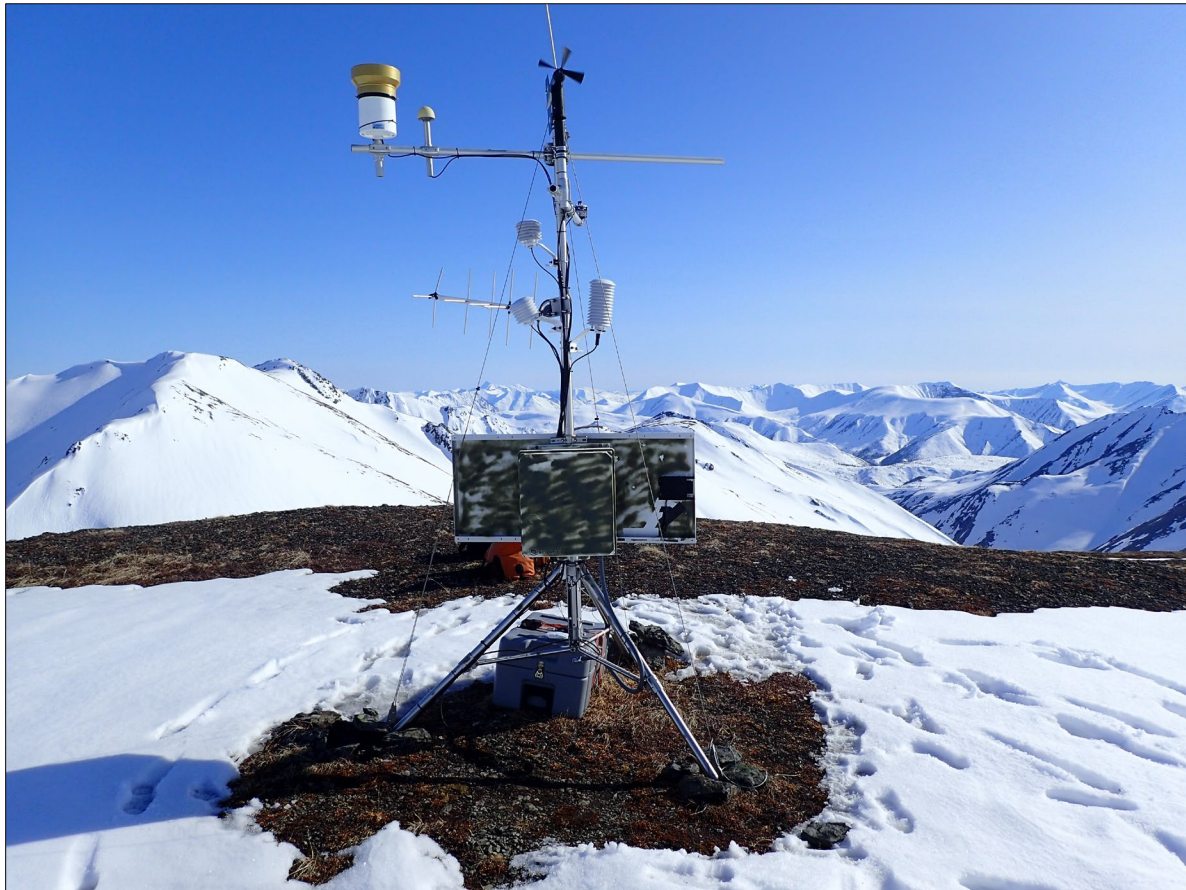


Climate Station Maintenance in the Arctic Inventory and Monitoring Network

2023 Summary



Authors
Ken Hill
Pam Sousanes

December 2023

National Park Service
4175 Geist Rd
Fairbanks, AK 9970:

Photo
Imelyak climate station 2023 in Noatak National Preserve. NPS/Ken Hill

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Abstract

The mission of the Arctic Network Inventory and Monitoring Program (ARCN) is to collect, compile and synthesize scientific information about the Arctic Network of parks in order to manage park resources unimpaired for the enjoyment of future generations. The Inventory and Monitoring (I&M) Program is a major component of the National Park Service's (NPS) strategy to improve park management through greater reliance on scientific information.

In an attempt to better understand climate variation as well as long-term changes in park ecosystems, seventeen I&M climate stations have been installed in the five ARCN parks. The objective of the climate monitoring program is to monitor and record weather conditions at representative locations throughout ARCN in order to identify long and short-term trends, provide reliable climate data to other researchers, and to participate in large scale climate monitoring and modeling efforts beyond park boundaries. Seventeen I&M stations and were maintained by NPS I&M Staff. The Kelly snow telemetry (SNOTEL) station was maintained by NRCS staff. Five additional fire RAWS were visited by the Alaska Fire Service in cooperation with NPS staff in Anchorage. This report summarizes the 2023 field season and includes current sensor metadata.

Acknowledgments

A successful field season would not have been possible without support from staff in Fairbanks, Nome, Kotzebue, and Bettles. Special thanks to all pilots for safely, efficiently, and happily delivering us to each climate station this season.

List of Acronyms

Ah	Amp hour
AKDST	Alaska Daylight Savings Time
AKRO	Alaska Regional Office
ARCN	Arctic Network
AS350	A-star 350 Helicopter
AT	Air Temperature
AT-RH	Air Temperature- Relative Humidity
BELA	Bering Land Bridge National Preserve
C185	Cessna 185 airplane
C206	Cessna 206 airplane
CAKR	Cape Krusenstern National Monument
CS	Campbell Scientific
DCS	Data Collection System
DLP	Data Logger Program
FTS	Forest Technology Systems
GAAR	Gates of the Arctic National Park and Preserve
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
I&M	Inventory and Monitoring
KOVA	Kobuk Valley National Park
LED	Light-Emitting Diode
NESDIS	National Environmental Satellite, Data, and Information Service
NIFC	National Interagency Fire Center
NOAT	Noatak National Park and Preserve

List of Acronyms (continued)

NPS	National Park Service
NRCS	Natural Resource Conservation Service
OAS	Office of Aviation Services
RAWS	Remote Automated Weather Station
RG-TB	Rain Gauge - Tipping Bucket
SD	Snow Depth
SDI	Serial Digital Interface
SNOTEL	Snow Telemetry
SR	Solar Radiation
ST	Soil Temperature
W	Watt
WEAR	Western Arctic National Parklands
WFMI	Wildland Fire Management Information
WRCC	Western Regional Climate Center
WS-WD	Wind Speed - Wind Direction
YUGA	Collective administrative unit for Yukon-Charley Rivers National Preserve and Gates of the Arctic National Park and Preserve

Climate Station Locations

For the 2023 field season, the Arctic Network (ARCN) continued its climate monitoring program by maintaining climate stations within the network (Figure 1, Table 1). The park units within ARCN include Gates of the Arctic National Park and Preserve (GAAR), Bering Land Bridge National Preserve (BELA), Cape Krusenstern National Monument (CAKR), Kobuk Valley National Park (KOVA), and Noatak National Preserve (NOAT). Maintenance includes downloading data, updating software and datalogger programs, replacing sensors, and troubleshooting problems. Maintenance is necessary in order to provide continuous, high-quality meteorological data. There are additional weather and climate stations in the parks that are operated by other state and federal agencies with specific objectives. Remote automated weather stations (RAWS) deployed as part of the NPS fire program record real-time weather data for fire management. NRCS snow telemetry (SNOTEL) stations record weather and snow information. It is in the best interest of the ARCN program to cooperate with these and other entities by assisting in station maintenance; a total of 23 sites are typically maintained annually, including 17 ARCN RAWS, 5 fire RAWS and 1 SNOTEL station.

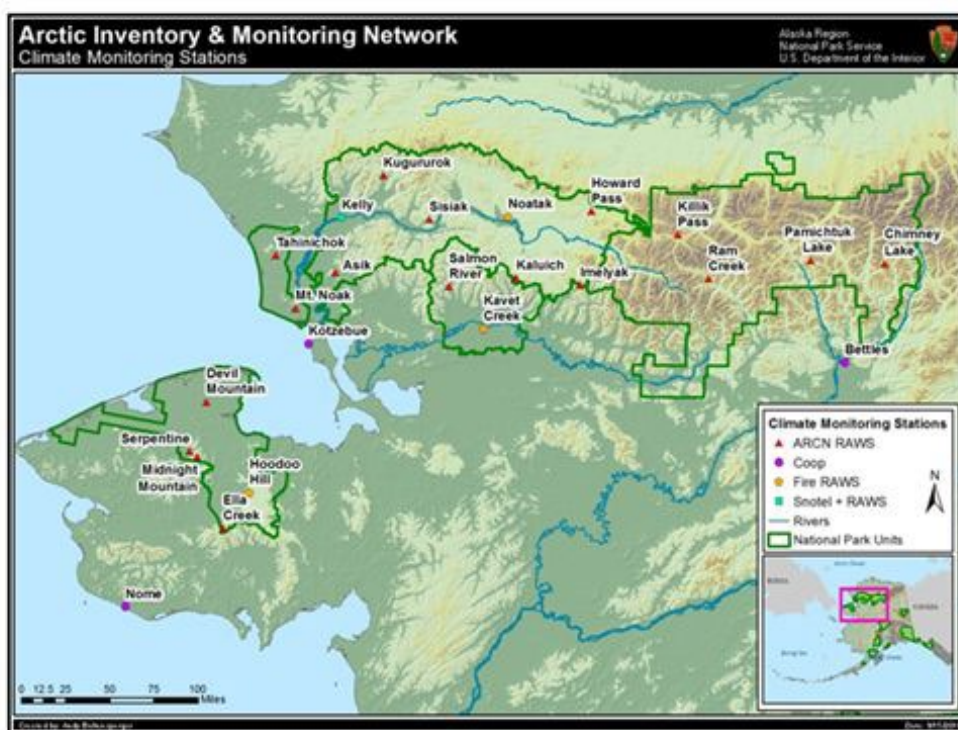


Figure 1. Locations of ARCN climate stations.

Table 1. Locations of ARCN climate stations maintained in 2023 field season.

Station Name	Station Type	Latitude (N)	Longitude (W)	Elevation (ft)	Park
Chimney Lake	ARCN RAWS	67° 42.853'	150° 35.100'	3780	GAAR
Killik Pass	ARCN RAWS	67° 59.007'	155° 00.782'	4355	GAAR
Pamichtuk Lake	ARCN RAWS	67° 45.977'	152° 09.854'	3294	GAAR
Ram Creek	ARCN RAWS	67° 37.458'	154° 20.678'	4110	GAAR
Asik	ARCN RAWS	67° 28.493'	162° 15.986'	1329	NOAT
Howard Pass*	ARCN RAWS	68° 09.361'	156° 53.749'	2062	NOAT
Imelyak	ARCN RAWS	67°32.689'	157° 04.646'	3620	NOAT
Kaluich	ARCN RAWS	67° 34.403'	158° 25.903'	2486	NOAT
Kavet Creek RAWS	Fire RAWS	67° 08.317'	159° 02.617'	235	KOVA
Kelly RAWS	Fire RAWS	67° 55.778'	162° 17.775'	412	NOAT
Kelly SNOTEL	SNOTEL	67° 55.780'	162° 17.410'	310	NOAT
Kugururok	ARCN RAWS	68° 19.003'	161° 29.518'	908	NOAT
Noatak RAWS	Fire RAWS	68° 04.222'	158° 42.224'	1040	NOAT
Salmon River	ARCN RAWS	67° 27.594'	159° 50.475'	1262	KOVA
Sisiak	ARCN RAWS	67° 59.702'	160° 23.739'	1823	NOAT
Tahinichok	ARCN RAWS	67° 33.009'	163° 34.031'	966	CAKR
Mt. Noak	ARCN RAWS	67° 08.486'	162° 59.672'	809	CAKR
Devil Mountain	ARCN RAWS	66° 16.553'	164° 31.851'	285	BELA
Ella Creek*	ARCN RAWS	65° 16.289'	163° 48.681'	2258	BELA
Hoodoo Hills RAWS	Fire RAWS	65° 35.711'	163° 24.671'	1550	BELA
Midnight Mountain	ARCN RAWS	65° 49.220'	164° 32.565'	2267	BELA
Quartz Creek RAWS	Fire RAWS	65° 24.429'	164° 39.444'	276	BELA
Serpentine	ARCN RAWS	65° 51.138'	164° 42.469'	518	BELA

Climate Station Maintenance Summaries

This section describes the maintenance details of seventeen climate stations in ARCN organized by site visit date. This work is being implemented based on the ARCN climate vital sign protocol implementation plan (Sousanes et al. 2017a) and updated standard operating procedures (Sousanes et al. 2017b).

See Appendix A for detailed logistics. Appendices B and C provide sensor specifications and metadata.

Gates of the Arctic National Park and Preserve

Chimney Lake

Date/Time: 5/19/2023 14:20

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 40s

Damage: none

Sensors replaced:

Removed AT/RH EE181 #139580

Installed AT/RH EE181 #009FA

Other hardware replaced: none

Additional Comments: station looked great. Fence looked good – no repairs needed.

Potential Data Issues: none

To Do:

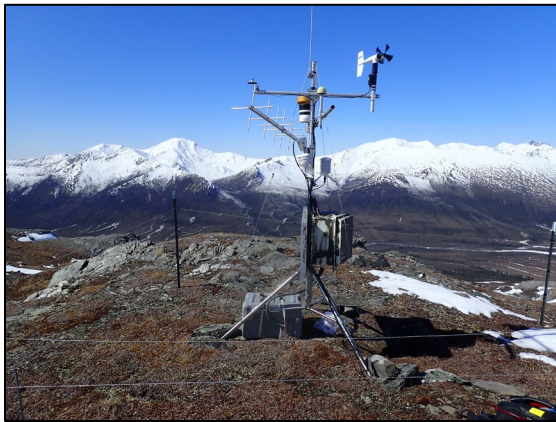


Figure 2. Chimney Lake climate station May 19, 2023.

Killik Pass

Date/Time: 5/20/2023 11:15

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 30s

Damage: none

Sensors replaced:

Removed AT/RH EE181 #151546, SR Licor #43042

Installed AT/RH EE181 #4801A2, SR Licor #43089

Other hardware replaced: Tightened several loose elements on Yagi antenna.

Additional Comments: Station looked great. Some snow at site.

Potential Data Issues: none

To Do:



Figure 3. Killik Pass climate station May 20, 2023.

Pamichtuk Lake

Date/Time: 5/19/2023 15:30

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: upper 40s

Damage: solar panel for camera horizontal to 90°

Sensors replaced:

Removed AT/RH EE181 #12734B, SR Licor 60173

Installed AT/RH EE181 #50582, SR Licor 100476

Other hardware replaced: SD memory card in CC5MPX camera replaced.

Additional Comments: Station and fence looked great.

Potential Data Issues: none

To Do:

1. Flag WS-WD #95226, request cable replacement in 2025.

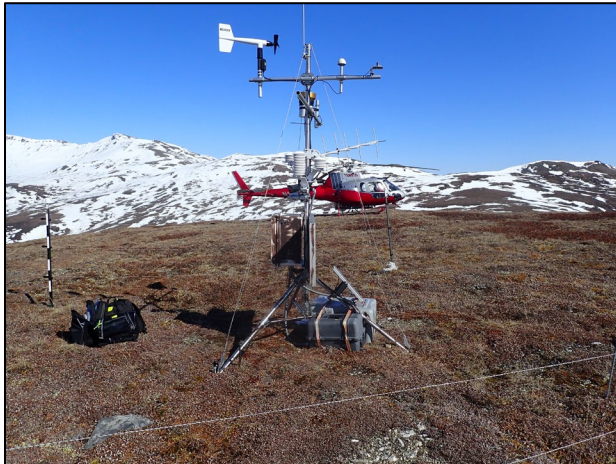


Figure 4. Pamichtuk Lake climate station May 19, 2023.

Ram Creek

Date/Time: 5/19/2023 17:35

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 50's

Damage: None

Sensors replaced:

Removed AT/RH EE181 #12772A, WS/WD 05103 #87999

Installed AT/RH EE181 #2498E, WS/WD 05103 #90934

Other hardware replaced: none

Additional Comments: One insulator replaced on fence. Polywire tightened.

Potential Data Issues: none

To Do:

1. Replace SR50a transducer



Figure 5. Ram Creek climate station May 19, 2023.

Noatak National Preserve

Asik

Date/Time: 6/4/2023 17:00

Personnel: Pam Sousanes, Ken Hill

Logistics: A-star helicopter – Temsco – N149AE – Steve Welter (relief pilot)

Weather: low 40s

Damage: Solar panel askew, Yagi antenna elements bent, alignment was slightly off. Fence posts heaved and polywire was loose.

Sensors replaced:

Removed AT/RH EE181 #0343E4, SR Licor #43080

Installed A/RH EE181 #2307C, SR Licor #14047

Other hardware replaced: Yagi antenna replaced and realigned. Tightened guy wires.

Additional Comments: Pounded fence posts in (heaved). Replaced ~ six fence connectors. Tightened polywire. Checked tipping bucket – good.

Potential Data Issues: none

To Do:



Figure 6. Asik climate station June 4, 2023. The Yagi antenna was damaged and out of alignment (left). The station at end of site visit (right).

Howard Pass

Date/Time: 5/20/2023 13:00

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 40s

Damage: Fence wire was strung out. STF2 was on surface.

Sensors replaced:

Removed: AT/RH EE181 #02DA, SR Licor #60149, WS/WD 05108 160868

Installed: AT/RH EE181 #1464, SR Licor #60147, WS/WD 05108 187771

Replaced STF2 107 probe (soil temperature 20 cm was damaged)

Swapped secondary air temp sensor from ThermX to Campbell 109.

Other hardware replaced: Replaced large damaged solar panel with smaller profile panel.

Additional Comments: Top bar on new solar panel might be a weak spot, bent. Charging, tested at 22 volt in. Sent new program for the 109 sensor replacement.

Potential Data Issues: STF2 sensor damaged starting mid-April 2023.

To Do:

1. Monitor solar panel, especially top bar which might be vulnerable to wind damage.

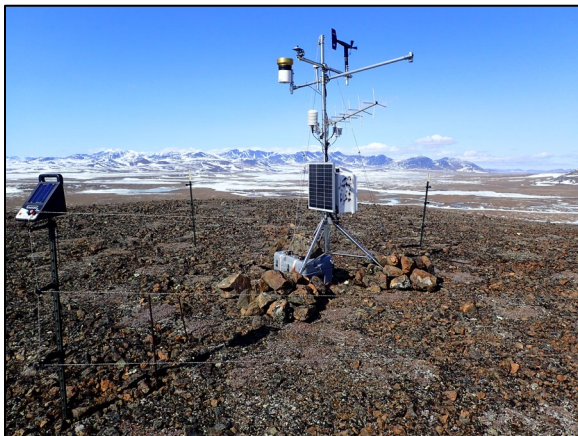
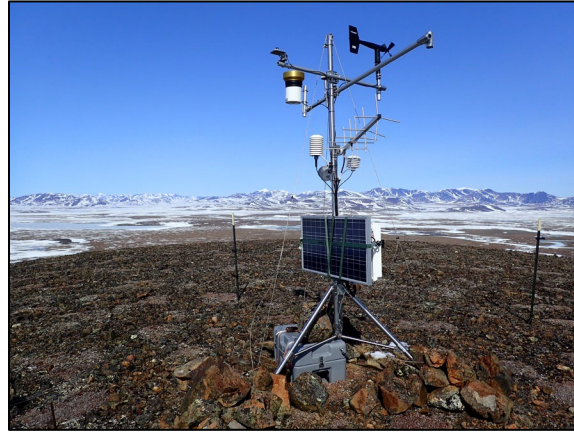


Figure 7. Howard Pass climate station 2023. Damaged soil sensor (upper left), photo of site before solar panel replacement (upper right), photo after site visit with new, smaller solar panel (bottom left). May 20, 2023.

Imelyak

Date/Time: 5/20/2023 17:00

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 30s

Damage: Wind sensor slightly out of level. Water in enclosure door.

Sensors replaced:

Removed: AT/RH EE181 #1941E, SR Licor #83212

Installed: AT/RH EE181 #0094F, SR Licor #63674

Other hardware replaced: Three Yagi elements replaced.

Additional Comments: Water was in enclosure door, but not in enclosure. Seals looked OK. Checked tipping bucket – OK. Ratchet strap on battery box tightened. A few claw marks on battery box. Lots of snow in vicinity, only 3-6 inches near station. Many avalanches on north aspects.

Potential Data Issues: none

To Do:

1. Monitor enclosure door and seals.

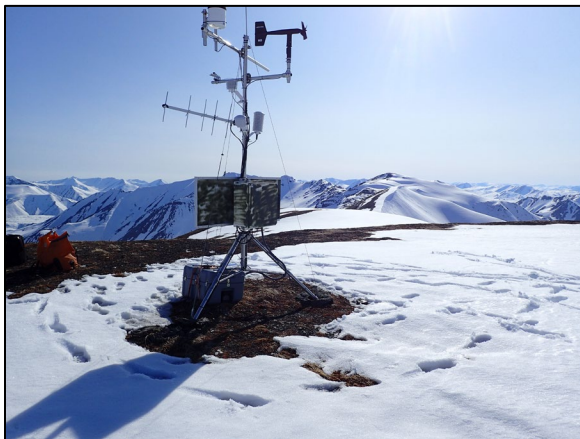


Figure 8. Imelyak climate station May 20, 2023.

Kaluich

Date/Time: 5/21/2023 10:30

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 40s

Damage: Slight damage to 109_1, 109_2, and AT/RH shields. One antenna element on Yagi missing.

Sensors replaced:

Removed: AT/RH EE181 #044AB, WS/WD 05108 #146182

Installed: AT/RH EE181 #294D6, WS/WD 05108 #160367

Other hardware replaced: Replaced solar panel – had to move a few things on mast to secure. Check charge voltage in – good at 22 volts.

Additional Comments: Patchy snow in vicinity. Bear tracks on snow leading up to fence. Fence strung out. Ice on ground at station looks like high water content rime ice that fell off station. Tipping bucket was checked – OK. Did not replace shields, only minor damage.

Potential Data Issues: none

To Do:

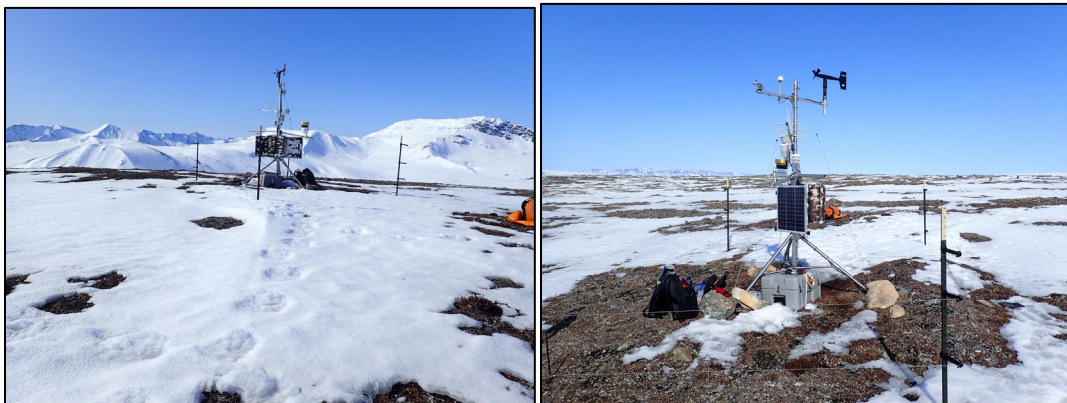


Figure 9. Bear tracks on snow leading up to fence (left). Station at end of site visit (right) May 21, 2023.

Kugururok

Date/Time: 6/4/2023 14:35

Personnel: Pam Sousanes and Ken Hill

Logistics: A-star helicopter – Temsco – N149AE – Steve Welter (relief pilot)

Weather: upper 30s

Damage: Failsafe tripped 9/21/2022.

Sensors replaced:

Removed AT/RH EE181 #119D3, SR Licor 52877, SD SR50a

Installed AT/RH EE181 #21005, SR Licor #60148, SD SR50a #4529

Other hardware replaced: none.

Additional Comments: Failsafe on TX321 was tripped – reset. Swapped SD memory card in CC5MPX camera. Bird poop on crossbars, solar panel and SR mount. Replaced 2 insulators on fence. Otherwise, station looked great.

Potential Data Issues: none

To Do:

1. Install CR1000X/TX325 since failsafe has tripped multiple times at this site.

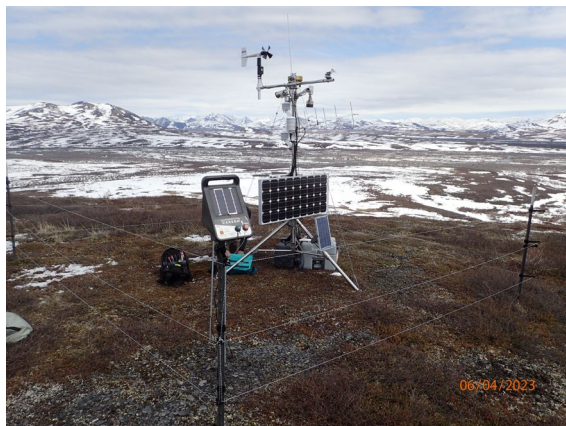


Figure 10. Kugururok climate station June 4, 2023.

Sisiak

Date/Time: 5/21/2023 13:30

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: upper 40s

Damage: Tipping bucket screws securing lid beginning to wear/loosen.

Sensors replaced:

Removed AT/RH EE181 #04379, SR Licor #102543

Installed AT/RH EE181 #501E3, SR Licor #64395

Other hardware replaced: Added crossarm brace. Replaced 109_2 radiation shield.

Additional Comments: Added rubber gasket and electrical tape to secure tipping bucket funnel.

Fence down on arrival; wire restrung.

Potential Data Issues: none

To Do:

1. Replace tipping bucket.

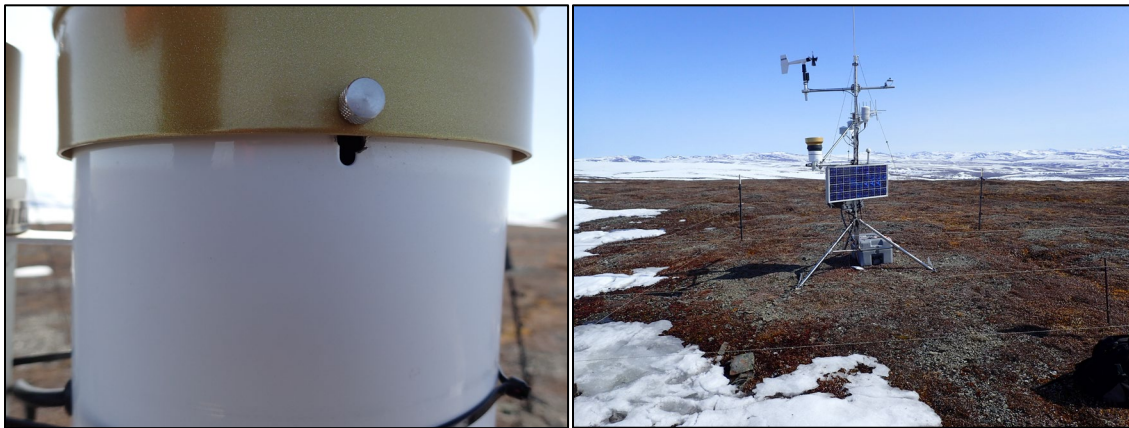


Figure 11. Sisiak climate station May 21, 2023. The screw securing the tipping bucket funnel is vibrating loose/showing wear (left). The station after site visit (right).

Kelly SNOTEL

The Kelly SNOTEL was maintained on 6/4/2022 by Tony DeMarco and Daniel Fisher (NRCS). The damaged snow pillow was replaced. The helicopter landed at the Kelly RAWS site, and the crew walked down to the Snotel site. The gear/crew haul required two trips with the helicopter. After the second drop off Pam and Ken continued to the Kugururok and Asik climate sites and then Ken was dropped off in Kotzebue and more fuel was obtained before returning to pick up the NRCS crew at Kelly. The site was repaired, and sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015). The precipitation gages were flushed, and 10 gallons of fresh antifreeze liquid added for the winter. The electric fence was repaired.

Fire RAWS stations: Noatak RAWS and Kelly RAWS

Annual maintenance was completed at the Noatak (5/11/2023) and Kelly (5/10/2023) RAWS by the Alaska Fire Service according to WFMI records. Details are available on WFMI. Ken contacted AFS in early May before their site visit to chat about the soil sensors, but there must have been too much snow on site to make repairs. The STF3 sensor at Noatak is still not working and the station is not transmitting. **For 2024: Contact Alaska Fire Service staff early in the spring before their maintenance run to ensure they have the necessary sensors and to request downloaded data files.**

Kobuk Valley National Park

Salmon River

Date/Time: 5/21/2023 16:00

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: upper 40s

Damage: none.

Sensors replaced:

Removed: AT/RH EE181 #03057, SR Licor 64359, WS/WD 05103 #53109

Installed: AT/RH EE181 #0674F, SR Licor 90546, WS/WD 05103 #95214

Other hardware replaced:

Additional Comments: Swapped SD memory card in CC5MPX camera. Checked tipping bucket - OK. Fence repaired. Cables coming out of enclosure had all been pulled on, but there was no visible damage. 1+ feet of snow on north side of fence, zero on south side, zero directly under snow depth sensor.

Potential Data Issues: None

To Do:

1. Replace SR50a transducer (many sensor errors)

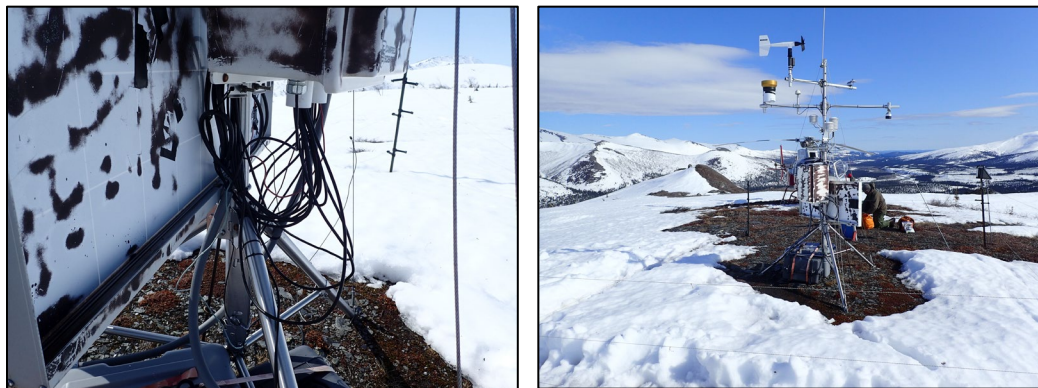


Figure 12. Salmon River climate station May 21, 2023. Cables pulled out of enclosure (left). Photo after site visit.

Fire RAWS stations: Kavet Creek

Annual maintenance was completed at the Kavet Creek fire RAWS by the Alaska Fire Service on 5/11/2023 according to WFMI records. Details are available at WX-Weather. Soil temperature sensor 2 is currently not working (10/24/2023). Contact Alaska Fire Service in early spring to provide replacement sensor and request station download.

Cape Krusenstern National Monument

Mt. Noak

Date/Time: 5/22/2023 13:45

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 40s

Damage: Screws securing tipping bucket funnel wearing out.

Sensors replaced:

Removed AT/RH EE181 #096B6, SR Licor #83323

Installed AT/RH EE181 #284D0, SR Licor #63691

Other hardware replaced: Swapped small shield for 2nd 109 sensor.

Additional Comments: SD memory card on CC5MPX camera swapped. Camera lens had some condensation, cleaned with rag and replaced desiccant. Snow at site 0-12” within fence, zero under tripod. Bent back AT/RH shield seems Ok, did not replace.

Potential Data Issues: None

To Do:

1. Bring rubber gasket for tipping bucket next year.
2. Check AT-RH shield. EE181 reading lower than 109_1 and 109_2

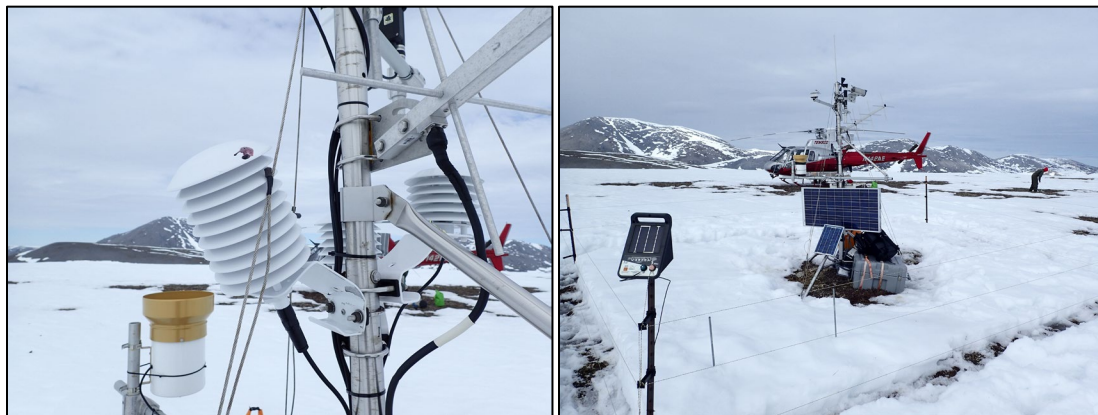


Figure 13. Mt. Noak climate station May 22, 2023. Slightly askew AT/RH radiation shield (left). Site prior to departure (right).

Tahinichok

Date/Time: 5/22/2023 11:00

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 40s

Damage: None.

Sensors replaced:

Removed AT/RH EE181 #011692, SR Licor #102544

Installed AT/RH EE181 #25188, SR Licor #68923 (and leveling base)

Other hardware replaced: Replaced leveling base on SR. Added crossarm brace; needed to move things on mast to make it work.

Additional Comments: Reset RNIN to 1.06, may have tipped during maintenance. Snow at site 0-12” within fence; about 3” directly under long crossarm. Repaired fence after digging it out. Station looks good.

Potential Data Issues: none.

To Do:

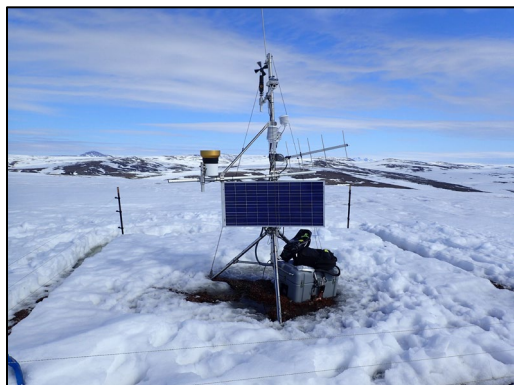


Figure 14. Tahinichok climate station May 22, 2023.

Bering Land Bridge National Preserve

Devil Mountain

Date/Time: 5/23/2023 12:00

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather:

Damage: Power cable damaged. AT/RH reading bad, SR and WS out of level, STF 1, 2, 3 cables cut. RNIN (TE525) hanging and damaged. out of level.

Sensors replaced:

Removed AT/RH EE181 #022892, SR Licor #64397

Installed AT/RH EE181 #207AA, SR Licor #46239

Replaced 107 probes at 10, 20, 50 cm

Replaced tipping bucket

Other hardware replaced: Replaced Yagi antenna and coax cable.

Additional Comments: Need to drill enclosure and battery box to accommodate battery conduit.

Battery box moved to north side. Station seems to be sinking. Bent AT/RH shield back into position.

TX31 not transmitting, PS OK, some antenna elements missing. Data RC=2, RC Status = 2. Bird poop on shields and SR mount and enclosure (purple berries). Had to leave site early due to incoming fog layer – station needs more attention.

Potential Data Issues:

1. RNIN (hanging/damaged)
2. AT EE181 (reading bad)
3. RH EE181 (reading bad)
4. STF1 (cable cut)
5. STF2 (cable cut)
6. STF3 (cable cut)
7. STF4 (cable cut)
8. SR (out of level)
9. WS (out of level)

To Do:

1. Bring drill for enclosure/battery box holes.
2. Consider Geoblock for under tripod feet.
3. Consider visiting BELA sites later in summer when ground thaws. Bears seem to like this station. Probably best to replace electric fence, 3 posts are out there in the ground, but if ground is frozen they will be hard to work with. Consider bringing 4 new T-posts.
4. Replace 109_2; readings seem off compared to 109_1 and EE181.
5. Consider swapping CR1000X and TX325.



Figure 15. Devil Mountain climate station May 23, 2023. Tipping bucket damage (upper left), more station damage (upper right), station after maintenance visit (lower left).

Devil Mountain has not transmitted since Feb 2023.

Ella Creek

Date/Time: 5/22/2023

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: mid 40s

Damage: Tripod was tipped over on arrival with the south leg pulled out.

Sensors replaced: All removed except air temperature

Other hardware replaced:

Additional Comments: Battery was OK. Tripod was tilted back into place and sensors were removed.

Left soils in ground and edited program. Swapped large solar panel for 10 W panel. Removed guy wires. Wiring for air temperature sensors: 109_1, Red 1H [1], Black EX1; 109_2, Red 1L[2], EX2.

Site was knocked over in 2021 and 2022 and was rebuilt in 2023.

Potential Data Issues:

1. AT HMP45
2. RH HMP45
3. RNIN
4. WS
5. ThermX
6. STF1
7. STF2
8. STF3

To Do:

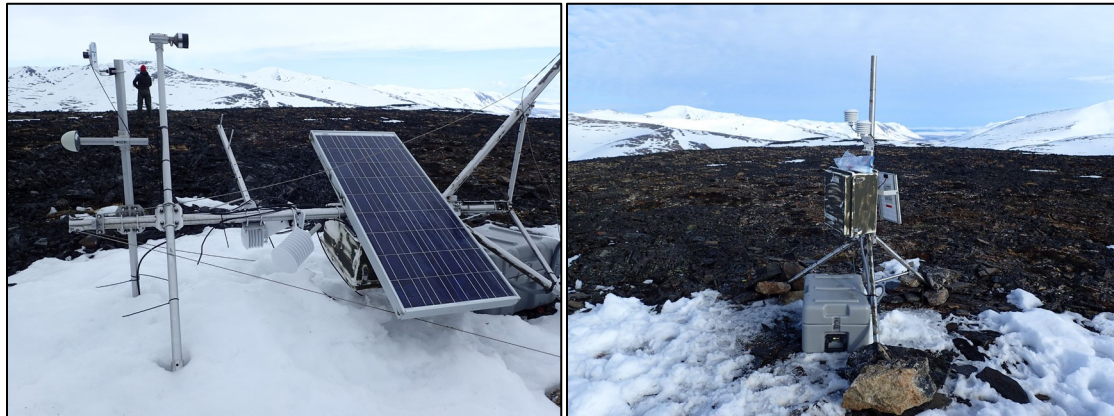


Figure 16. Ella Creek climate station May 22, 2023. Site tipped over since 2022 (left). Station rebuilt with only air temperature sensors and a smaller profile to withstand riming and wind (right).

Midnight Mountain

Date/Time: 5/23/2023 18:45

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: Cloudy

Damage: none

Sensors replaced: none

Other hardware replaced: none

Additional Comments: 12+ inches of snow at site, radiation shields still bent at 90°, not worth swapping it will just happen again.

Potential Data Issues: None

To Do:

1. If/when possible, remove 75 W solar panel from site.
2. Remove ThermX2 (reading high) and install a new 109 sensor.
3. Add radiation shield so that each sensor has a separate shield.
4. Consider replacing/repairing/bending horizontal shields back to vertical.



Figure 17. Midnight Mountain climate station May 23, 2023.

Serpentine Hot Springs

Date/Time: 5/23/2023 16:45

Personnel: Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Erik Steinberg/Tim Nolan

Weather: Cloudy, mid 40s

Damage: none

Sensors replaced:

Removed AT/RH EE181 #023406

Installed AT EE181 #206E5

Other hardware replaced:

Additional Comments: Station looked great on arrival. Replaced SR but new sensor was reading zero, so put old sensor back. Swapped camera with new SD card. Sun shield on (old) camera was upside down.

Potential Data Issues: None

To Do:

1. Consider replacing solar panel with smaller panel to reduce wind catch. Consider alternative anchoring for station.
2. Check STF3. STF3 is reading warmer in summer and colder in winter compared to STF2, suggesting it is installed at a shallower depth than STF2. Consider reinstalling STF3.

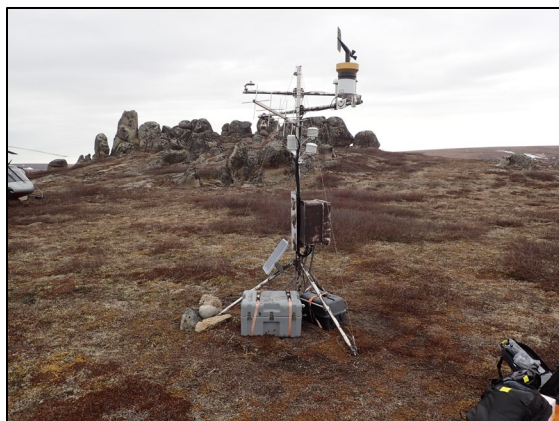


Figure 18. Serpentine climate on May 23, 2023.

Fire RAWS stations: Hoodoo Hills and Quartz Creek

Annual maintenance was completed at the Hoodoo Hills fire RAWS on 5/29/2023 by the Alaska Fire Service according to WFMI records. Details are available on WFMI. Annual maintenance was completed at the Quartz Creek fire RAWS on 5/12/2023 by the Alaska Fire Service according to WFMI records. Details are available on WFMI. Oly STF3 is working at the Hoodoo Hills RAWS.

Literature Cited

National Engineering Handbook. 2015. United States Department of Agriculture Natural Resources Conservation Service. Part 622, Snow Survey and Water Supply Forecasting. Chapter 5, Maintenance and Calibration.

Sousanes PJ and Others. 2017a. Protocol implementation plan for monitoring weather and climate in the Arctic Network. Natural Resource Report. NPS/ARCN/NRR—2017/1537. National Park Service. Fort Collins, Colorado

Sousanes, P. J., K. Hill, M. Bower, W. F. Johnson, and S. D. Miller. 2017b. Standard operating procedure updates 2017: Central Alaska Network (CAKN) climate monitoring protocol. Natural Resource Report NPS/CAKN/NRR—2017/1504. National Park Service, Fort Collins, Colorado.

Appendix A. Logistics Summary

Bettles, Dahl Creek, Kotzebue, Nome Logistics May 19-23, 2023

Personnel: Ken Hill (ARCN physical scientist), Tim Nolan (EAFM Fire Helicopter manager)

Pilot: Erik Steinberg (Temsco pilot)

Aircraft: N142AE. Temsco A-star on exclusive use contract with NPS eastern area fire program.

Fuel: Fairbanks (AFS Helibase), Bettles (Brooks Range Aviation), Dahl Creek (NPS Jet A Tank), Kotzebue (Crowley), Galena (AFS). Confirm contact information, fuel quantity and key locks/codes before departure.

Helicopter Parking: Bettles (main airport apron), Dahl Creek (main airport apron), Kotzebue (FWS hangar), Nome (transient aircraft parking).

Housing: Bettles NPS housing, Dahl Creek NPS Cabin/camping, Kotzebue NPS housing, Nome NPS housing. Confirm all housing arrangements well in advance of trip with local contacts.

Vehicles: NPS vehicles were used in Bettles and Nome as needed. Arranged with local staff prior to trip. Nome staff left vehicle outside gate for airport transient parking prior to climate personnel arrival. The Kotzebue vehicle was unavailable during this visit and all personnel walked to/from the FWS hangar.

Equipment staging: none

Narrative:

This was the earliest in the year the climate stations had been maintained and early/mid-May was cooler than normal. As a result, there was snow at/near all climate stations. Most landing zones were snow-free. Overall, weather was good with temperatures primarily in the 40's and 50's and light winds.

5/19: Crew departs Fairbanks AFS, Jet A from Brooks Range Aviation (89.1 gallons), completes maintenance at Chimney, Pamichtuk, and Ram Creek. Housing at NPS/FWS bunkhouse in Bettles. The NPS office was closed, and no staff were available. A key for the bunkhouse was obtained from the key box outside the bunkhouse.

5/20: Jet A from Brooks Range Aviation (114 gallons). Maintenance at Killik, Howard, and Imelyak. Housing at Dahl Creek. The runway and apron were free of snow, but there was 2-3 feet of isothermal snow in forested areas and along the road to the NPS cabin. Crew brought drinking water with them. Used 113 gallons from NPS Jet A tank.

5/21: Maintenance at Kaluich, Sisiak, and Salmon en route to Kotzebue. Arrive in Kotzebue late and no vehicle was available. Could not find a taxi, so crew walked to NPS housing. Jet A from Crowley 91.7 gallons.

5/22: Maintenance at Tahinichok and Mt. Noak before returning to Kotzebue for Jet A (73.3 gallons). Continued on to Nome with a stop for repairs at Ella Creek climate station. Picked up NPS vehicle outside airport gate in Nome and stayed at NPS bunkhouse along with a Dutch research group (birds).

5/23: Jet A from Crowley (90 gallons). Maintenance at Devil Mtn, Serpentine, and Midnight Mtn. Checked NPS warehouse and inventoried one solar panel, two fence chargers and one battery (2018).

5/24: Left NPS vehicle at airport gate outside transient parking following instructions from NPS staff. Jet A from Crowley (121 gallons). Jet A from Galena AFS with account code (110 gallons). Returned to Fairbanks AFS.

Kotzebue Logistics June 2-5, 2023. Pam, Ken, Josh Han (primary pilot), Steve Welter (relief pilot).

Personnel: Ken Hill, Pam Sousanes, Daniel Fisher (NRCS), Tony Demarco (NRCS)

Aircraft/Pilots: N149AE AS350 B3; Josh Han (primary), Steve Welter

Fuel: Galena AFS (contact dispatch 907-356-5616 and/or AFS 907-656-9650 ~1 week prior to fueling; account code acquired through local NPS fire staff / Fort Wainwright Helibase). Local fueler was Nate Gilmore who was also familiar with RAWs sites/maintenance.

Helicopter Parking: The helicopter was staged at the FWS hangar.

Vehicle: Arranged well in advance with Kotzebue / ARCN staff. ARCN truck had some maintenance issues and became unavailable on 6/5/2023. Sharing vehicles with bird crew and aquatic ecology team (Jon O'Donnell).

Lodging: Hill, Sousanes, Fisher, Demarco at Kotzebue bunkhouse (297A 5th Avenue). Reserved in advance through Kotzebue staff/ARCEN on SharePoint calendar. Two rooms were shared by four people. Pilots stayed at Kotzebue Hotel.

Other logistics: The ARCN bird crew was available in Kotzebue to assist with vehicle shuttles and local logistics. Total weight for climate crew with gear was ~550# or less and within allowable payload with full fuel.

Equipment staging: The NRCS Snotel gear was shipped prior to the trip by NRCS staff via Northern Air Cargo. No ARCN equipment was staged prior to the trip.

Field Sites Completed: Kelly Snotel, Kugururok, Asik

Narrative:

Friday 6/2/2023: Hill/Sousanes departed Fairbanks at 0700 and drove to Denali. Jordan McCabe (assistant fire helicopter manager) was on site at the INR airstrip. Total weight was 560# with 654# allowable. Weather on departure was marginal, but quickly improved after leaving INR. Fuel in Galena (115 gallons) and a quick stop at the amazing cafeteria. Weather on final approach to Kotzebue was marginal. Total flight time 4.6 hours. Daniel Fisher and Steve Welter (relief pilot) had arrived midday and were picked up by Jared Hughey and brought to Northern Air Cargo/bunkhouse/hotel. Tony Demarco arrived on the evening jet.

Saturday 6/3/2023: Poor weather did not allow any flights. Jet A from Crowley fuel truck 58.1 gallons.

Sunday 6/4/2023: Relief Pilot Steve Welter. Good weather. Sousanes/Demarco fly to Kelly Snotel with Snotel Gear. Pilot returns to Kotzebue, fuels (103.5 gallons), and takes Hill/Fisher to Kelly Snotel. Fisher stays at Kelly with Demarco, while Hill/Sousanes complete site maintenance at Kugururok and Asik before returning to Kotzebue for fuel (102.9 gallons). Sousanes returns to Kelly to pick up Fisher and Demarco. At Kelly, the snow pillow was re-plumbed and a new datalogger (CR1000x) and air temperature sensor were installed. The rocket gage was recharged per typical maintenance.

Monday 6/5/2023: Fisher, Demarco, and Welter depart Kotzebue via Alaska Airlines. Hill, Sousanes, and Han return to Denali in helicopter with a fuel stop in Galena (102 gallons). Total flight time 5.1 hours. Sousanes and Hill drive back to Fairbanks that evening.

Appendix B. ARCN RAWS Station Specifications

Table B1. Sensor specifications.

Measurements	Model/Manufacturer/Item#	Purchased from:
Air Temperature 1/Relative Humidity	HMP-45C/HMP155/EE181 Temperature and Relative Humidity Probe	Campbell Scientific
Air Temperature 2	109 Temperature Probe (primary beginning summer 2016)	Campbell Scientific
Air Temperature 3	109 Temperature Probe (replaced ThermX in 2022)	Campbell Scientific
Wind Speed and direction	RM Young 05103/05103-45 (alpine version); or 05108 HD Alpine version	Campbell Scientific
Precipitation (summer rainfall)	Texas Electronics TE525WS Rain Gage	Campbell Scientific
Solar Radiation (incoming)	LI-COR LI200X / LI200RX	Campbell Scientific
Snow Depth	SR50A sonic ranging sensor	Campbell Scientific
Soil Temperature	107 Temperature Probe (3)	Campbell Scientific

Table B2. Datalogger specifications.

Datalogger	Purchased from:
CR1000-XT Measurement and Control System	Campbell Scientific
CR1000X-XT Measurement and Control System (started replacing CR1000s in 2023)	Campbell Scientific

Table B3. Satellite communication specifications.

Satellite Communication	Model/Item #	Purchased From:
GOES Satellite transmitter	TX321/TX325 GOES Transmitter	Campbell Scientific
GPS Antenna	GPS Antenna 3.3 V 17992	Campbell Scientific
GPS Cable	Antenna Cable 18017	Campbell Scientific
GOES Antenna	GOES 11 dBi YAGI RHCP Antenna 25316	Campbell Scientific
Coaxial Cable	Antenna Cable RG8 COAXNTN	Campbell Scientific

Table B4. Power specifications.

Power	Model	Purchased From:
Batteries	Concorde Sun Extender PV 1040 T 12 Volt 100 Amp hour (2)	ABS Alaskan
Solar Panel	60-75 watt	Varies
Battery Box	Pelican Hardigg Single Lid Case	AllCases
Charging Regulator	CH100/200 12V Charging Regulator	Campbell Scientific

Table B5. Hardware specifications.

Station Hardware - Item	Type/Model	Purchased from:
Tripod	CM110 10 ft. stainless-steel tripod w/grounding kit	Campbell Scientific
Guyline Kit	Guy Kit for Tripod 19239	Campbell Scientific
Crossarm – 4 ft.	CM204 Sensor crossarm with mounting hardware – 4ft	Campbell Scientific
Crossarm – 6 ft.	CM206 Sensor crossarm with mounting hardware – 6ft	Campbell Scientific
Enclosure with (2) 1.5" diameter holes and mounting hardware for tripod	Weather Resistant 16" x 18" enclosure ENC 16/18 – DC -MM	Campbell Scientific

Table B6. Electric fence specifications.

Electric Fence Parts	Type/Model	Purchased from:
Metal fence posts	6 ft. T-Posts	Various local vendors
T-Post Insulators	5-inch extender insulators	Various local vendors
Poly wire	200 ft. Poly-wire	Various local vendors
Solar fence charger	10 mile low impedance fence charger – various models	Various local vendors

Appendix C. ARCN RAWS Components by Climate Station

Table C1. Metadata for Asik climate station.

Station Name	Item	Model	Start Date
Asik	Antenna	25316 YAGI	6/4/2023
Asik	AT	109	6/8/2022
Asik	AT (2)	109	6/8/2022
Asik	AT-RH	EE181	6/4/2023
Asik	Battery	100 AH (x2)	7/13/2012
Asik	Cross arm	CM204	7/13/2012
Asik	Cross arm	CM206	7/13/2012
Asik	Datalogger	CR1000	7/13/2012
Asik	DLP	Asik2022	6/8/2022
Asik	GPS	17992 GPS	7/13/2012
Asik	RG-TB	TE525	7/13/2012
Asik	SD	SR50a	Out 2021
Asik	Solar Panel	75 W	7/13/2012
Asik	SR	Li200x	7/13/2021
Asik	ST -10 cm	107	7/13/2021
Asik	ST -20 cm	107	8/5/2019
Asik	ST -50 cm	107	7/13/2012
Asik	Tripod	CM106	7/13/2012
Asik	TX321	NESDIS ID 3961A40E	7/13/2021
Asik	WS/WD	5103	6/8/2022

Table C2. Metadata for Chimney Lake climate station.

Station Name	Item	Model	Start Date
Chimney Lake	Antenna	25316 YAGI	8/7/2012
Chimney Lake	AT	109	7/25/2016
Chimney Lake	AT (2)	109 (2)	6/6/2022
Chimney Lake	AT-RH	EE181	5/19/2023
Chimney Lake	Battery	100 AH (x2)	8/7/2012
Chimney Lake	Cross arm	CM204	8/7/2012
Chimney Lake	Cross arm	CM206	8/7/2012
Chimney Lake	Datalogger	CR1000	8/7/2012
Chimney Lake	DLP	Chimney2022	6/6/2022
Chimney Lake	Electric Fence	T-post, poly-wire solar charger	5/27/2013
Chimney Lake	GPS	17992 GPS	8/7/2012
Chimney Lake	RG-TB	TE525	8/7/2012
Chimney Lake	SD	SR50a	Out 2021
Chimney Lake	Solar Panel	75 W	8/7/2012
Chimney Lake	SR	Li200x	6/6/2022
Chimney Lake	ST -10 cm	107	8/7/2012
Chimney Lake	ST -20 cm	107	8/7/2012
Chimney Lake	ST -50 cm	107	8/7/2012
Chimney Lake	ST -75 cm	107	5/27/2013
Chimney Lake	Tripod	CM106	8/7/2012
Chimney Lake	TX312	NESDIS ID 3961F472	8/7/2012
Chimney Lake	WS/WD	5103	7/15/2021

Table C3. Metadata for Devil Mountain climate station.

Station Name	Item	Model	Start Date
Devil Mountain	Antenna	25316 YAGI	5/23/2023
Devil Mountain	AT	109	6/1/2016
Devil Mountain	AT (2)	109 (2)	6/11/2022
Devil Mountain	AT-RH	EE181	5/23/2023
Devil Mountain	Battery	100 AH (x1)	6/11/2022
Devil Mountain	Cross arm	CM204	8/18/2011
Devil Mountain	Cross arm	CM206	8/6/2013
Devil Mountain	Datalogger	CR1000	8/18/2011
Devil Mountain	DLP	Devil2022	10/10/2022
Devil Mountain	Electric Fence	T-post, poly-wire solar charger	Out 2019
Devil Mountain	Enclosure	ENC 16/18	8/18/2011
Devil Mountain	GPS	17992 GPS	8/18/2011
Devil Mountain	RG-TB	TE525	5/23/2023
Devil Mountain	SD	SR50a	Removed
Devil Mountain	Solar Panel	75 W	8/18/2011
Devil Mountain	SR	Li200x	5/23/2023
Devil Mountain	ST -10 cm	107	5/23/2023
Devil Mountain	ST -20 cm	107	5/23/2023
Devil Mountain	ST -50 cm	107	5/23/2023
Devil Mountain	Tripod	CM106	8/18/2011
Devil Mountain	TX321	NESDIS ID 3961221A	8/1/2019
Devil Mountain	WS/WD	05108	10/10/2022

Table C4. Metadata for Ella Creek climate station.

Station Name	Item	Model	Start Date
Ella Creek	Antenna	25316 YAGI	Removed 2023
Ella Creek	AT	109	6/2/2016
Ella Creek	AT	109_2	5/22/2023
Ella Creek	AT-RH	HMP45	Removed 2023
Ella Creek	Battery	100 AH (x2)	9/18/2012
Ella Creek	Cross arm	CM204	9/18/2012
Ella Creek	Cross arm	CM206	9/18/2012
Ella Creek	Datalogger	CR1000	9/18/2012
Ella Creek	DLP	Ella2023	8/9/2017
Ella Creek	Enclosure	ENC 16/18	9/18/2012
Ella Creek	GPS	17992 GPS	Removed 2023
Ella Creek	RG-TB	TE525	Removed 2023
Ella Creek	SD	SR50a	Removed 2023
Ella Creek	Solar Panel	75 W	5/22/2023
Ella Creek	SR	Li200x	Removed 2023
Ella Creek	ST -10 cm	107	8/1/2019
Ella Creek	ST -20 cm	107	9/18/2012
Ella Creek	ST -50 cm	107	9/18/2012
Ella Creek	Tripod	CM106	9/18/2012
Ella Creek	TX321	396182E2	Removed 2023
Ella Creek	WS/WD	5108-Alpine-HD	Removed 2023

Table C5. Metadata for Howard Pass climate station.

Station Name	Item	Model	Start Date
Howard Pass	Antenna	25316 YAGI	7/23/2018
Howard Pass	AT	109	7/23/2018
Howard Pass	AT	109_2	5/20/2023
Howard Pass	AT-RH	EE181	5/20/2023
Howard Pass	Battery	100 AH (x2)	7/7/2011
Howard Pass	Cross arm	CM204	7/7/2011
Howard Pass	Cross arm	CM206	7/7/2011
Howard Pass	Datalogger	CR1000	7/23/2018
Howard Pass	DLP	Howard2021	7/14/2021
Howard Pass	Electric Fence	T-post, poly-wire solar charger	8/5/2020
Howard Pass	Enclosure	ENC 16/18	7/7/2011
Howard Pass	GPS	17992 GPS	7/7/2011
Howard Pass	RG-TB	TE525	7/7/2011
Howard Pass	SD	SR50a	Removed
Howard Pass	Solar Panel	75 W	5/20/2023
Howard Pass	SR	Li200x	5/20/2023
Howard Pass	ST -10 cm	107	7/14/2021
Howard Pass	ST -20 cm	107	5/20/2023
Howard Pass	ST -50 cm	107	7/26/2016
Howard Pass	Tripod	CM106	7/7/2011
Howard Pass	TX321	NESDIS ID 39617266	8/5/2020
Howard Pass	WS/WD	5108-Alpine-HD	5/20/2023

Table C6. Metadata for Imelyak climate station.

Station Name	Item	Model	Start Date
Imelyak	Antenna	25316 YAGI	6/11/2019
Imelyak	AT	109	7/26/2016
Imelyak	AT (2)	109 (2)	6/8/2022
Imelyak	AT-RH	EE181	5/20/2023
Imelyak	Battery	100 AH (x2)	7/6/2011
Imelyak	Cross arm	CM204	7/6/2011
Imelyak	Cross arm	CM206	7/6/2011
Imelyak	Datalogger	CR1000	7/20/2012
Imelyak	DLP	Imelyak2022	6/8/2022
Imelyak	Enclosure	ENC 16/18	7/6/2011
Imelyak	GPS	17992 GPS	7/6/2011
Imelyak	RG-TB	TE525	8/5/2020
Imelyak	SD	SR50a	Removed
Imelyak	Solar Panel	75 W	7/6/2011
Imelyak	SR	Li200x	5/20/2023
Imelyak	ST -10 cm	107	7/6/2011
Imelyak	ST -20 cm	107	7/6/2011
Imelyak	ST -50 cm	107	7/6/2011
Imelyak	Tripod	CM106	7/6/2011
Imelyak	TX321	NESDIS ID 3961316C	8/5/2020
Imelyak	WS/WD	5108 Alpine HD	7/14/2021

Table C7. Metadata for Kaluich climate station.

Station Name	Item	Model	Start Date
Kaluich	Antenna	25316 YAGI	6/12/2019
Kaluich	AT	109	7/27/2016
Kaluich	AT (2)	109 (2)	6/8/2022
Kaluich	AT-RH	EE181	5/21/2023
Kaluich	Battery	100 AH (x2)	7/20/2012
Kaluich	Cross arm	CM204	7/20/2012
Kaluich	Cross arm	CM206	7/20/2012
Kaluich	Datalogger	CR1000	7/20/2012
Kaluich	DLP	Kaluich2022	6//2022
Kaluich	Electric Fence	T-post, poly-wire solar charger	8/4/2020
Kaluich	Enclosure	ENC 16/18	7/20/2012
Kaluich	GPS	17992 GPS	7/20/2012
Kaluich	RG-TB	TE525	7/20/2012
Kaluich	SD	SR50a	Out 2020
Kaluich	Solar Panel	75 W	5/21/2023
Kaluich	SR	Li200x	6/8/2022
Kaluich	ST -10 cm	107	7/20/2012
Kaluich	ST -20 cm	107	7/20/2012
Kaluich	ST -50 cm	107	7/20/2012
Kaluich	Tripod	CM106	7/20/2012
Kaluich	TX321	NESDIS ID 39617266	8/4/2020
Kaluich	WS/WD	5108 Alpine HD	5/21/2023

Table C8. Metadata for Killik Pass climate station.

Station Name	Item	Model	Start Date
Killik Pass	Antenna	25316 YAGI	8/8/2012
Killik Pass	AT	109	7/15/2021
Killik Pass	AT (2)	109 (2)	6/7/2022
Killik Pass	AT-RH	EE181	5/20/2023
Killik Pass	Battery	100 AH (x2)	8/8/2012
Killik Pass	Cross arm	CM204	8/8/2012
Killik Pass	Cross arm	CM206	8/8/2012
Killik Pass	Datalogger	CR1000	8/8/2012
Killik Pass	DLP	Killik2022	6/7/2022
Killik Pass	Enclosure	ENC 16/18	8/8/2012
Killik Pass	GPS	17992 GPS	8/8/2012
Killik Pass	RG-TB	TE525	6/24/2015
Killik Pass	SD	SR50a	6/27/2018
Killik Pass	Solar Panel	75 W	8/8/2012
Killik Pass	SR	Li200x	5/20/2023
Killik Pass	ST -10 cm	107	8/8/2012
Killik Pass	ST -20 cm	107	8/8/2012
Killik Pass	ST -50 cm	107	8/8/2012
Killik Pass	Tripod	CM106	8/8/2012
Killik Pass	TX312	NESDIS ID 3961C1E8	8/8/2012
Killik Pass	WS/WD	5103	7/15/2021

Table C9. Metadata for Kugururok climate station.

Station Name	Item	Model	Start Date
Kugururok	Antenna	25316 YAGI	7/18/2014
Kugururok	AT	109	7/12/2016
Kugururok	AT (2)	109 (2)	6/9/2022
Kugururok	AT-RH	EE181	6/4/2023
Kugururok	Battery	100 AH (x2)	7/18/2014
Kugururok	Camera	CC5MPX	6/5/2015
Kugururok	Camera battery/solar panel	12 V - 100 AH/10 W solar panel	6/5/2015
Kugururok	Cross arm	CM204	7/18/2014
Kugururok	Cross arm	CM206	7/18/2014
Kugururok	Datalogger	CR1000	7/18/2014
Kugururok	DLP	Kugururok2022	6/9/2022
Kugururok	Electric Fence	T-post, poly-wire solar charger	7/21/2018
Kugururok	GPS	17992 GPS	7/18/2014
Kugururok	RG-TB	TE525	7/18/2014
Kugururok	SD	SR50a	7/18/2014
Kugururok	Solar Panel	75 W	7/18/2014
Kugururok	SR	Li200x	6/4/2023
Kugururok	ST -10 cm	107	7/18/2014
Kugururok	ST -20 cm	107	7/18/2014
Kugururok	ST -50 cm	107	7/18/2014
Kugururok	ST -80 cm	107	7/13/2021
Kugururok	Tripod	CM106	7/18/2014
Kugururok	TX321	NESDIS ID 396203F8	7/13/2021
Kugururok	WS/WD	5103	7/13/2021

Table C10. Metadata for Midnight Mountain climate station.

Station Name	Item	Model	Start Date
Midnight Mountain	AT_1	ThermX	8/6/2013
Midnight Mountain	AT_2	ThermX	8/6/2013
Midnight Mountain	AT_3	ThermX	8/6/2013
Midnight Mountain	Battery	12 V	9/3/2014
Midnight Mountain	Datalogger	CR1000	8/6/2013
Midnight Mountain	DLP	Midnight_2017_ThermX_Air	8/6/2013
Midnight Mountain	Enclosure	Small	7/8/2011
Midnight Mountain	Solar Panel	20 W	8/1/2019
Midnight Mountain	Tripod	CM106	7/8/2011

Table C11. Metadata for Mt. Noak climate station.

Station Name	Item	Model	Start Date
Mt. Noak	Antenna	25316 YAGI	7/22/2018
Mt. Noak	AT	109	7/14/2016
Mt. Noak	AT (2)	109 (2)	6/9/2022
Mt. Noak	AT-RH	EE181	5/22/2023
Mt. Noak	Battery	100 AH (x2)	7/11/2011
Mt. Noak	Camera	CC5MPX	7/27/2017
Mt. Noak	Camera battery/solar panel	12 V - 100 AH/10 W solar panel	Out 2017
Mt. Noak	Cross arm	CM204	7/11/2011
Mt. Noak	Cross arm	CM206	7/11/2011
Mt. Noak	Datalogger	CR1000	7/11/2011
Mt. Noak	DLP	Noak2022	6/9/2022
Mt. Noak	Electric Fence	T-post, poly-wire solar charger	7/22/2018
Mt. Noak	GPS	17992 GPS	7/11/2011
Mt. Noak	RG-TB	TE525	7/12/2021
Mt. Noak	SD	SR50a	Out 2021
Mt. Noak	Solar Panel	75 W	7/11/2011
Mt. Noak	SR	Li200x	5/22/2023
Mt. Noak	ST -10 cm	107	7/11/2011
Mt. Noak	ST -20 cm	107	7/11/2011
Mt. Noak	ST -50 cm	107	6/29/2013
Mt. Noak	ST -75 cm	107	6/29/2013
Mt. Noak	Tripod	CM106	7/11/2011
Mt. Noak	TX321	NESDIS ID 39616110	7/12/2021
Mt. Noak	WS/WD	5103	7/12/2021

Table C12. Metadata for Pamichtuk climate station.

Station Name	Item	Model	Start Date
Pamichtuk	Antenna	25316 YAGI	8/6/2012
Pamichtuk	AT	109	7/25/2016
Pamichtuk	AT (2)	109 (2)	6/7/2022
Pamichtuk	AT-RH	EE181	5/19/2023
Pamichtuk	Battery	100 AH (x2)	8/6/2012
Pamichtuk	Camera	CC5MPX	5/28/2013
Pamichtuk	Camera battery/solar panel	12V-100 AH/10 W solar panel	6/22/2015
Pamichtuk	Cross arm	CM204	8/6/2012
Pamichtuk	Cross arm	CM206	8/6/2012
Pamichtuk	Datalogger	CR1000	8/6/2012
Pamichtuk	DLP	Pamichtuk2022	6/7/2022
Pamichtuk	Electric Fence	T-post, poly-wire solar charger	5/28/2013
Pamichtuk	Enclosure	ENC 16/18	8/6/2012
Pamichtuk	GPS	17992 GPS	8/6/2012
Pamichtuk	RG-TB	TE525	8/6/2012
Pamichtuk	SD	SR50a	Out 2021
Pamichtuk	Solar Panel	75 W	8/6/2012
Pamichtuk	SR	Li200x	5/19/2023
Pamichtuk	ST -10 cm	107	8/6/2012
Pamichtuk	ST -20 cm	107	8/6/2012
Pamichtuk	ST -50 cm	107	8/6/2012
Pamichtuk	Tripod	CM106	8/6/2012
Pamichtuk	TX312	NESDIS ID 3961E704	8/6/2012
Pamichtuk	WS/WD	5103	6/7/2022

Table C13. Metadata for Ram Creek climate station.

Station Name	Item	Model	Start Date
Ram Creek	Antenna	25316 YAGI	8/7/2012
Ram Creek	AT	109	6/27/2018
Ram Creek	AT (2)	109 (2)	6/7/2022
Ram Creek	AT-RH	EE181	5/19/2023
Ram Creek	Battery	100 AH (x2)	8/7/2012
Ram Creek	Cross arm	CM204	8/7/2012
Ram Creek	Cross arm	CM206	8/7/2012
Ram Creek	Datalogger	CR1000	8/7/2012
Ram Creek	DLP	Ram2022	6/7/2022
Ram Creek	Electric Fence	T-post, poly-wire solar charger	6/10/2014
Ram Creek	Enclosure	ENC 16/18	8/7/2012
Ram Creek	GPS	17992 GPS	8/7/2012
Ram Creek	RG-TB	TE525	6/27/2018
Ram Creek	SD	SR50a	7/15/2021
Ram Creek	Solar Panel	75 W	8/7/2012
Ram Creek	SR	Li200x	6/7/2022
Ram Creek	ST -10 cm	107	6/27/2018
Ram Creek	ST -20 cm	107	6/27/2018
Ram Creek	ST -50 cm	107	6/27/2018
Ram Creek	Tripod	CM106	8/7/2012
Ram Creek	TX312	NESDIS ID 3961D29E	6/10/2014
Ram Creek	WS/WD	5103	5/19/2023

Table C14. Metadata for Salmon River climate station.

Station Name	Item	Model	Start Date
Salmon River	Antenna	25316 YAGI	7/17/2013
Salmon River	AT	109	7/27/2016
Salmon River	AT (2)	109 (2)	6/8/2022
Salmon River	AT-RH	EE181	5/21/2023
Salmon River	Battery	100 AH (x2)	7/8/2011
Salmon River	Camera	CC5MPX	7/17/2013
Salmon River	Camera battery/solar panel	12 V - 100 AH/10 W solar panel	2020 (batt)
Salmon River	Cross arm	CM204	7/8/2011
Salmon River	Cross arm	CM206	7/8/2011
Salmon River	Datalogger	CR1000	7/17/2013
Salmon River	DLP	Salmon2022	6/8/2022
Salmon River	Electric Fence	T-post, poly-wire solar charger	7/17/2013
Salmon River	Enclosure	ENC 16/18	7/8/2011
Salmon River	GPS	17992 GPS	7/17/2013
Salmon River	RG-TB	TE525	7/17/2013
Salmon River	SD	SR50a	8/4/2020
Salmon River	SR	Li200x	5/21/2023
Salmon River	ST -10 cm	107	8/4/2020
Salmon River	ST -20 cm	107	7/17/2013
Salmon River	ST -50 cm	107	7/17/2013
Salmon River	Tripod	CM106	7/17/2013
Salmon River	TX321	NESDIS ID 3960F688	7/14/2021
Salmon River	WS/WD	5103	5/21/2023

Table C15. Metadata for Serpentine climate station.

Station Name	Item	Model	Start Date
Serpentine	Antenna	25316 YAGI	7/25/2018
Serpentine	AT	109	6/1/2016
Serpentine	AT (2)	109 (2)	6/11/2022
Serpentine	AT-RH	EE181	5/23/2023
Serpentine	Battery	100 AH (x2)	8/18/2011
Serpentine	Camera	CC5MPX	5/23/2023
Serpentine	Camera battery/solar panel	12 V - 100 AH/10 W solar panel	6/2/2015
Serpentine	Cross arm	CM204	8/18/2011
Serpentine	Cross arm	CM206	8/18/2011
Serpentine	Datalogger	CR1000	8/18/2011
Serpentine	DLP	Serpentine2022	6/11/2022
Serpentine	Enclosure	ENC 16/18	8/18/2011
Serpentine	GPS	17992 GPS	8/18/2011
Serpentine	RG-TB	TE525	8/18/2011
Serpentine	SD	SR50a	6/4/2021
Serpentine	Solar Panel	75 W	8/18/2011
Serpentine	SR	Li200x	6/4/2021
Serpentine	ST -10 cm	107	6/11/2022
Serpentine	ST -20 cm	107	8/18/2011
Serpentine	ST -50 cm	107	6/11/2022
Serpentine	Tripod	CM106	8/18/2011
Serpentine	TX321	NESDIS ID 3961C1E8	9/22/2019
Serpentine	WS/WD	5103	6/4/2021

Table C16. Metadata for Sisiak climate station.

Station Name	Item	Model	Start Date
Sisiak	Antenna	25316 YAGI	7/26/2017
Sisiak	AT	109	7/13/2016
Sisiak	AT (2)	109 (2)	6/10/2022
Sisiak	AT-RH	EE181	5/21/2023
Sisiak	Battery	100 AH (x2)	7/13/2011
Sisiak	Cross arm	CM204	7/13/2011
Sisiak	Cross arm	CM206	7/13/2011
Sisiak	Datalogger	CR1000	7/13/2011
Sisiak	DLP	Sisiak2022	6/11/2022
Sisiak	Enclosure	ENC 16/18	7/13/2011
Sisiak	GPS	17992 GPS	7/13/2011
Sisiak	RG-TB	TE525	7/13/2021
Sisiak	SD	SR50a	Removed
Sisiak	Solar Panel	75 W	7/13/2016
Sisiak	SR	Li200x	5/21/2023
Sisiak	ST -10 cm	107	7/26/2017
Sisiak	ST -20 cm	107	7/13/2011
Sisiak	ST -50 cm	107	6/12/2019
Sisiak	ST -75 cm	107	7/13/2021
Sisiak	Tripod	CM106	7/13/2011
Sisiak	TX321	NESDIS ID 3961548A	7/13/2021
Sisiak	WS/WD	5103	7/13/2021

Table C17. Metadata for Tahinichok climate station.

Station Name	Item	Model	Start Date
Tahinichok	Antenna	25316 YAGI	7/27/2017
Tahinichok	AT	109	7/13/2016
Tahinichok	AT (2)	109 (2)	6/10/2022
Tahinichok	AT-RH	EE181	5/22/2023
Tahinichok	Battery	100 AH (x2)	7/10/2011
Tahinichok	Cross arm	CM204	7/10/2011
Tahinichok	Cross arm	CM206	7/10/2011
Tahinichok	Datalogger	CR1000	7/10/2011
Tahinichok	DLP	Tahinichok2022	6/11/2022
Tahinichok	Electric Fence	T-post, poly-wire solar charger	7/18/2015
Tahinichok	Enclosure	ENC 16/18	7/10/2011
Tahinichok	GPS	17992 GPS	7/10/2011
Tahinichok	RG-TB	TE525	7/10/2011
Tahinichok	SD	SR50a	Out 2021
Tahinichok	Solar Panel	75 W	7/10/2011
Tahinichok	SR	Li200x	5/23/2023
Tahinichok	ST -10 cm	107	7/10/2011
Tahinichok	ST -20 cm	107	7/10/2011
Tahinichok	ST -50 cm	107	7/10/2011
Tahinichok	ST -75 cm	107	6/30/2013
Tahinichok	Tripod	CM106	7/10/2011
Tahinichok	TX312	NESDIS ID 3961548A	7/10/2011
Tahinichok	WS/WD	5103	7/12/2021