

Climate Station Maintenance in the Arctic Network

2021 Summary



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Photo
Chimney Lake climate station, Gates of the Arctic National Park. NPS/Pam Sousanes

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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 and NPS staff. Five additional fire RAWS were visited by the Alaska Fire Service in cooperation with NPS staff in Anchorage. This report summarizes the 2021 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 2021 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.

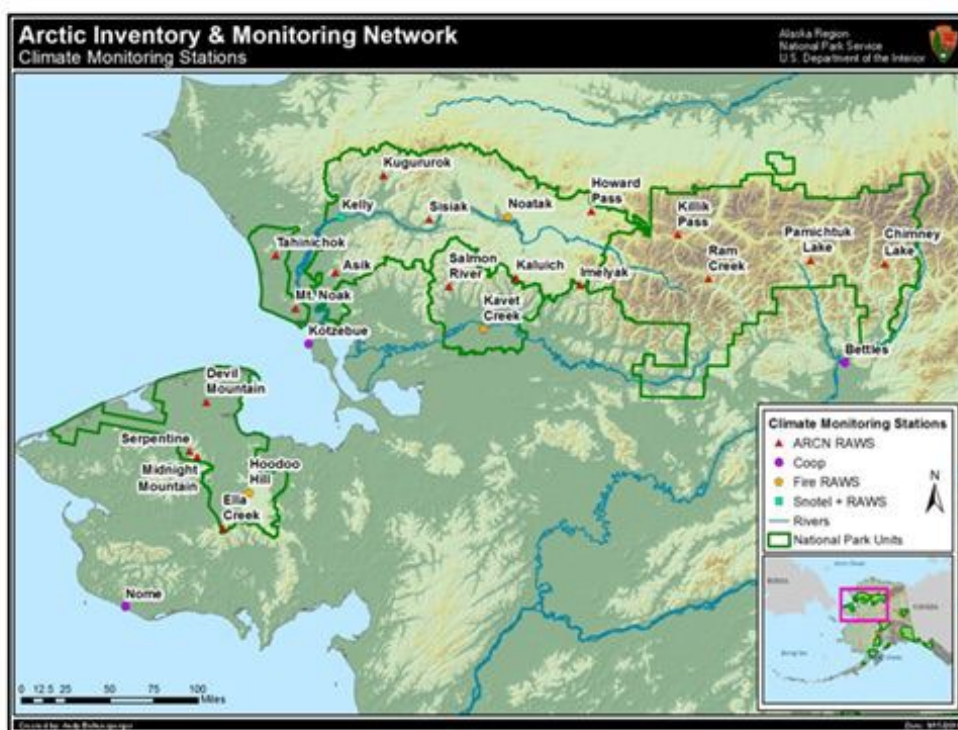


Figure 1. Locations of ARCN climate stations.

Table 1. Locations of ARCN climate stations maintained in 2021 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: 7/15/2021 16:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: high 50's

Damage: none

Sensors replaced:

1. AT-RH (HMP45)
2. WS-WD (05103)
3. SDI (SR50a): removed

Other hardware replaced: none

Additional Comments: station was in good condition, including fence.

Potential Data Issues:

To Do:



Figure 2. Chimney Lake climate station July 15, 2021.

Killik Pass

Date/Time: 7/15/2021 14:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 60's

Damage: Bear damage. Most sensor cables were damaged/pulled out, but station was structurally intact. Very few transmissions September 2020 – July 2021.

Sensors replaced:

1. AT-RH (HMP45). Sensor replaced. Cable re-wired.
2. SR (Li200x)
3. WS-WD (05103)
4. AT (109) replaced.

Other hardware replaced:

1. Battery cable was pulled out. Replaced.

Additional Comments:

1. Air Temperature ThermX sensor re-wired.
2. Battery cable replaced. Conduit was damaged and could not be re-used.
3. Tipping bucket cable repaired by splicing. Crossarm was slightly out of level.
4. U-bolt mount for lightning rod is missing.

Potential Data Issues: All sensors except ST1, ST2, ST3.

To Do:

1. Replaced battery cable conduit. Hole is 1.25 inches. Fittings need to be 1.25" or slightly larger for power cable.



Figure 3. Killik Pass climate station July 15, 2021. Bear damage included crossarm orientation (left), sensors/cables (middle), and the battery cable (right).

Pamichtuk Lake

Date/Time: 7/15/2021 14:40

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 60's

Damage: none

Sensors replaced:

1. AT-RH (HMP45)
2. SR (Li200x)
3. SDI (SR50a) removed.

Other hardware replaced:

1. SD memory card in CC5MPX camera replaced.

Additional Comments:

1. Station was in good condition, including fence.
2. Re-oriented camera to help with back plate access. Retained original scene.

Potential Data Issues:

To Do:



Figure 4. Pamichtuk Lake climate station July 15, 2021.

Ram Creek

Date/Time: 7/15/2021 12:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 50's

Damage: None

Sensors replaced:

1. AT-RH (HMP45)
2. SDI (SR50a). No readings November 2020 – July 2021.

Other hardware replaced:

Additional Comments:

1. Fence was repaired. Insulators replaced, polywire restrung, grounding rods reconnected.

Potential Data Issues:

1. SDI (SR50a) quit November 2020.

To Do:

1. Replace CR1000 lithium battery. 3.1 V on 7/15/2021.



Figure 5. Ram Creek climate station July 15, 2021.

Noatak National Preserve

Asik

Date/Time: 7/13/2021 18:50

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: low 60's

Damage: station had some damage - suspect wildlife/bear.

1. Tipping bucket / snow depth crossarm out of level.
2. Some sensor cables had been pulled on at the enclosure box.
3. STF1 sensor reading warm. Sensor damaged.

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. SR (Li200x)
3. STF1 (107) at 10-cm.

Other hardware replaced:

1. Transmitter (TX321) installed

Additional Comments:

1. All sensors were re-leveled.
2. New program (Asik_2021.CR1) to integrate EE181 sensor.

Potential Data Issues: STF1, SDI, RNIN (see above)

To Do:

1. Replace AT-RH (EE181) radiation shield.
2. Some station damage expected. Spotty transmissions since mid-November 2020. Reviewed transmitted data as of May 2022. Suspect sensors include: AT (109), Battery voltage (bring new cable).



Figure 6. Asik climate station July 13, 2021. The crossarms were out of level (left) and the sensor cables had been pulled out at the enclosure (middle). The station was repaired (right).

Howard Pass

Date/Time: 7/14/2021 18:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 50's, 25-30 mph

Damage:

1. NE Tripod leg was pulled out 4 inches but held in by rocks anchoring the leg. Put back in place and secured with rocks. Station listing to the southwest at 3 degrees.
2. STF1 (107) damaged and replaced.

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. STF1 (107) at 10 cm.

Other hardware replaced:

1. A few insulators were replaced on the electric fence. Posts felt solid.

Additional Comments:

1. New program (HowardPass_2021.CR1) sent to logger.

Potential Data Issues:

1. STF1

To Do:

1. Bring small solar panel to mount behind enclosure. Enclosure is 16" wide by 18" high. Panel is beginning to crack at the U-bolt frame mount.



Figure 7. Howard Pass climate station, July 14, 2021. The NE tripod leg had been pulled out about four inches (left).

Imelyak

Date/Time: 7/14/2021 14:45

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 50's

Damage: none

Sensors replaced:

1. AT-RH (EE181)
2. SR (Li200x)
3. WS-WD (05108)

Other hardware replaced:

Additional Comments:

Potential Data Issues:

1. Wind speed data will be corrected in Aquarius for 8/5/2020 11:00 – 7/14/2021 15:00 time period. Station was incorrectly programmed for 05103 sensor instead of 05108 sensor.

Correction factor = $\text{Multiplier}_{05108} / \text{Multiplier}_{05103} = 0.3726 / 0.2192 = 1.6998$

$WS_{05108} = WS_{05103} * 1.6998$

To Do:

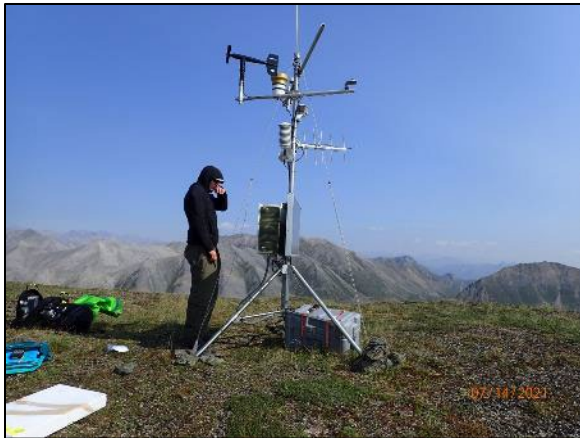


Figure 8. Imelyak climate station July 14, 2021.

Kaluich

Date/Time: 7/14/2021 13:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 50's

Damage:

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)

Other hardware replaced:

Additional Comments:

1. Four elements on YAGI antenna replaced
2. Bent AT-RH radiation shields back into place. Did not replace.

Potential Data Issues:

1. Site visit notes indicate potential WS data correction issues due to possible programming error, but initial review of data indicate that raw data are okay, and no corrections are needed.

To Do:

1. Crossarm for tipping bucket is bent. Consider replacing with new crossarm and brace. Very few tips recorded in winter/spring 2021-2022 (as of May 2022).
2. Check telemetry system. Spotty transmissions in winter.



Figure 9. Kaluich climate station July 14, 2021.

Kugururok

Date/Time: 7/13/2021 11:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 60's

Damage: none

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. SR (Li200x)
3. WS-WD (05103)
4. STF4 (107) installed at 80 cm

Other hardware replaced:

1. Transmitter (TX321 Installed)

Additional Comments:

1. Swapped SD memory card in CC5MPX camera. One screw on camera is stripped and was not replaced.
2. New program sent with STF4 (Kugururok_2021.CR1)

Potential Data Issues:

To Do:

1. No transmissions since July 28, 2021. Sensors looked good before loss of transmissions. Note that station was also damaged ~July 30, 2019 (suspect porcupine?).
2. Consider replacing bent AT-RH and/or ThermX radiation shields.
3. Replace screw on back of CC5MPX

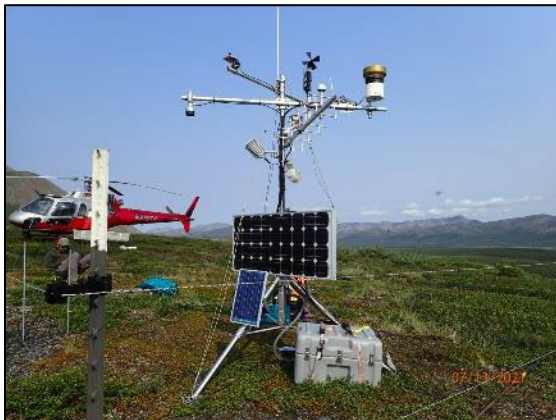


Figure 10. Kugururok climate station July 13, 2021.

Sisiak

Date/Time: 7/13/2021 16:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: high 60's. 10-15 mph.

Damage:

1. AT-RH (HMP45): sensor was attached, but shield was damaged.
2. STF4 (107): ground wire was disconnected
3. RNIN (TE525): tipping bucket was on ground, destroyed, and cable disconnected.

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. SR (Li200x)
3. WS-WD (05103)
4. RNIN (damaged TE525 was replaced)
5. STF4 (107) installed at 75 cm

Other hardware replaced:

1. Transmitter (TX321 installed)
2. Tipping bucket crossarm moved down on mast.

Additional Comments: station damaged, presumably by a bear.

1. New program sent to logger (Sisiak_2021.CR1)
2. Repaired electric fence

Potential Data Issues:

1. AT-RH, STF4, and RNIN suspect.
2. Potential mix-up on ST sensor wiring 2019-2021. See site visit worksheet.

To Do:

1. Replace AT-RH and ThermX radiation shields.
2. Consider crossarm brace for tipping bucket.

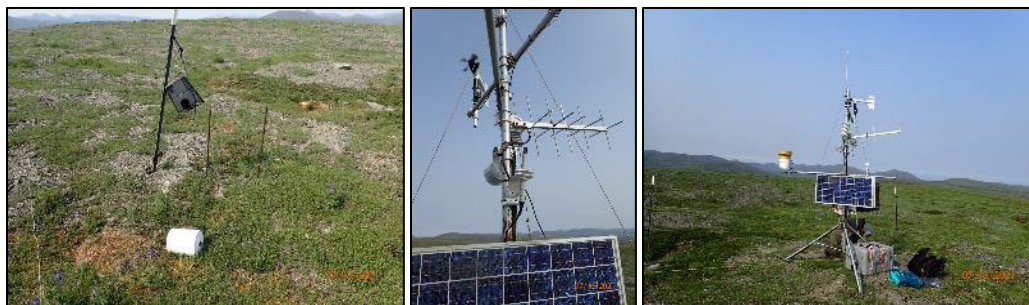


Figure 11. Sisiak climate station July 13, 2021. The fence and tipping bucket had been damaged (left). The AT-RH sensor was disconnected, and the radiation shield was damaged (middle). The station was repaired (right).

Kelly SNOTEL

The Kelly SNOTEL was maintained on 7/13/2022. Tony DeMarco (NRCS) and Ken Hill accessed the site via helicopter while Pam Sousanes visited the Kugururok station. 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 fences were repaired.

Fire RAWS stations: Noatak RAWS and Kelly RAWS

Annual maintenance was completed at the Noatak (5/20/2021) and Kelly (5/28/2021) RAWS by the Alaska Fire Service according to WFMI records. Details are available on WFMI. Noatak RAWS has not been transmitting since 9/1/2021. STF3 was not working prior to transmissions stopping. Alaska Fire Service staff visiting the stations in 2021 were very helpful in repairing soil temperature sensors, but it may be worth considering standalone sensors (Hobo Onset) in the future. It is best practice to contact Alaska Fire Service staff prior to the field season to ensure they have the necessary sensors and to request downloaded data files.

Kobuk Valley National Park

Salmon River

Date/Time: 7/14/2021 10:45

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: mid 60's

Damage: Bear damage suspected 6/9/2021.

1. RNIN tipping bucket damaged (repaired by splicing)
2. CC5MPX: sensor cable pulled on and camera angle altered (reoriented to old scene)

Sensors replaced:

1. AT-RH (EE181)
2. SR (Li200x)

Other hardware replaced:

1. Transmitter (TX321 installed)

Additional Comments:

1. RNIN spliced and releveled. Note that cable was also spliced in 2020.
2. Fence was repaired. A few insulators were replaced, the polywire was re-used.

Potential Data Issues:

1. RNIN (6/9/2021-7/14/2021). Cable damaged and out of level.
2. Phenology camera images (6/9/2021-7/14/2021) disoriented.

To Do:

1. Check RNIN cable repair and replace if necessary.



Figure 12. Salmon River climate station July 14, 2021. The camera had been disoriented (left) and some cables had been pulled on at the enclosure (middle). The station was repaired (right).

Fire RAWS stations: Kavet Creek

Annual maintenance was completed at the Kavet Creek fire RAWS by the Alaska Fire Service on 5/20/2021 according to WFMI records. Details are available on WFMI. The station has not been transmitting since 11/13/2021. All sensors were working before transmissions ended, although the wind sensor may have been heavily rimed the first two weeks of November 2021. Alaska Fire Service staff visiting the station in 2021 were very helpful in repairing soil temperature sensors, but it may be worth considering standalone sensors (Hobo Onset) in the future. It is best practice to contact

Alaska Fire Service staff prior to the field season to ensure they have the necessary sensors and to request downloaded data files.

Cape Krusenstern National Monument

Mt. Noak

Date/Time: 7/12/2021 18:40

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: low 60's

Damage: Suspect environmental damage as opposed to wildlife.

1. RNIN (TE525): tipping bucket on ground and cable severed.
2. SDI (SR50a): cable corroded

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. SR (Li200x)
3. WS-WD (05103)
4. SDI (SR50a) removed (scoured site and data are not useful)
5. RNIN (TE525) replaced

Other hardware replaced:

1. Transmitter (TX321 installed)
2. SD memory card on CC5MPX camera replaced
3. Fence repaired: many insulators replaced, polywire replaced, 1 T-post bent.

Additional Comments:

1. Unsure if crossarm brace was added to support tipping bucket crossarm. Site visit worksheet indicates that a brace was added, but it is not visible in the photos. The photos may have been taken before the brace was installed. Consider bringing/installing a brace if it has not yet been installed.

Potential Data Issues:

1. RNIN and SDI sensors suspect

To Do:

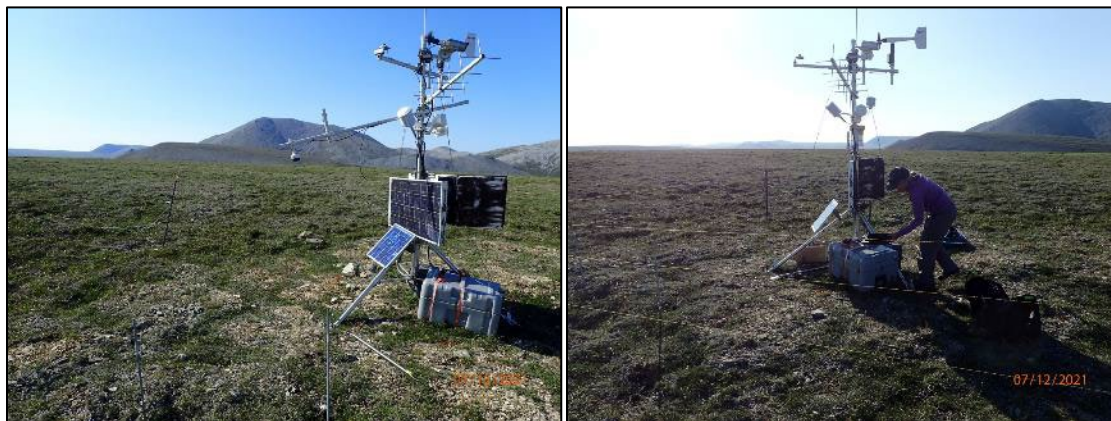


Figure 13. Mt. Noak climate station July 12, 2021. Station shown before (left) and after (right) repairs.

Tahinichok

Date/Time: 7/12/2021 16:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N970TH – Travis Monahan

Weather: low 60's

Damage: Suspect damage was caused by bear.

1. AT-RH (HMP45) sensor was on ground and cable disconnected
2. SDI (SR50a) sensor cable severed
3. RNIN (TE525) tipping bucket out of level
4. AT (ThermX) cable severed

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. SR (Li200x)
3. WS-WD (05103)
4. SDI (SR50a) removed. Site scoured and data not useful.

Other hardware replaced:

1. Transmitter (TX321 installed)

Additional Comments:

1. Two T-post fence posts were mangled. Repair was fairly successful, but fence is short.

Potential Data Issues: see damage (above)

To Do:

1. Bring SR leveling base and replace if needed.
2. Consider adding crossarm brace to support tipping bucket mount.

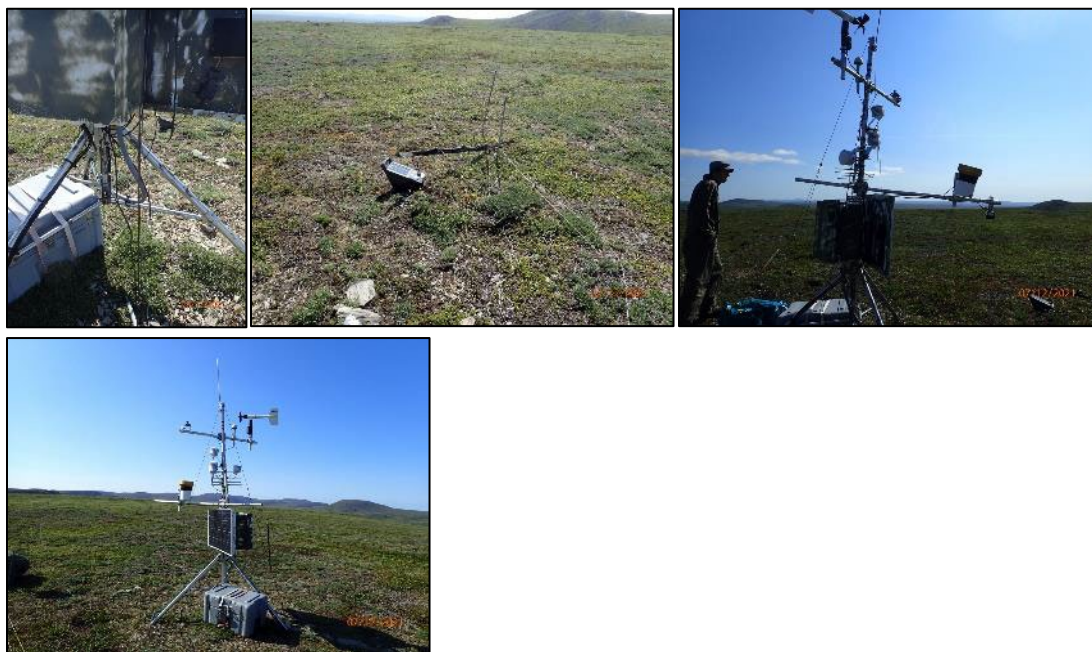


Figure 14. Tahinichok climate station July 12, 2021. Station shown before (top row) and after (bottom) repairs.

Bering Land Bridge National Preserve

Devil Mountain

Date/Time: 6/4/2021 16:10

Personnel: Ken Hill, Pam Sousanes

Logistics: R-44 Helicopter – Bering Air – N155H – Pablo Neira-Montoya

Weather: Gray, brown, cold

Damage: Suspect bear damage.

1. Batteries dead on arrival (< 5 V). Solar panel cable was disconnected. Batteries stopped charging 9/14/2019. No data after 11/19/2020.
2. RNIN (TE525) out of level
3. STF2 (107) cable severed at ground surface

Sensors replaced:

1. AT-RH (HMP45 replaced with EE181)
2. SR (Li200x)
3. WS-WD (05103)
4. STF2 (107) replaced at 20 cm depth

Other hardware replaced:

1. Batteries (x2) uninstalled and replaced with one battery. The replacement battery had been in storage at the Nome NPS warehouse.

Additional Comments:

1. Had to leave site in a rush due to incoming snow showers.
2. New program sent to logger (Devil_2021.CR1)
3. The dead batteries (x2) were removed from the station at a later date by Bering Air.

Potential Data Issues: No data 11/19/2020 – 6/4/2021 due to low battery voltage.

1. RNIN (suspect beginning 6/26/2020)

To Do:

1. Consider adding second battery. This would need to be shipped to Nome in advance.
2. Consider straightening/replacing ThermX radiation shield (bent 90 degrees).



Figure 15. Devil Mountain climate station June 4, 2021, before (left) and after (right) repairs.

Ella Creek

Date/Time: 6/4/2021 10:30

Personnel: Ken Hill, Pam Sousanes

Logistics: R-44 Helicopter – Bering Air – N155H – Pablo Neira-Montoya

Weather: Cold, scattered snow showers

Damage: Tripod was tipped over on arrival with the south leg pulled out. Suspect that some damage occurred on 8/3/2019 (66 mph gust) with possible additional damage/tipping on 11/14/2019 (45 mph gust). The WS-WD sensor was destroyed, the snow cable was pulled out. The antenna and other sensors looked okay, although they were laying on the ground surface.

Sensors replaced:

1. SR (Li200x)
2. WS-WD (05108). Sensor only, not the cable.
3. RNIN (TE525)

Other hardware replaced:

Additional Comments:

1. As of May 2022, station has very few transmissions since October 2021 with last sporadic transmissions in March 2022. Most sensor values looked reasonable from March transmissions, except perhaps RNIN.
2. Staff had to exit site early due to deteriorating weather conditions.

Potential Data Issues: tripod was tipped over, probably on 8/3/2019.

1. Sensors on ground that are okay and/or suspect 8/3/2019-6/4/2021: AT-RH
2. Sensors damaged and/or with bad data 8/3/2019-6/4/2021: RNIN, WS-WD, SDI.

To Do:

1. Consider replacing solar panel with a smaller panel to reduce wind catch.
2. Consider adding crossarm brace for RNIN tipping bucket. Sensor often receives wind damage and possibly tips during high wind events.



Figure 16. Ella Creek climate station June 6, 2021, before (left) and after (right) repairs..

Midnight Mountain

Date/Time: 6/4/2021 18:15

Personnel: Ken Hill, Pam Sousanes

Logistics: R-44 Helicopter – Bering Air – N155H – Pablo Neira-Montoya

Weather: Snow showers

Damage: none

Sensors replaced: none

Other hardware replaced: none

Additional Comments:

1. Site only has three air temperature sensors (ThermX)
2. Fresh snow at site with rime ice on radiation shields

Potential Data Issues:

To Do:

1. If/when possible, remove 75 W solar panel from site.



Figure 17. Midnight Mountain climate station June 4, 2021.

Serpentine Hot Springs

Date/Time: 6/4/2021 13:00

Personnel: Ken Hill, Pam Sousanes

Logistics: R-44 Helicopter – Bering Air – N155H – Pablo Neira-Montoya

Weather:

Damage: Tripod tipped over on 10/16/2020 during 30+ mph gusts and heavy rain.

1. AT-RH (HMP155) disconnected and on ground.
2. All sensors on ground due to tripod being tipped over

Sensors replaced:

1. AT-RH (HMP155 replaced with EE181)
2. SR (Li200x)
3. WS-WD (05103)
4. SDI (SR50a) sensor head

Other hardware replaced:

Additional Comments:

1. CC5MPX camera lens was smooshed in the tundra and wet. Cleaned, dried, refocused, and swapped SD memory card.
2. Put rocks on south leg.
3. Note that tripod also tipped over 10/30/2016 during 40 mph gusts and rain.

Potential Data Issues: see damage above.

1. Suspect and/or okay: AT (10/16/2020 – 6/4/2021). Sensors on/near ground surface.
2. Data to be deleted/suppressed: SR, WS-WD, SDI (10/16/2020-6/4/2021)

To Do:

1. Consider replacing solar panel with smaller panel to reduce wind catch. Consider alternative anchoring for station.
2. As of May 2022, ST1 and ST3 reading -99. Plan to replace/repair.
3. As of May 2022, RNIN tipping bucket suspect. Plan to replace/repair.



Figure 18. Serpentine climate station June 4, 2021, before (left) and after (right) repairs.

Fire RAWS stations: Hoodoo Hills and Quartz Creek

Annual maintenance was completed at the Hoodoo Hills fire RAWS on 5/28/2021 by the Alaska Fire Service according to WFMI records. Details are available on WFMI. The station has not been transmitting since late September 2020. Most sensors (except ST1 and ST2) appeared to be working before transmissions ended, but it's likely that the batteries were not connected/charging. Alaska Fire Service staff visiting the stations in 2021 were very helpful in repairing soil temperature sensors, but it may be worth considering standalone sensors (Hobo Onset) in the future. It is best practice to contact Alaska Fire Service staff prior to the field season to ensure they have the necessary sensors and to request downloaded data files.

Annual maintenance was completed at the Quartz Creek fire RAWS on 6/18/2021 by the Alaska Fire Service according to WFMI records. Details are available on WFMI.

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

CAKR-NOAT-GAAR 7/12/2021 – 7/15/2021

Personnel: Travis Monahan (Temsco pilot), Pam Sousanes (ARCN physical scientist), Ken Hill (ARCN physical scientist).

Aircraft: N970TH. Temsco A-star on exclusive use contract with NPS western area fire program.

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

Housing: Kotzebue NPS housing (7/12-7/13), Camping at Howard Pass (7/14)

Vehicles: NPS vehicle in Kotzebue and Bettles as needed. Arranged with local staff prior to trip.

Stations maintained: CAKR (7/12), NOAT/KOVA (7/13-7/14), GAAR (7/15)

Equipment staging: none. Staff flew with all equipment. The current inventory of climate equipment in the Kotzebue warehouse is unknown but expected to be minimal/non-existent. Staff should visit the warehouse in the next field season to note any equipment in storage.

Narrative: Sousanes flew via commercial airlines from Fairbanks to Kotzebue on 7/12. Monahan ferried N970TH from Denali to Fairbanks on 7/12 where he met Hill at the east ramp transient parking. Hill and Monahan flew from Fairbanks to Kotzebue in N970TH, refueling in Galena. Sousanes retrieved an NPS vehicle in Kotzebue and met Hill and Monahan at the Kotzebue hangar. Staff completed maintenance at Tahinichok and Mt. Noak station the afternoon/evening of 7/12. On 7/13, Tony DeMarco (NRCS) arrived in Kotzebue. Hill and DeMarco completed maintenance at the Kelly Snotel station while Sousanes and Monahan visited the Kugururok station. Asik and Sisiak stations were visited the afternoon/evening of 7/13. All staff stayed in Kotzebue for the night. On 7/14, maintenance was completed at Salmon River, Kaluich, and Imelyak en route to Dahl Creek where fuel was obtained from the NPS Jet A tank. Staff then completed maintenance at Howard Pass the evening of 7/14 and camped on site. On 7/15, maintenance at Killik Pass and Ram Creek was completed before fuel was purchased at Bettles from Brooks Range Aviation. Pamichtuk Lake and Chimney Lake stations were visited in the afternoon before staff returned to Fairbanks via Bettles.

BELA 6/3/2021-6/5/2021

Personnel: Pablo Neira-Montoya (Bering Air pilot), Pam Sousanes (ARCN physical scientist), Ken Hill (ARCN physical scientist).

Aircraft: N155H. Bering Air R44 helicopter.

Fuel: Bering Air (Nome and Quartz Creek)

Housing: NPS housing in Nome arranged with local staff prior to trip.

Vehicles: NPS vehicle arranged with local staff prior to trip.

Stations maintained: Ella Creek, Serpentine, Devil Mountain, Midnight Mountain

Equipment staging: One climate station battery was taken from the warehouse and installed at Devil Mountain. The current inventory of climate equipment in the Nome warehouse is unknown but expected to be minimal/non-existent. Staff should visit the warehouse in the next field season to note any equipment in storage.

Narrative: Hill and Sousanes flew commercially to Nome on 6/3/2021. Housing and vehicles were arranged in advance with local staff. On 6/4/2021, Hill and Sousanes visited Ella Creek, Serpentine,

Devil Mountain, and Midnight Mountain. The weather was cold and marginal with numerous snow showers which led to a somewhat rushed field schedule. On 6/5/2021, the weather continued to deteriorate. Hill and Sousanes returned to Fairbanks on commercial airlines.

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	Resistance Temperature Detector (RTD) Thermistor. Custom build.	Therm-X
Air Temperature 3	109 Temperature Probe (primary beginning summer 2016)	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

Table B3. Satellite communication specifications.

Satellite Communication	Model/Item #	Purchased From:
GOES Satellite transmitter	TX312/TX320/TX321 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 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	7/13/2012
Asik	AT	109	7/12/2016
Asik	AT	ThermX	7/13/2012
Asik	AT-RH	EE181	7/13/2021
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	Asik2021	7/27/2017
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	8/5/2019

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	ThermX	5/27/2013
Chimney Lake	AT-RH	HMP45	7/15/2021
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	Chimney2017	6/27/2017
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	7/30/2020
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	8/23/2012
Devil Mountain	AT	109	6/1/2016
Devil Mountain	AT	ThermX	8/18/2011
Devil Mountain	AT-RH	EE181	6/4/2021
Devil Mountain	Battery	100 AH (x1)	6/4/2021
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	Devil2021	6/4/2021
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	6/1/2016
Devil Mountain	SD	SR50a	8/10/2017
Devil Mountain	Solar Panel	75 W	8/18/2011
Devil Mountain	SR	Li200x	6/4/2021
Devil Mountain	ST -10 cm	107	8/18/2011
Devil Mountain	ST -20 cm	107	6/4/2021
Devil Mountain	ST -50 cm	107	8/18/2011
Devil Mountain	Tripod	CM106	8/18/2011
Devil Mountain	TX321	NESDIS ID 3961221A	8/1/2019
Devil Mountain	WS/WD	5103	6/4/2021

Table C4. Metadata for Ella Creek climate station.

Station Name	Item	Model	Start Date
Ella Creek	Antenna	25316 YAGI	8/1/2019
Ella Creek	AT	109	6/2/2016
Ella Creek	AT	ThermX	9/18/2012
Ella Creek	AT-RH	HMP45	8/1/2019
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	Ella2017	8/9/2017
Ella Creek	Enclosure	ENC 16/18	9/18/2012
Ella Creek	GPS	17992 GPS	9/18/2012
Ella Creek	RG-TB	TE525	6/4/2021
Ella Creek	SD	SR50a	7/24/2018
Ella Creek	Solar Panel	75 W	9/18/2012
Ella Creek	SR	Li200x	6/4/2021
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	8/1/2019
Ella Creek	WS/WD	5108-Alpine-HD	6/4/2021

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	ThermX	7/7/2011
Howard Pass	AT-RH	EE181	7/14/2021
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	7/7/2011
Howard Pass	SR	Li200x	8/5/2020
Howard Pass	ST -10 cm	107	7/14/2021
Howard Pass	ST -20 cm	107	7/7/2011
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	6/11/2018

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	ThermX	7/6/2011
Imelyak	AT-RH	EE181	7/14/2021
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	Imelyak2020	6/27/2017
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	7/14/2021
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	ThermX	7/20/2012
Kaluich	AT-RH	EE181	7/14/2021
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	Kaluich2021	7/14/2021
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	7/20/2012
Kaluich	SR	Li200x	8/4/2020
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	8/4/2020

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	ThermX	5/29/2013
Killik Pass	AT-RH	HMP45	7/15/2021
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	Killik2017	6/27/2017
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	7/15/2021
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	ThermX	7/18/2014
Kugururok	AT-RH	EE181	7/13/2021
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	Kugururok2021	7/13/2021
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	7/13/2021
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	ThermX	7/11/2011
Mt. Noak	AT-RH	EE181	7/12/2021
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	Noak2021	7/12/2021
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	7/12/2021
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	ThermX	5/29/2013
Pamichtuk	AT-RH	HMP45	7/15/2021
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	Pamichtuk2017	6/27/2017
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	7/15/2021
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	6/10/2019

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	ThermX	5/28/2013
Ram Creek	AT-RH	HMP45	7/15/2021
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	Ram2017	6/27/2017
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	7/30/2020
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	7/30/2020

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-RH	EE181	7/14/2021
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	Salmon2020	6/28/2017
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	7/14/2021
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	8/4/2020

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	ThermX	8/18/2011
Serpentine	AT-RH	EE181	6/4/2021
Serpentine	Battery	100 AH (x2)	8/18/2011
Serpentine	Camera	CC5MPX	8/1/2019
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	Serpentine2021	6/4/2021
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	8/10/2017
Serpentine	ST -20 cm	107	8/18/2011
Serpentine	ST -50 cm	107	8/10/2017
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	ThermX	7/13/2011
Sisiak	AT-RH	EE181	7/13/2021
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	Sisiak2021	7/13/2021
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	7/13/2021
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	ThermX	7/27/2017
Tahinichok	AT-RH	EE181	7/12/2021
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	Tahinichok2021	7/12/2021
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	7/12/2021
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