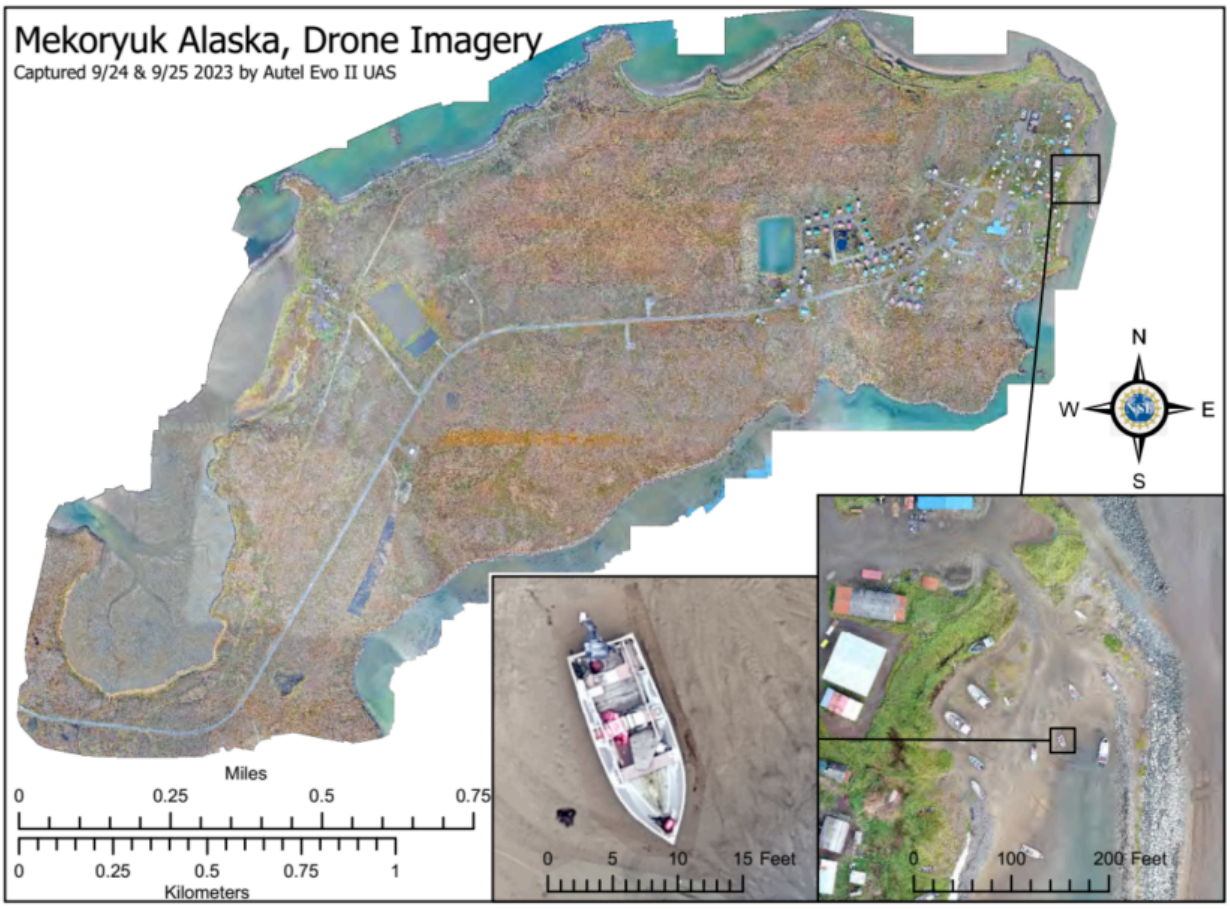


Figure 7. UAS Imagery Orthomosaic generated from 7810 overlapping images processed into a seamless Orthomosaic with a ground sampling distance of 1 inch.

Coastal Profiles:

Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

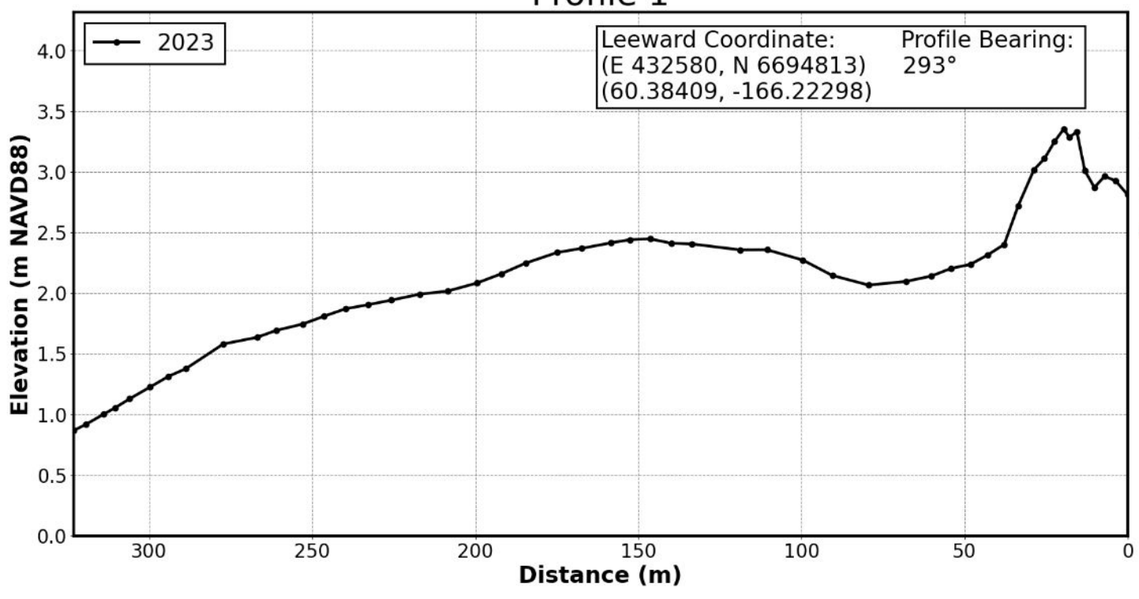
Profile 1

Profile 2

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 1







Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 5
Profile 4
Profile 3
Profile 2

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 2

2023

Leeward Coordinate:
(E 432627, N 6694917)
(60.38503, -166.22215)

Profile Bearing:
302°

Elevation (m NAVD88)

0 1 2 3 4

200 150 100 50 0

Distance (m)





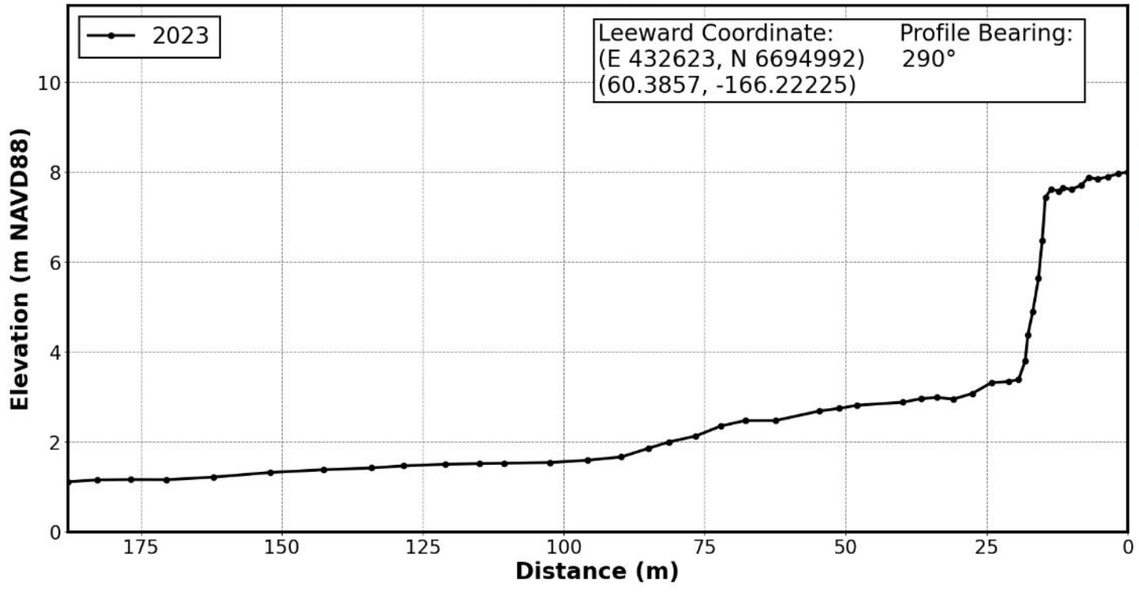
Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 1
Profile 2
Profile 3
Profile 4
Profile 5

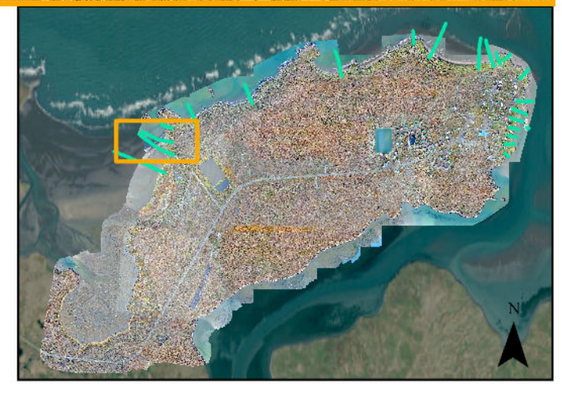
Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 3







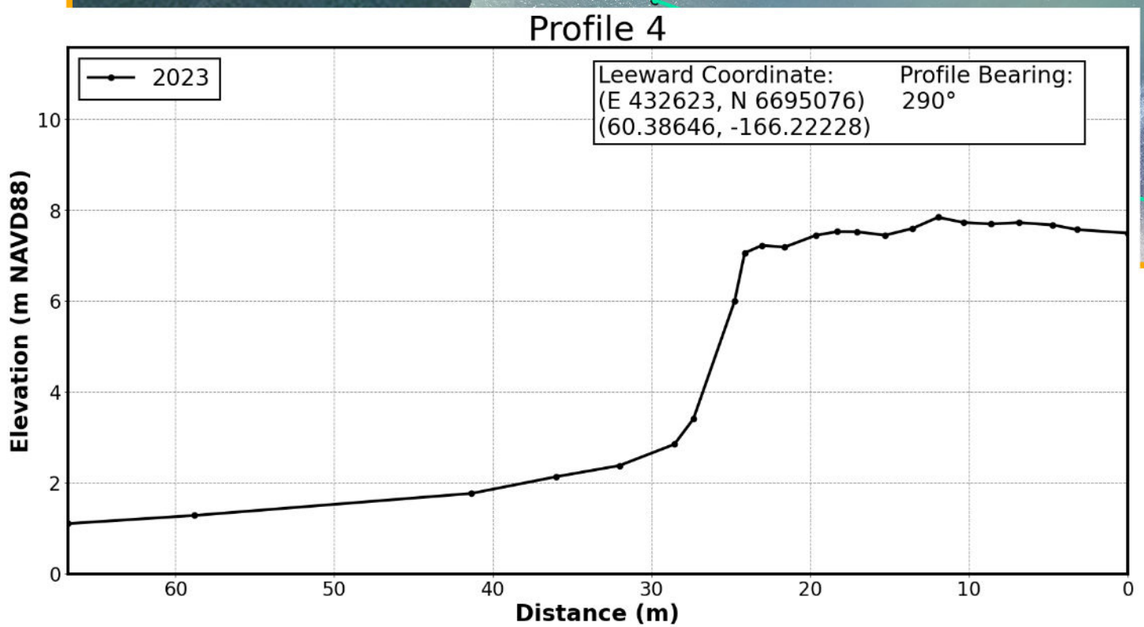
Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 4

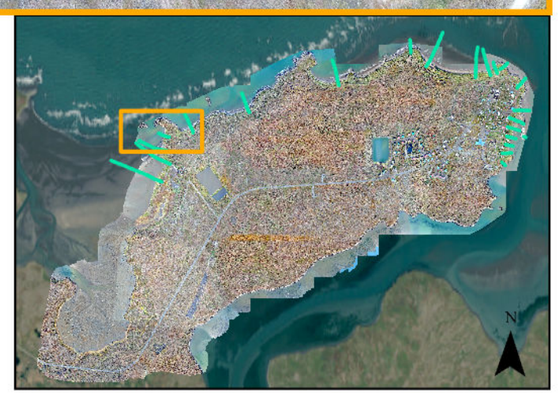
Profile 5

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters





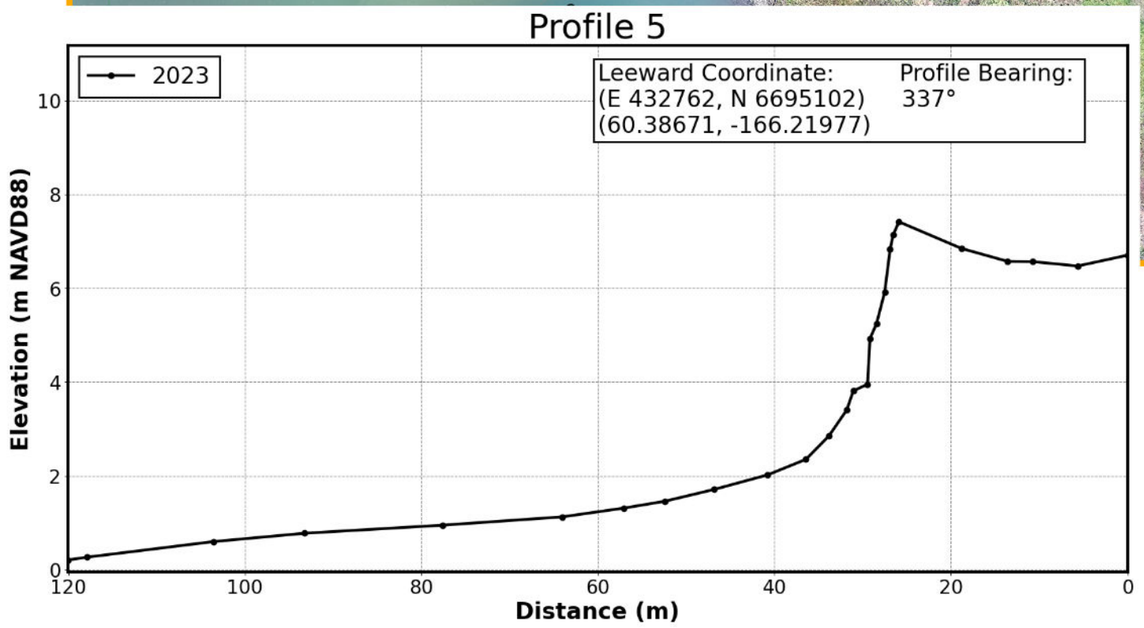


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 5

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters







Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 6

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 6

2023

Leeward Coordinate:
(E 433093, N 6695221)
(60.38783, -166.21382)

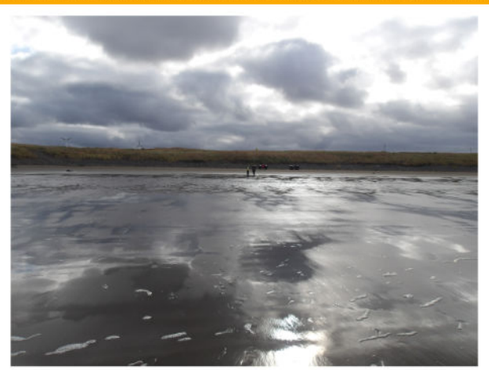
Profile Bearing:
339°

Elevation (m NAVD88)

0 2 4 6 8 10

120 100 80 60 40 20 0

Distance (m)



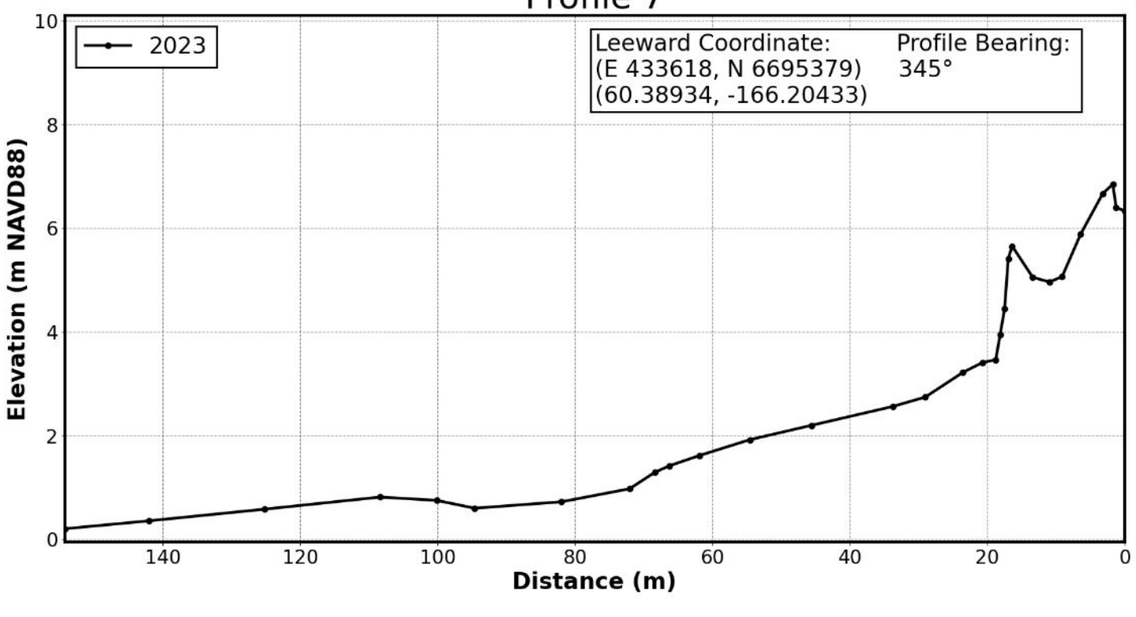


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 7

Profile pts
Shore / Vegetation Line
Profile Lines

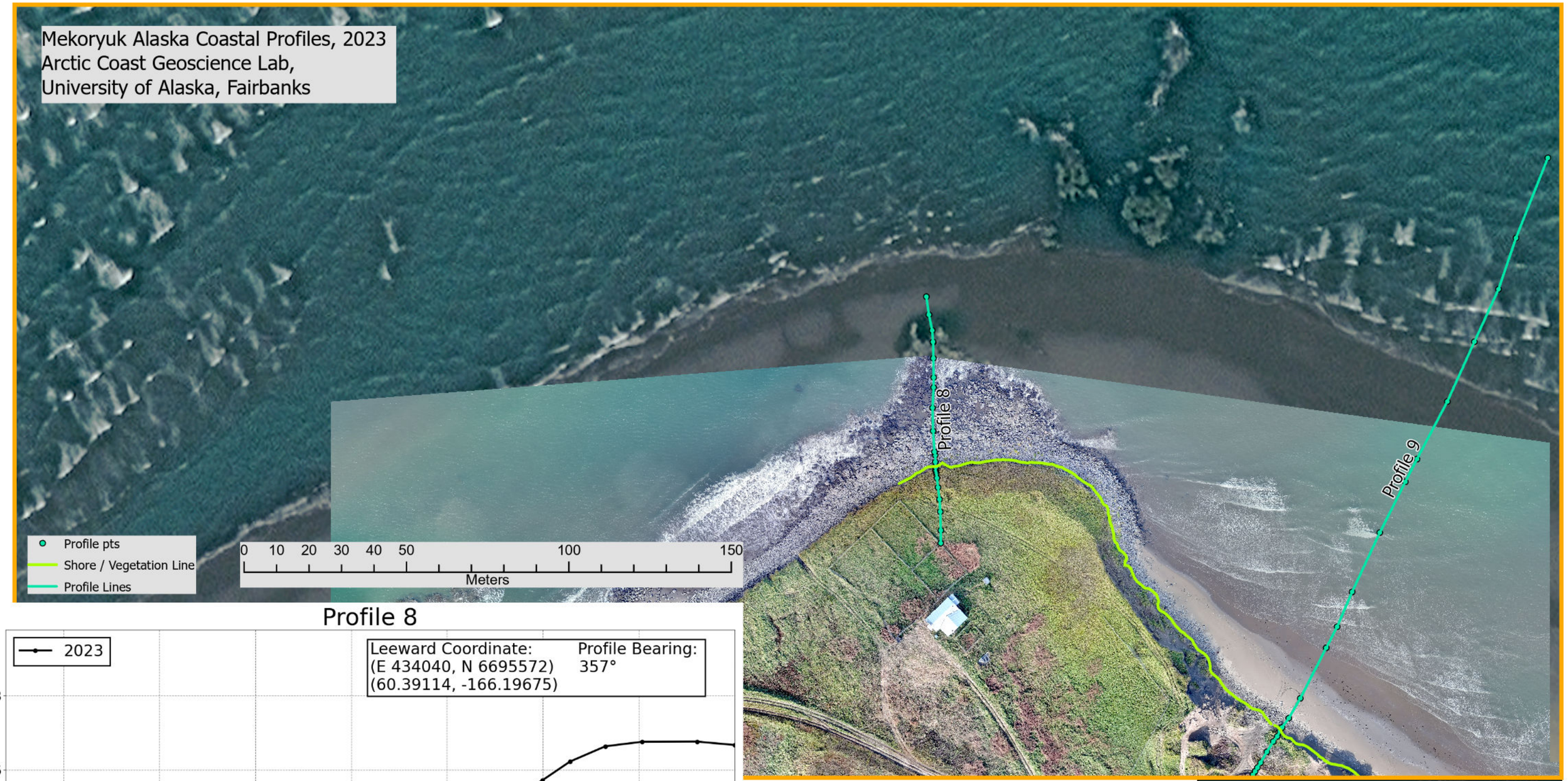
0 10 20 30 40 50 100 150
Meters

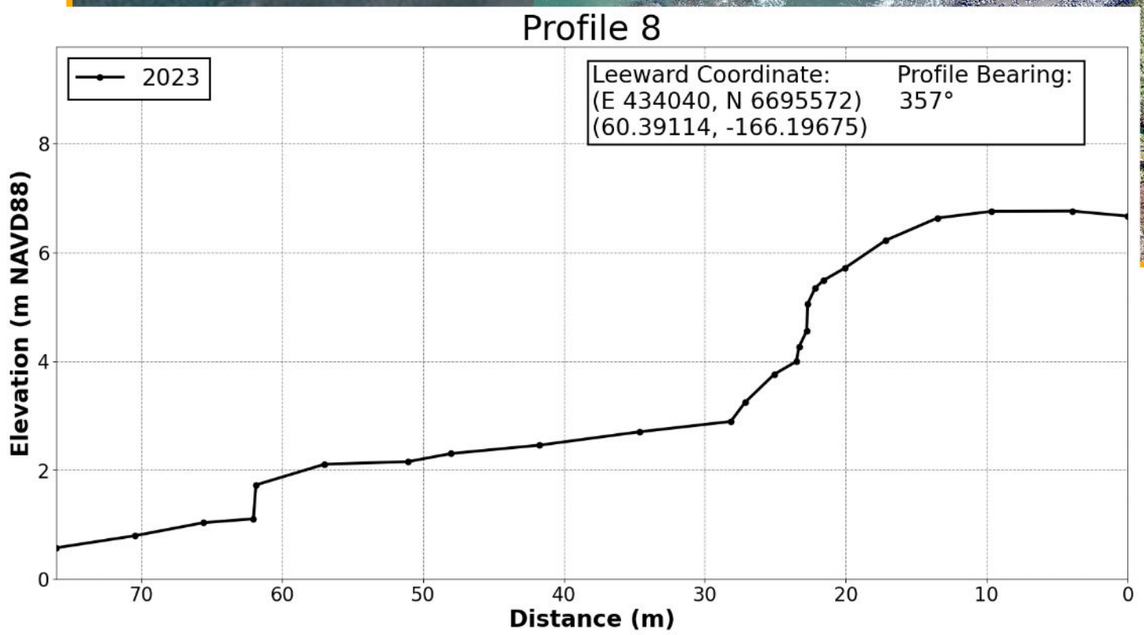




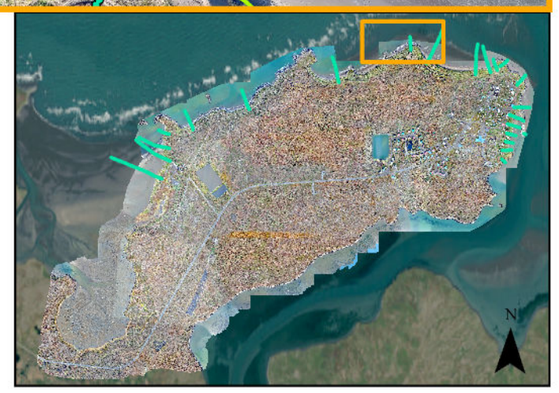


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks









Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 8

Profile 9

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 9

2023

Leeward Coordinate:
(E 434130, N 6695489)
(60.39042, -166.1951)

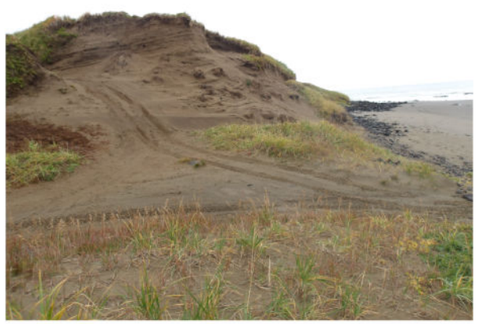
Profile Bearing:
26°

Elevation (m NAVD88)

0 2 4 6 8 10

200 175 150 125 100 75 50 25 0

Distance (m)



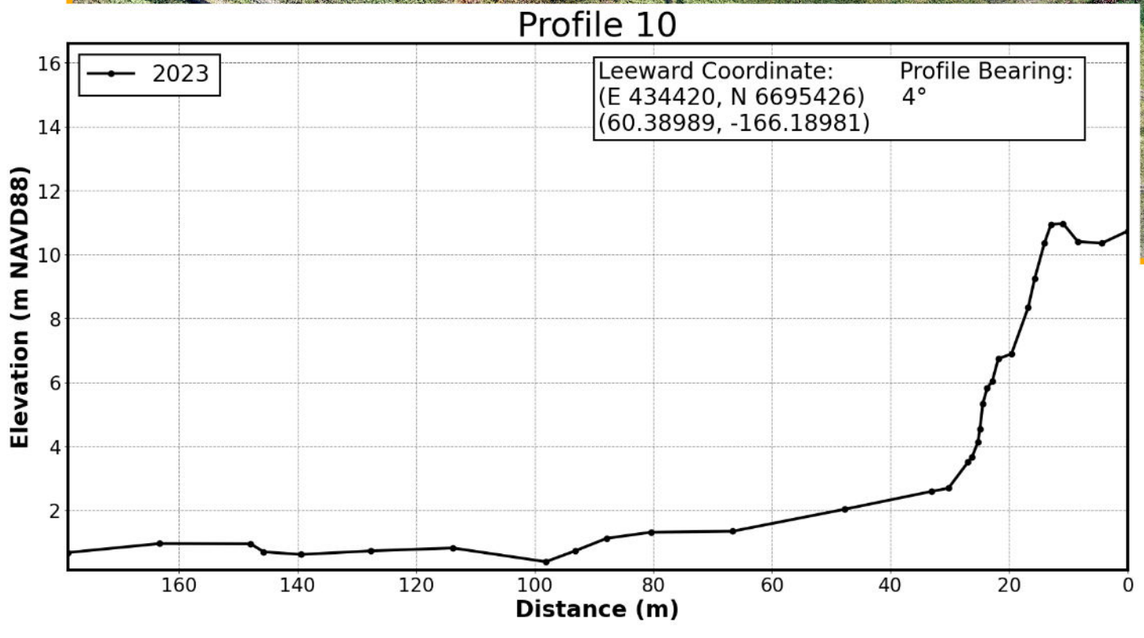


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

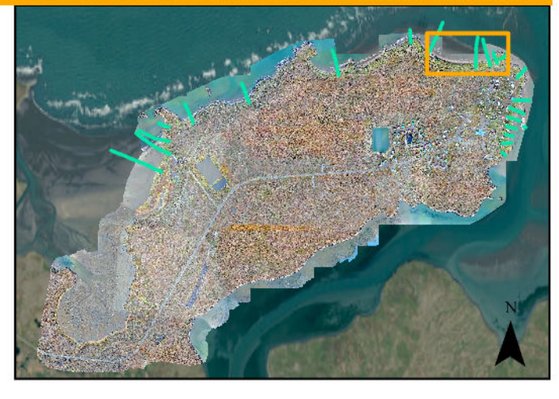
Profile 9
Profile 10
Profile 11
Profile 12
Profile 13

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters







Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 10
Profile 11
Profile 12
Profile 13

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 11

2023

Leeward Coordinate:
(E 434508, N 6695437)
(60.39001, -166.18822)

Profile Bearing:
344°

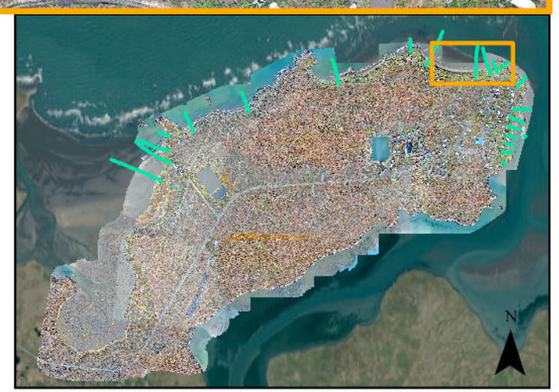
Elevation (m NAVD88)

16
14
12
10
8
6
4
2

160 140 120 100 80 60 40 20 0

Distance (m)



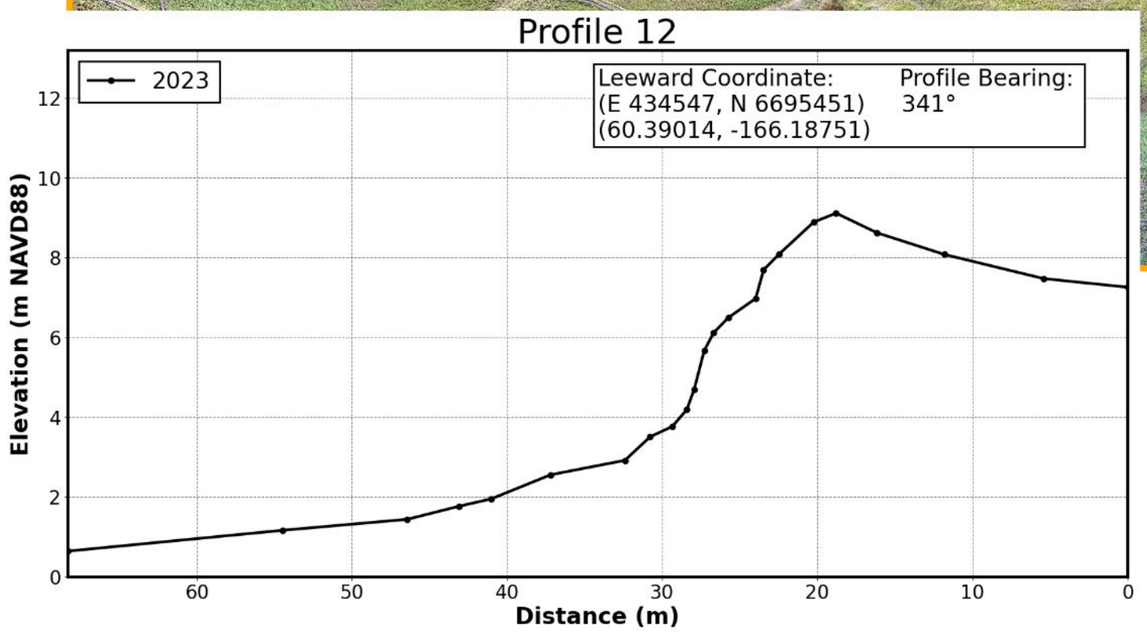


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

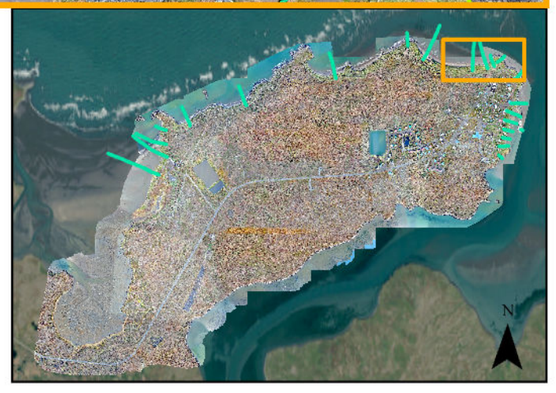
Profile 10
Profile 11
Profile 12
Profile 13
Profile 14

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters







Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 10
Profile 11
Profile 12
Profile 13
Profile 14

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

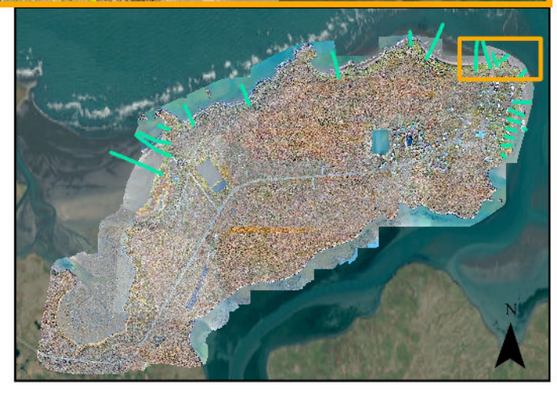
Profile 13

2023

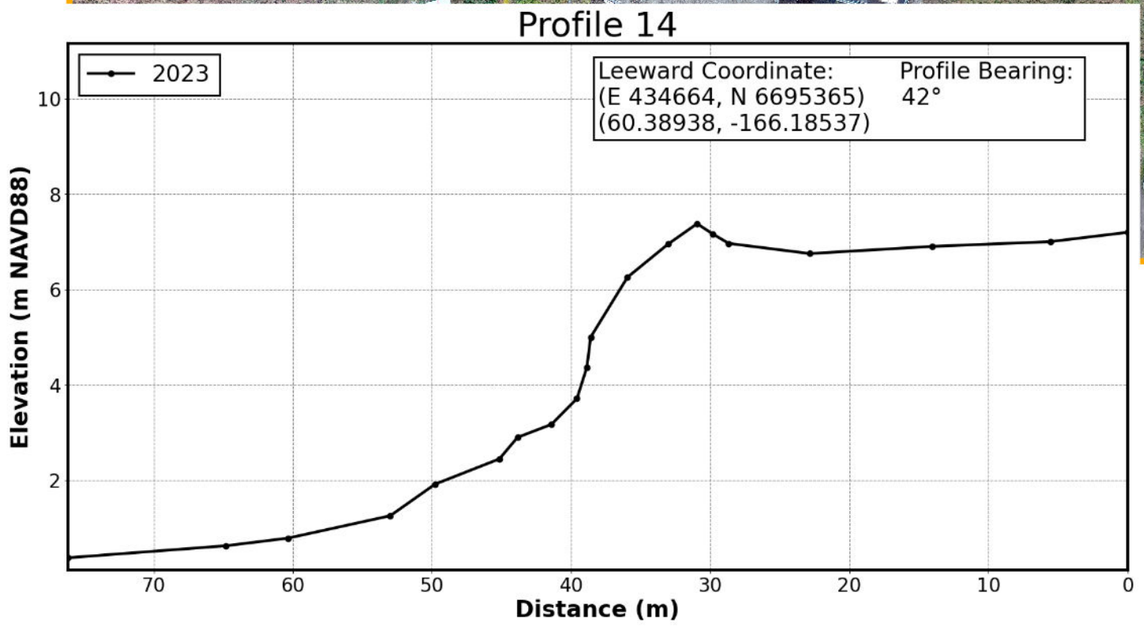
Leeward Coordinate: (E 434564, N 6695475) (60.39035, -166.18722)
Profile Bearing: 51°

Elevation (m NAVD88)
8
6
4
2
50 40 30 20 10 0
Distance (m)






Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks
Profile 10
Profile 11
Profile 12
Profile 13
Profile 14
Profile pts
Shore / Vegetation Line
Profile Lines
0 10 20 30 40 50 100 150
Meters


Profile 14
2023
Leeward Coordinate:
(E 434664, N 6695365)
(60.38938, -166.18537)
Profile Bearing:
42°
Elevation (m NAVD88)
Distance (m)
10
8
6
4
2
70
60
50
40
30
20
10
0




N

Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 14

Profile 15

Profile 16

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

N

Profile 15

2023

Leeward Coordinate:
(E 434646, N 6695233)
(60.3882, -166.18565)

Profile Bearing:
91°

Elevation (m NAVD88)

12
10
8
6
4
2

80 60 40 20 0

Distance (m)





Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 15
Profile 16
Profile 17
Profile 18
Profile 19

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters

Profile 16

2023

Leeward Coordinate:
(E 434619, N 6695189)
(60.3878, -166.18612)

Profile Bearing:
114°

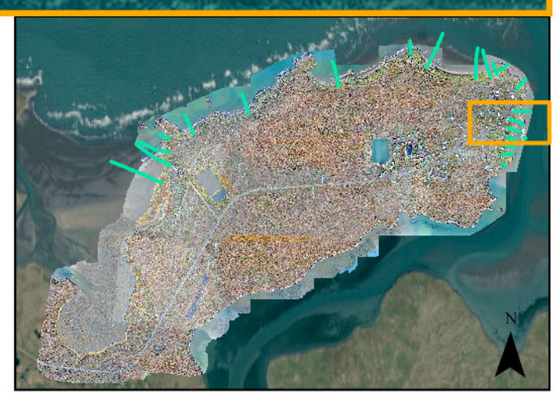
Elevation (m NAVD88)

0 2 4 6 8 10 12 14

80 60 40 20 0

Distance (m)



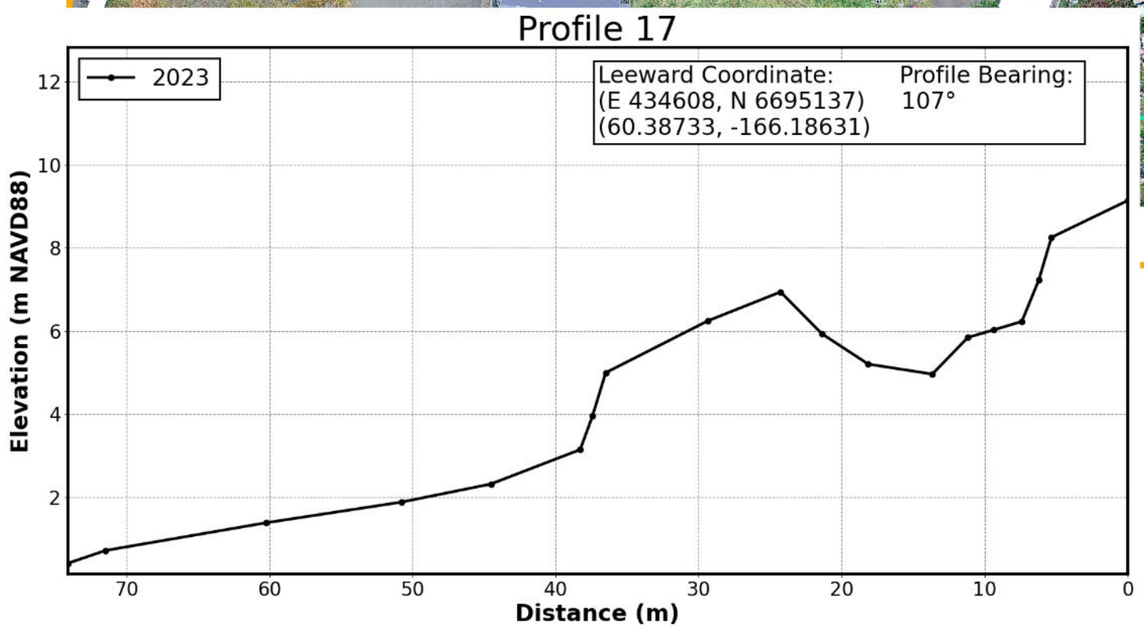


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 15
Profile 16
Profile 17
Profile 18
Profile 19

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50 100 150
Meters





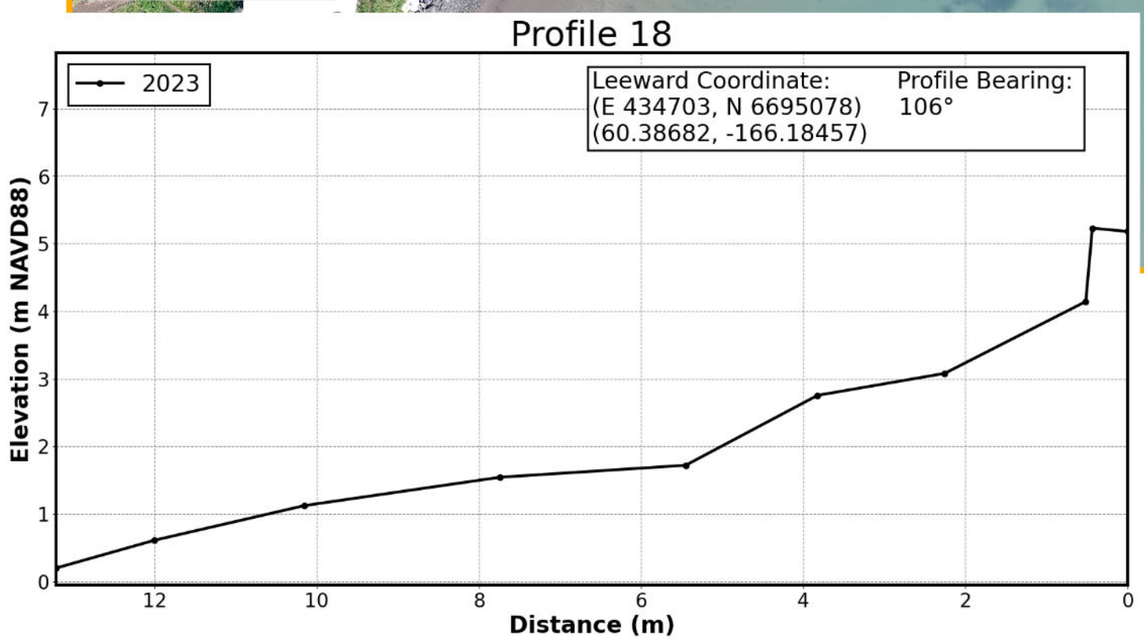


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 17
Profile 18
Profile 19

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50
Meters





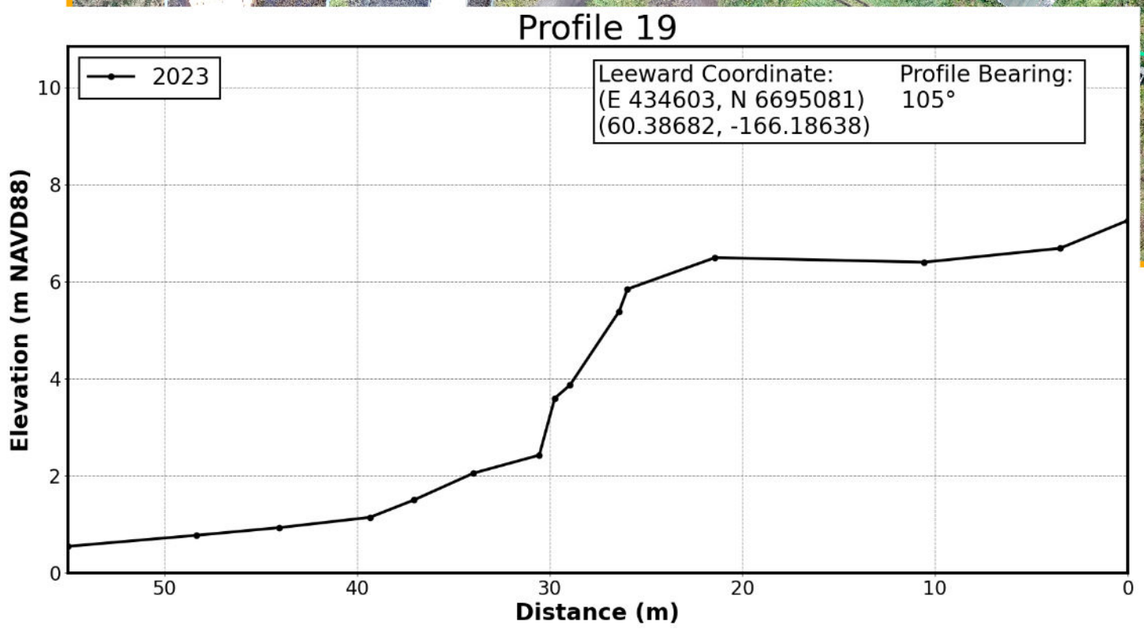


Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 17
Profile 18
Profile 19
Profile 20

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50
Meters







Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 18
Profile 19
Profile 20
Profile 21

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50
Meters

Profile 20

2023

Leeward Coordinate:
(E 434595, N 6695033)
(60.38639, -166.18651)

Profile Bearing:
102°

Elevation (m NAVD88)

12
10
8
6
4
2

40 30 20 10 0

Distance (m)





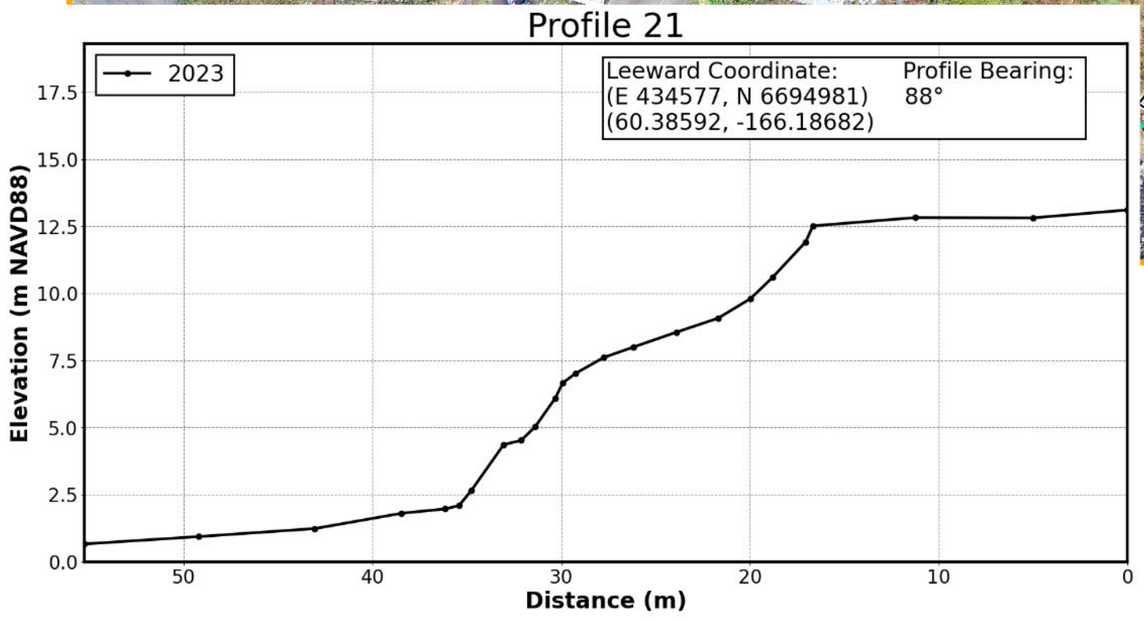
Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50
Meters

Profile 21

Profile 22







Mekoryuk Alaska Coastal Profiles, 2023
Arctic Coast Geoscience Lab,
University of Alaska, Fairbanks

Profile 22

Profile pts
Shore / Vegetation Line
Profile Lines

0 10 20 30 40 50
Meters

