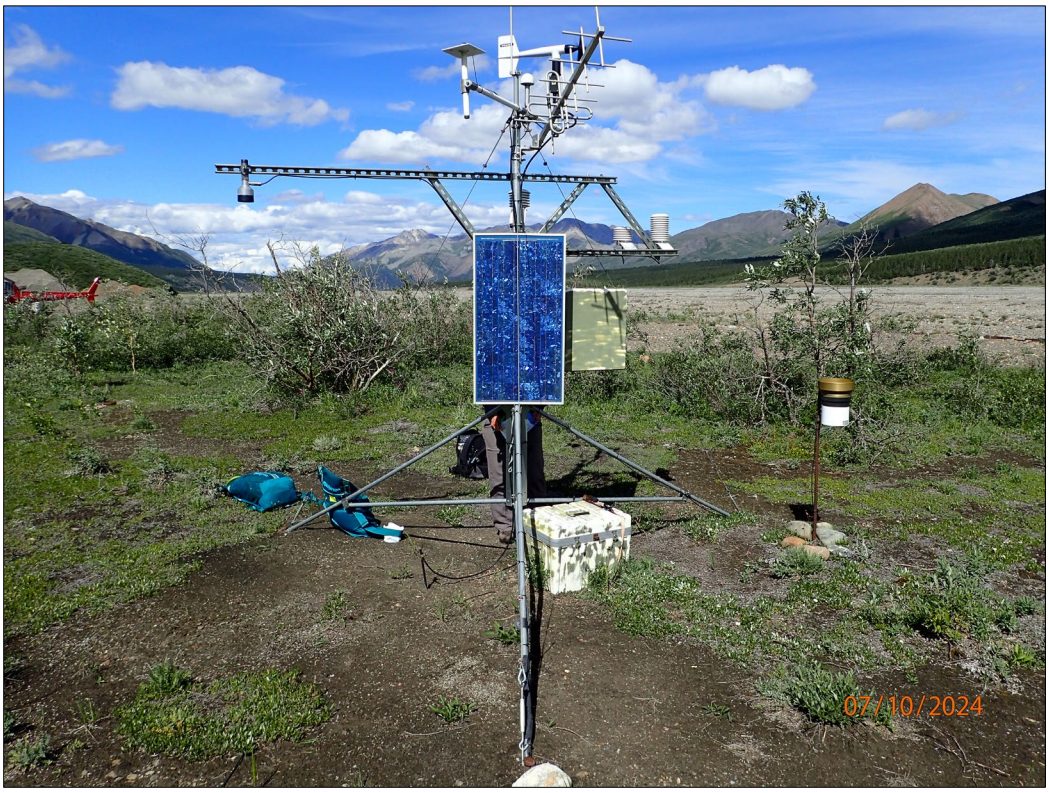
Climate Station Maintenance in the Central Alaska Inventory and Monitoring Network

2024 Summary



Pam Sousanes and Ken Hill

October 2024

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Photo
Toklat weather station, Denali National Park and Preserve.
NPS/Ken Hill

Contents

Page

Figures....iv

Tables....v

Appendices....vi

Abstract....vii

List of Acronyms....viii

Climate Station Locations....9

Climate Station Maintenance Summaries....11

Denali National Park and Preserve....11

Eielson Visitor Center....11

Stampede....12

Toklat....13

Wigand....14

Dunkle Hills....15

Ruth Glacier....16

Denali Fire RAWS....17

Denali SNOTEL....17

Wonder Lake Climate Reference Network Station (AK Denali 27N)....17

Wrangell-St. Elias....18

Chicken Creek....18

Chititu....19

Gates Glacier....20

Tebay....21

Tana Knob....22

Wrangell-St. Elias Fire RAWS....23

Wrangell-St. Elias SNOTEL....23

Yukon-Charley Rivers National Preserve....24

Coal Creek 24
Upper Charley 25
Literature Cited 26

Figures

Page

Figure 1. Locations of CAKN climate stations. 9

Figure 2. Eielson Visitor Center climate station, August 13, 2024. 11

Figure 3. Stampede climate station, July 10, 2024. The station with two solar panels (left). End of site visit photo with one solar panel removed (right). 12

Figure 4. Toklat climate station, July 10, 2024. 13

Figure 5. Wigand climate station July 10, 2024. 14

Figure 6. Dunkle Hills climate station July 10, 2024. Damaged soil sensors (left) and station at end of site visit (right). 15

Figure 7. Ruth Glacier climate station July 11, 2024. 16

Figure 8. Chicken Creek climate station, July 15, 2024. 18

Figure 9. Chititu climate station, July 14, 2024. 19

Figure 10. Gates Glacier climate station on July 14, 2024. 20

Figure 11. Tebay climate station, July 14, 2024. Site had been damaged (left and center). Station after site maintenance was completed (right). 21

Figure 10. Tana Knob climate station on July 15, 2024. Crossarms were out of level when we arrived (left). Site after maintenance visit (right). 22

Figure 12. Coal Creek climate station, June 18, 2024. Broken door hinge on enclosure (left). After station visit with new enclosure (right). 24

Figure 13. Upper Charley station June 18, 2024. 25

Tables

Page

Table 1. Locations of CAKN climate stations maintained in 2024 field season. 10
Table B1. Sensor specifications. 29
Table B2. Datalogger specifications. 29
Table B3. Satellite communication specifications. 29
Table B4. Power specifications. 30
Table B5. Hardware specifications. 30
Table B6. Electric fence specifications. 30
Table C1. Metadata for Chicken Creek climate station. 31
Table C2. Metadata for Chititu climate station. 32
Table C3. Metadata for Coal Creek climate station. 33
Table C4. Metadata for Dunkle Hills climate station. 34
Table C5. Metadata for Eielson Visitor Center climate station. 35
Table C6. Metadata for Gates Glacier climate station. 36
Table C7. Metadata for Ruth Glacier climate station. 37
Table C8. Metadata for Stampede climate station. 38
Table C9. Metadata for Tana Knob climate station. 39
Table C10. Metadata for Tebay climate station. 40
Table C11. Metadata for Toklat climate station. 41
Table C12. Metadata for Upper Charley climate station. 42
Table C13. Metadata for Wigand climate station. 43

Appendices

	Page
Appendix A. Logistics Summary 2024	27
Appendix B. CAKN I&M Station Specifications	29
Appendix C. CAKN RAWS Components by Climate Station	31

Abstract

The mission of the Central Alaska Network Inventory and Monitoring Program (CAKN) is to collect, compile and synthesize scientific information about the central network of parks 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.

The objective of the climate monitoring program is to monitor and record weather conditions at representative locations to identify long and short-term trends, provide reliable climate data to other researchers, and to participate in larger scale climate monitoring and modeling efforts beyond park boundaries. Thirteen remote automated I&M weather stations (RAWS) have been installed in CAKN parks since 2003. There are additional weather and climate stations in the parks run by state and federal agencies with specific objectives and missions. It is in the best interest of the CAKN program to cooperate with these other entities on maintenance site visits. During the 2024 field season maintenance site visits were conducted at twenty-five sites, including twelve CAKN RAWS, four SNOTEL (snow telemetry) stations, eight fire RAWS stations, and one NOAA climate reference network site.

This report summarizes all work for the 2024 field season and includes current sensor metadata. These annual operations reports are compiled each year along with other deliverables so that it is clear how the data were collected. For more information, including data access, weather summaries, and annual reports please visit the CAKN climate website at https://www.nps.gov/im/cakn/climate.htm.

List of Acronyms

Ah:	Amp hour
AT:	Air Temperature
AT-RH:	Air Temperature-Relative Humidity
CAKN:	Central Alaska Network
DENA:	Denali National Park and Preserve
DLP:	Data Logger Program
FTS:	Forest Technology Systems
GOES:	Geostationary Operational Environmental Satellite
GPS:	Global Positioning System
I&M:	Inventory and Monitoring
NESDIS ID:	National Environmental Satellite, Data, and Information Service Identifier
NPS:	National Park Service
NRCS:	Natural Resource Conservation Service
RAWS:	Remote Automated Weather Station
RG-TB:	Rain Gauge - Tipping Bucket
SD:	Snow Depth
SNOTEL:	Snow Telemetry
SR:	Solar Radiation
ST:	Soil Temperature
W:	Watt
WFMI:	Wildland Fire Management Information
WRST:	Wrangell-St. Elias National Park and Preserve
WS-WD:	Wind Speed - Wind Direction
YUCH:	Yukon-Charley Rivers National Preserve

Climate Station Locations

For the 2024 field season, the Central Alaska Network (CAKN) continued its climate monitoring program by visiting stations in Denali National Park and Preserve (DENA), Yukon-Charley Rivers National Preserve (YUCH), and Wrangell – St. Elias National Park and Preserve (WRST) (Figure 1). Thirteen CAKN climate stations were maintained (Table 1) along with NPS support at four NRCS snow and soil sites, eight fire RAWS stations, and one NOAA Climate Reference Network station. Annual maintenance includes downloading data, updating software and programming, replacing sensors, and troubleshooting problems. Maintenance is critical to provide continuous, high-quality meteorological data. The annual deliverables for the 2024 data year are available at: https://irma.nps.gov/DataStore/Reference/Profile/2305960.

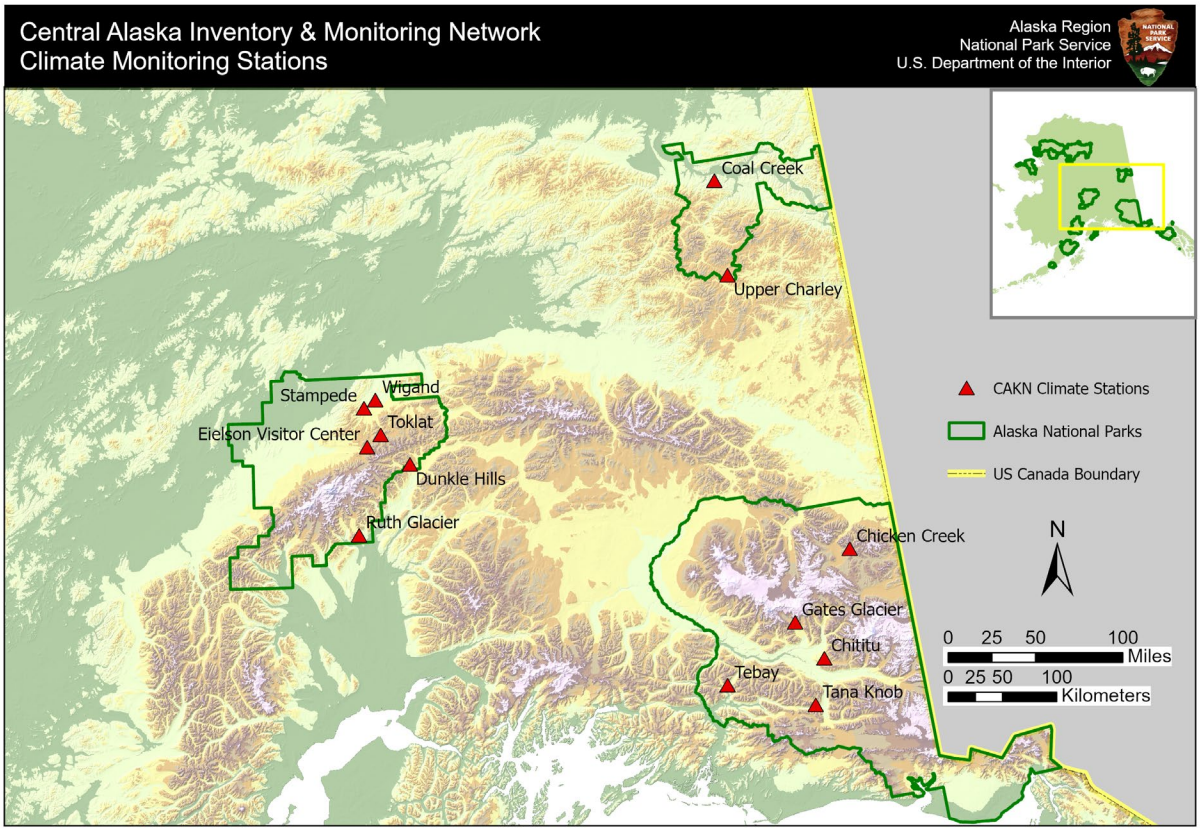


Figure 1. Locations of CAKN climate stations.

Table 1. Locations of CAKN climate stations maintained in 2024 field season.

Station Name	Latitude	Longitude	Elevation (m)	Park
Chititu	61.274	-142.621	1385	WRST
Chicken Creek	62.124	-141.847	1597	WRST
Tana Knob*	60.908	-142.901	1140	WRST
Gates Glacier	61.603	-143.013	1237	WRST
Tebay	61.181	-144.342	573	WRST
Chisana SNOTEL/RAWS	62.072	-142.065	1012	WRST
May Creek SNOTEL/RAWS	61.348	-142.694	503	WRST
Klawasi RAWS	62.217	-144.995	2513	WRST
Strelna/Chitina RAWS	61.521	-144.198	1232	WRST
Upper Charley	64.517	-143.202	1114	YUCH
Coal Creek	65.314	-143.132	292	YUCH
Toklat	63.524	-150.043	890	DENA
Eielson Visitor Center	63.431	-150.309	1202	DENA
Wigand	63.814	-150.109	1716	DENA
Ruth Glacier	62.710	-150.540	1006	DENA
Stampede	63.747	-150.328	549	DENA
Dunkle Hills	63.268	-149.539	808	DENA
Wonder Lake CRN	63.452	-150.875	2163	DENA
Kantishna SNOTEL	63.540	-150.990	472	DENA
Tokositna SNOTEL	62.629	-150.775	259	DENA

Climate Station Maintenance Summaries

This section describes the maintenance details of twenty-five climate stations in CAKN organized by park unit. This work is being implemented based on Central Alaska Network (CAKN) climate vital sign protocols (Sousanes 2018) and standard operating procedures (Sousanes et al. 2017). The 2024 protocol and SOPs are available at: https://irma.nps.gov/DataStore/Reference/Profile/2303381.

See Appendix A for detailed logistics for each of the base locations. Appendices B and C provide sensor specifications and metadata.

Denali National Park and Preserve

Eielson Visitor Center

Date/Time: 8/13/2024 15:50
Personnel: Pam Sousanes
Logistics: A-star helicopter – Temsco – N149AE – Josh Han
Weather: mid 50s
Damage:

1. Bear teeth marks on tipping bucket and battery box. Tipping bucket only slightly out of level.

Sensors replaced:

Removed AT/RH EE181 #202016000042CD
Installed AT/RH EE181 # 2016600073183

Other hardware replaced: none.
Additional Comments:
Potential Data Issues:

1. RN_IN and RN_TOT may be low; TB slightly out of level.

To Do:

1. Bring small radiation shield for 109_2 temp sensor.
2. Remove Davis unit.
3. Replace NEMA enclosure and battery box in next few years.
4. Bring straps for battery box.

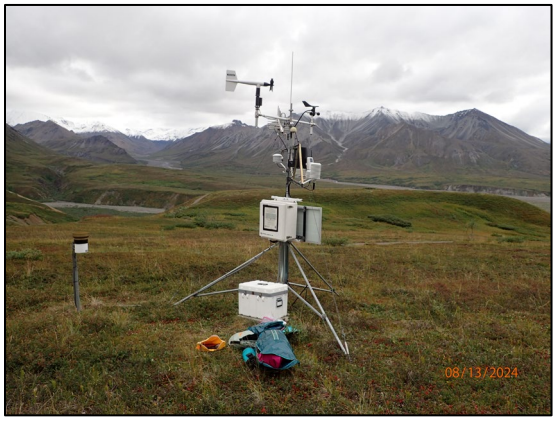


Figure 2. Eielson Visitor Center climate station, August 13, 2024.

Stampede

Date/Time: 7/10/2024 12:00

Personnel: Pam Sousanes, Ken Hill

Logistics: A-star helicopter – Temsco – N149AE – Josh Han

Weather: upper 60s, sunny.

Damage:

Sensors replaced:

Removed AT/RH 181 #139750, RM Young Wind #129043

Installed AT/RH EE181#0198BD, RM Young Wind #85177

Other hardware replaced: Swapped CR1000 (out #64827) for CR1000x (in #60252) and TX321 (out #2091) for TX325 (in #300003063). Replaced the two 12V batteries.

Additional Comments: Removed one of the older solar panels. All soil sensors are 109. New program SMPA_2024. After this visit the site stopped transmitting on August 20, 2024. There may be a problem with the GPS antenna or cable. Looking at downloaded data, there is no GPS data from 6/23/2023 2200 – 8/17/2023 0700, during this time there were erroneous values for RN_IN (a few) and RN_TOT (many), reading 7999. A few erroneous values for WS, BVV during this same period, while the other parameters look OK.

Potential Data Issues:

1. RN_IN, RN_TOT, BVV, WS 2023-06-23 1300 through 2023-08-17 0800

To Do:

1. Replace GPS antenna (egg) and cable.



Figure 3. Stampede climate station, July 10, 2024. The station with two solar panels (left). End of site visit photo with one solar panel removed (right).

Toklat

Date/Time: 7/10/2024 14:25
Personnel: Pam Sousanes, Ken Hill
Logistics: A-star helicopter – Temsco – N149AE – Josh Han
Weather: low 60s
Damage: none
Sensors replaced:

Removed AT/RH EE181 #74351, LiCor Li200X #60172
Installed AT/RH EE181 #1351AC, LiCor Li200X #68925

Other hardware replaced: none
Additional Comments: Station looked good. On first attempt to download data, message appeared < datalogger was performing another function>. Tried again and it worked.
Potential Data Issues: none
To Do:

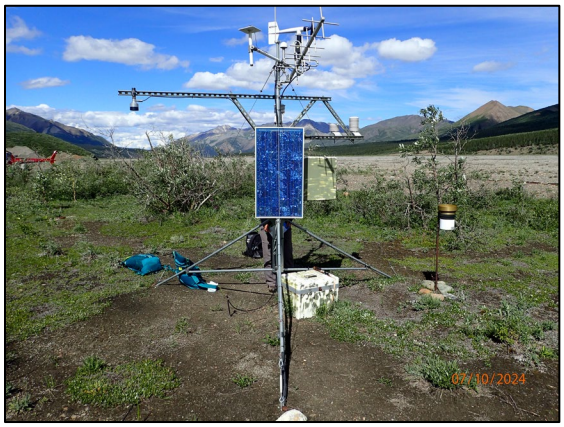


Figure 4. Toklat climate station, July 10, 2024.

Wigand

Date/Time: 7/10/2024 10:45
Personnel: Pam Sousanes, Ken Hill
Logistics: A-star helicopter – Temsco – N149AE – Josh Han
Weather: upper 50s, light winds
Damage: WD, blue excitation wire broken off at terminal (EX2). No other damage.
Sensors replaced:

Removed AT/RH EE181 #086CD, LiCor Li200X #63676
Installed AT/RH EE181 #003057, LiCor Li200X #60149

Other hardware replaced: none
Additional Comments: Station looked good, level and secure. EX2 blue wire on the wind sensor was broken off at the terminal. Plenty of slack, so not sure why this happened. Reconnected. The two deeper soil sensors heaved; 60 cm heaved 10 cm - evidence from exposed dirt line. 50 cm sensor may have heaved ~ 5 cm but there was no dirt on this sensor. Electric fence repaired.
Potential Data Issues:

1. WD – no data from 2024-04-11 1300 to 2024-07-10 1000
2. STF3 heaved ~ 5 cm
3. STF4 heaved ~10 cm.

To Do:

1. Consider bringing smaller piece of Geoblock to go under battery box.
2. Take notes on soil sensors – are they heaving, loose, good?



Figure 5. Wigand climate station July 10, 2024.

Dunkle Hills

Date/Time: 7/10/2024 15:30

Personnel: Pam Sousanes, Ken Hill

Logistics: A-star helicopter – Temsco – N149AE – Josh Han

Weather: low 60s

Damage: All soil sensors ripped out; possibly bear? Also chewed on the air temperature 109 sensor and coax, but damage to those two sensors/cables was minimal.

Sensors replaced:

Removed AT/RH EE181 #212916001391E1, SR50a

Installed AT/RH EE181 #023406, SR50a #2550

Other hardware replaced: Replaced all soil sensors, STF 1,2,3,4. Replaced tipping bucket screen.

Additional Comments:

Potential Data Issues:

1. STF 1, 2, 3, 4 bad data 2023-09-16 through 2024-07-10.

To Do:

1. Swap batteries



Figure 6. Dunkle Hills climate station July 10, 2024. Damaged soil sensors (left) and station at end of site visit (right).

Ruth Glacier

Date/Time: 7/11/2024 10:30

Personnel: Pam Sousanes

Logistics: A-star helicopter – Temsco – N570AE – Jon Combs

Weather: low 50s

Damage: Not transmitting, failsafe tripped. Snow depth sensor reading NAN.

Sensors replaced:

Removed AT/RH EE181 #192516000342BC, Sr50a

Installed AT/RH EE181 #0343E4, Sr50a

Other hardware replaced: Swapped CR1000 for CR1000X (#60253) and TX321 for TX325 (#300003067).

Additional Comments: Planned to move the enclosure 180° so it opened to the outside (for easier access) but ran out of time. Started site visit and then needed to pack up and move and wait down below for 1.5 hours until it cleared enough to get back to site. Site never transmitted after installing the new datalogger and transmitter.

Potential Data Issues: none. First glance at logged data looked good.

To Do:

1. Swap batteries
2. Swap snow depth cable
3. Swap EE181 sensor + cable in case there is a short

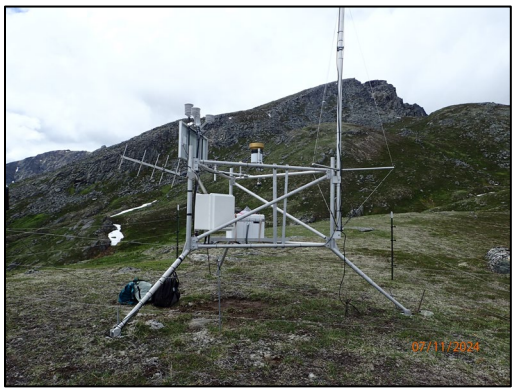


Figure 7. Ruth Glacier climate station July 11, 2024.

Denali Fire RAWS

DENA staff completed annual maintenance at all fire RAWS in summer 2024. More information is available through WXx-Weather.

Denali Visitor Center: Annual maintenance performed 5/20/2024 by Sarah Hayes and Shannon Coykendall. Replaced RH/AT (44666), replaced wind (41908). Station is not level on n/s axis and some nearby trees need to be removed.

Lake Minchumina: Annual maintenance performed 5/23/2024 by Shannon Coykendall and Lexie Regetz. Replaced RH/AT (40781) and solar radiation (4049). Performed tipping test and zeroed rain gauge, scanned all sensors, verified WS/WD, no sensors required mapping. No software updates available. Station and surround vegetation in good condition.

McKinley River: Annual maintenance completed 5/22/2024 by Sarah Hayes. Replaced RH/AT (41672), rain (47791). Rain gauge zeroed. Sensors scanned. Reset tipping bucket. Snow depth sensor showing 0.0 inches and "err" for all readings. South post of bear fence (with controller) bent down but fence was still functional. Replaced post, straightened and adjusted fence wires/posts/resisters. Cover for back of solar panel wiring still secured with tape. Trimmed small vegetation (alder, balsam poplar) around station and LZ. Good practice to bring fence post pounder, spare resisters, spare fence post in case one is bent. One spare coil of fencing wire in the RAWS panel box (used one on this visit.)

Wonder Lake: Annual maintenance completed 5/25/2024 by Shannon Coykendall and Lexie Regetz. Replaced RH/AT sensor (58203). Tipping bucket reset. Performed tipping test and zeroed rain gauge, scanned all sensors, verified WS/WD, no sensors required mapping. No software updates available. Station and surrounding veg in good condition.

Denali SNOTEL

Tokositna SNOTEL 6/24/2024: Daniel Fisher and Keegan Krantz from the Natural Resources Conservation Service completed the annual maintenance. Access was from Talkeetna with 570AE. Managed by Talkeetna climbing ranger Chelsea Bomba through Joe Reichert. The precipitation gage was flushed, and 10 gallons of fresh antifreeze were added for the winter. Sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015).

Kantishna SNOTEL 7/14/2024: Daniel Fisher and new Fairbanks hydrologist (name?) completed the maintenance. Access was by fixed-wing aircraft (N709M) with Denali fleet pilot Justin Wiseman. The precipitation gage was flushed, and 10 gallons of fresh antifreeze were added for the winter. Sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015).

Wonder Lake Climate Reference Network Station (AK Denali 27N)

8/13/2024: Pam Sousanes with Chuck Lindsay and Blake Randolph (NOAA) maintained the station according to CRN standards. The site was accessed by A-Star helicopter N149AE. Staff stayed in NPS housing (Panabode at park headquarters) on August 12 and 13, reserved through DENA_Housing email.

Wrangell-St. Elias

Chicken Creek

Date/Time: 7/15/2024 16:15
Personnel: Pam Sousanes
Logistics: A-star helicopter – Temsco – N142AE – Eric Steinbauer, Justin Stramer-Smith
Weather: low 50s.
Damage: none
Sensors replaced:
Removed: AT/RH EE181 #183116000047DE, LiCor Li200x# 43036, TB #70374-816
Installed: AT/RH EE181 #271102, LiCor Li200X #PY102543, TB
Other hardware replaced: Replaced tipping bucket, no obvious damage or wiring issues on old sensor.
Additional Comments: Station looked good. The second set of guys wires that are in between the tripod legs on this station were off the rebar on arrival, replaced and tightened.
Potential Data Issues:

1. RN_IN and RN_TOT from 2023-10-13 07:00 through 2024-07-15 16:00.

To Do:

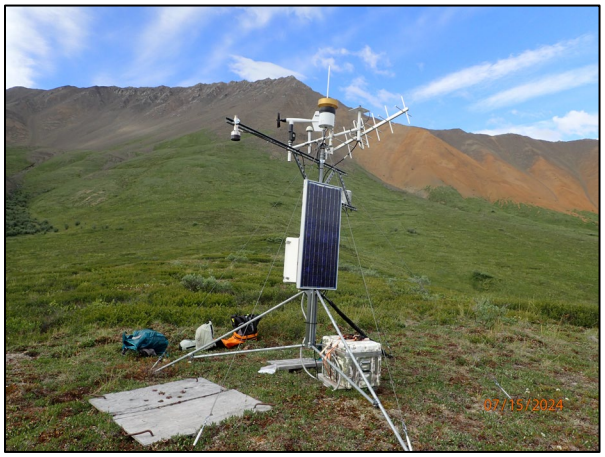


Figure 8. Chicken Creek climate station, July 15, 2024.

Chititu

Date/Time: 7/14/2024 18:00

Personnel: Pam Sousanes, Ken Hill

Logistics: A-star helicopter – Temsco – N142AE – Eric Steinbauer, Justin-Stramer Smith

Weather: high 40s.

Damage: Soil sensors damaged by ground squirrels.

Sensors replaced:

Removed: AT/RH EE181 #1929160001188D, LiCor Li200X # 63692, RM Young 05103 #87992

Installed: AT/RH EE181 #3088D9, LiCor Li200X # 83323, RM Young 05103 #95200

Other hardware replaced: Replaced STF1, 2, and 3 sensor cables damaged by resident ground squirrels with new 107 sensors.

Additional Comments: Used existing conduit for the new soil sensors. Reconnected the large ground wire to the tripod leg. Tightened guy wires.

Potential Data Issues:

- STF suspect (?) – cable damaged, data looks reasonable at first glance.
- STF 2 bad from 2023-09-06 20:00 through 2024-07-25 19:00.
- STF 3 bad from 2023-09-06 18:00 through 2024-07-25 19:00.
- STF 4 – Data look OK, except for 4 values on 2024-07-12 where temps were erratic between 09:00 and 15:00, after that seemed OK until site visit a few days later.

To Do: Bring micro SD card for the CR1000X datalogger.



Figure 9. Chititu climate station, July 14, 2024.

Gates Glacier

Date/Time: 7/14/2024 16:30

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N142AE – Eric Steinbauer, Justin Stramer-Smith

Weather: low 50s.

Damage: none

Sensors replaced:

Removed AT/RH EE181 20181600056321, SR Licor #63675, RM Young 05103 #87995

Installed AT/RH EE181 #087651, SR Licor #83212, RM Young #90948

Other hardware replaced: SD memory card on CC5MPX phenology camera. The SD card that was removed was corrupt and no photos were obtained.

Additional Comments: Station looked good. South leg of leg has slight bow, no action needed at this time.

Potential Data Issues: none

To Do:

1. Swap batteries



Figure 10. Gates Glacier climate station on July 14, 2024.

Tebay

Date/Time: 7/15/2024 11:30
Personnel: Ken Hill and Pam Sousanes
Logistics: A-star helicopter – Temsco – N142AE – Eric Steinbauer, Justin Stramer-Smith
Weather: low 60s
Damage: Station damaged again, presumably by bear. Wasp hive inside enclosure, Hill got 1 sting. Hill removed hive. ALL sensors and cables were damaged except for GPS cable. Batteries okay
Sensors replaced: Almost everything was replaced:

- AT/RH: Swapped EE181 sensor. In: #8956F, Out: #70904
- SR: Removed CS320 and replaced with Li200x #36882
- WS/WD: RM Young 05103. In: #87992, Out: #132712
- Snow Depth: Cable replaced; sensor left in place.
- No soils reinstalled this time.
- Tipping Bucket: Replaced.
- Air Temp: Primary and Secondary 109 sensors replaced.
- YAGI Coax cable replaced.

Other hardware replaced: Reconnected battery cable to battery box. Used old wind sensor (from Chititu) and old solar radiation sensor (from action packer). Added 4th strand of poly wire to fence.
Additional Comments: All sensors and cables damaged again. Had to rebuild entire site after the wasp nest was removed by Hill.
Potential Data Issues: All parameters. Bear first pulled the soil sensors on 2023-09-09. Then returned on 2023-09-27 and pulled all the other sensors out of the enclosure: 109-1, 109_2, EE181, CS320, RM Young.
To Do: Monitor one more year – if bear destroys this year remove it.



Figure 11. Tebay climate station, July 14, 2024. Site had been damaged (left and center). Station after site maintenance was completed (right).

Tana Knob

Date/Time: 7/15/2024 10:00

Personnel: Ken Hill, Pam Sousanes

Logistics: A-star helicopter – Temsco – N142AE – Eric Steinbauer, Justin Stramer-Smith

Weather: low 50s.

Damage: Solar radiation, wind, and snow depth sensor, and tipping bucket all tipping 10° to the south out of level.

Sensors replaced:

Removed AT/RH EE181 #1449D0, SR Licor LI200X #52878

Installed AT/RH EE181 #38123, SR Licor Li200X #43042

Other hardware replaced: Replaced GPS mount.

Additional Comments: Crossarms were out of level. Re-leveled. Rest SR50a sensor height to 97 inches. Tightened guy wires. Mast leg (S and SE especially) have a slight bow from snow – no action needed yet.

Potential Data Issues: SR (overestimate – leaning 10° to south), WS/WD (suspect out of level), SDI (overestimate ~ 6 inches), and RNIN and RN_TOT (under catch). All suspect due to crossarm being out of level.

Suspect that the SDI sensor may have been hitting the surface of snow, need more sleuthing with wind data, long stretches where sensor was reading 99.6 (SR50a sensor height), not sure when the crossarm shifted out of level.

To Do:



Figure 12. Tana Knob climate station on July 15, 2024. Crossarms were out of level when we arrived (left). Site after maintenance visit (right).

Wrangell-St. Elias Fire RAWS

Chad Leshuk and Tim Nolan completed RAWS maintenance at May Creek (5/21/2024). Sousanes and Hill replaced YAGI on 7/14/2024. Leshuk and Nolan also did the maintenance on the Chitina/Strelna site on 5/19/2024 and at Chisana 5/22/2024. No info in WXx on sensor swaps. Klawasi was done by Leshuk and Nolan on 5/23/2024; at Klawasi swapped RH/AT (43567), and SR (124564), and RG (114721). Rain gauge was zeroed. Replace GPS cable next time, made repair with electrical tape. All sensors scanned. Additional details are available in WXx-Weather.

Wrangell-St. Elias SNOTEL

The SNOTEL site at May Creek was maintained by NRCS on May 22, 2024. Daniel Fisher and Keegan Krantz accessed the site via eastern area fire helicopter N31NS from Gulkana with Erik Steinbauer as pilot and Chad Leshuk and Tim Nolan as helicopter managers. 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.

Yukon-Charley Rivers National Preserve

Coal Creek

Date/Time: 6/18/2024 13:10
Personnel: Pam Sousanes, Ken Hill
Logistics: A-star helicopter – Temsco – N31NS – Eric Steinbauer, Tim Nolan
Weather: low 70s, calm, buggy
Damage: NEMA enclosure hinge seal is failing. Replaced.
Sensors replaced:

Removed AT/RH EE181#149866, Wind O5103 #105732
Installed AT/RH EE181 #11910A, Wind O5103 #105731

Other hardware replaced: Replaced NEMA enclosure, battery box, and two 12 volt batteries.
Additional Comments: Station looked great; swap outs went well. Light brushing was done around site. No evidence of heaving for the replicate soil sensors.
Potential Data Issues: none
To Do:

1. Make new wiring diagram. Single ended inputs for original soil sensors SE 8, 9, 10 for replicate set SE 13, 14, 15.
2. Bring FedEx mailing insert for the wiring diagram.

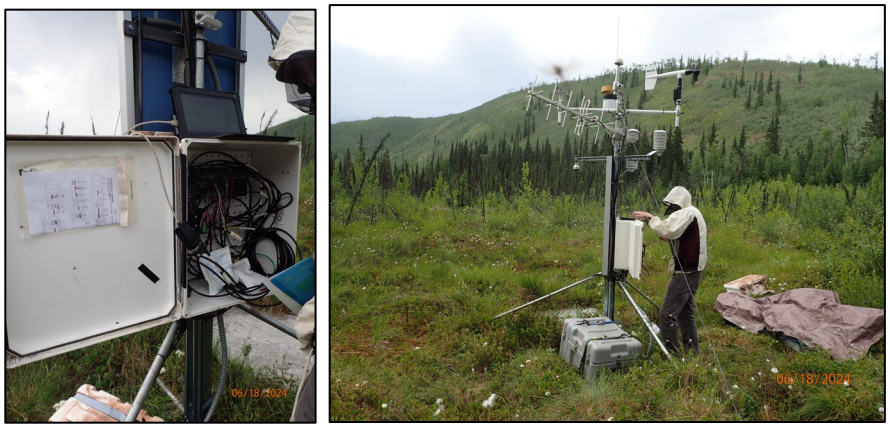


Figure 13. Coal Creek climate station, June 18, 2024. Broken door hinge on enclosure (left). After station visit with new enclosure (right).

Upper Charley

Date/Time: 6/18/2024 11:25
Personnel: Ken Hill, Pam Sosuanes
Logistics: A-star helicopter – Temsco – N31NS – Erik Steinbauer, Tim Nolan
Weather: low 60s
Damage: none
Sensors replaced:

Removed AT/RH EE181 #5345F, LI200X #52879
Installed AT/RH EE181 #139580, LI200X #43130

Other hardware replaced: Swapped SD memory card in CC5MPX camera.
Additional Comments: Site looked good. Part of poly wire fence was missing and many of the insulators were bent. Replaced insulators and restrung poly wire. Camera images looked good, some external icing in winter.
Potential Data Issues: none.
To Do:

1. Swap batteries



Figure 14. Upper Charley station June 18, 2024.

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, P.J. 2018. Climate monitoring protocol for the Central Alaska Network: Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Version 1.01. Natural Resource Report. NPS/CAKN/NRR—2018/1599. National Park Service. Fort Collins, Colorado.

Sousanes, P., K. Hill, M. Bower, W. Johnson, and S. Miller. 2017. 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 2024

DENA Logistics

June 24, 2024: Tokostina Snotel accessed by helicopter 570AE from Talkeetna. Daniel Fisher (NRCS) and Keegan Krantz (NRCS) did the maintenance. Chelsea Bomba was the helicopter manager in Talkeetna.

July 10, 2024: Wigand, Stampede, Toklat, and Dunkle were completed by Pam Sousanes and Ken Hill. Site accessed via DENA fire A-star helicopter N149AE with pilot Josh Han. Pam and Ken drove from FAC in a.m. Pam spent evening in Admin Camp; Ken returned to Fairbanks.

July 11, 2024: Ruth Glacier. Pam Sousanes drove from DENA park headquarters met Talkeetna based helicopter N570AE at the mile 131 Parks Hwy gravel pit. Returned to Fairbanks that evening.

July 17, 2024: Kantishna SNOTEL accessed by park plane (N709M) with NPS pilot Justin Wiseman from the park airstrip. Daniel Fisher and new Fairbanks NRCS hydrologist (name?) did the maintenance. Drove down from Fairbanks in a.m., returned in afternoon.

August 13, 2024. Wonder Lake CRN. Pam Sousanes, Chuck Lindsay (NOAA partner), and Zach Henderson (NOAA) accessed station by helicopter from Denali Park headquarters with the Temsco A-star western area fire helicopter N149AE with pilot Josh Han. Arrived on August 12 from Fairbanks (Pam) and Anchorage (Chuck and Zach). Spent Aug 12 and 13 in NPS housing (Panabode) at park HQ.

WRST Logistics

May 22. The SNOTEL site at May Creek and Chisana was accessed from Gulkana with the N31NS with pilot Erik Steinbauer and helicopter manager Chad Leshuk and Tim Nolan. Daniel Fisher and Keegan Krantz (NRCS) drove from Palmer to complete the maintenance.

July 14-16, 2024

Personnel: Pam Sousanes, Ken Hill, Justin Stramer-Smith (helicopter manager), and Erik Steinbauer (Temsco pilot).
Aircraft: Eastern area exclusive use helicopter N31NS. We shared the helicopter with Fleur Nicklen and her fire ecology crew.
Fuel: Fireweed Airstrip, using Fireweed Fuel LLC. Account and PIN arranged prior to project. Contact Lori Rowland in McCarthy.
Housing: May Creek Camp. Tent camping with use of main building for cooking and eating.
Vehicles: Two government vehicles from Fairbanks, one dropped at the Chitina Airport and one parked at McCarthy west housing area.
Stations maintained: Chititu, Tana Knob, Gates Glacier, Tebay and Chicken Creek.
Narrative: Justin Stramer-Smith flew with Erik Steinbauer and met the crew in McCarthy on July 14. Shuttled Fleur and her crew to May Creek from Fireweed Airstrip in a.m. Pam and Ken traveled to Chitina Airstrip separately and dropped one car there before heading to McCarthy arriving the

afternoon of the 14th. Parked second car at McCarthy West parking area. Shuttled gear from Fireweed strip to May Creek with helicopter and started working that afternoon. Helicopter and all crew stayed at May Creek. Fleur's crew got dropped off in a.m. and we used the helicopter for the day to get to our sites, returning to pick up Fleur and crew in the evening. Fuel was purchased at the Fireweed Airstrip since there were issues with fueling at the McCarthy strip this year. On day 2 after the Tebay site visit Ken was dropped off at the Chitina Airstrip so he could head back. Pam continued to last site at Chicken Creek, spent the night in May Creek and then headed back to Fairbanks on the 16th.

YUCH Logistics

6/18/2024

Personnel: Ken Hill, Pam Sousanes, Tim Nolan (helicopter manager), and Erik Steinbauer (pilot).
Aircraft: N31NS. Temsco A-star on exclusive use contract with NPS eastern area fire program.
Fuel: Jet A tanks at AFS, Fort Wainwright. Refueled at Coal Creek.
Vehicles: Government vehicle to Fort Wainwright/AFS heli base
Stations maintained: Coal Creek and Upper Charley
Equipment: All equipment transported via government vehicle and aircraft.
Narrative: Crew flew from Fort Wainwright to Upper Charley and Coal Creek and returned to Fairbanks the same day.

Appendix B. CAKN I&M Station Specifications

Tables B1 through B6 provide details on the climate station specifications.

Table B1. Sensor specifications.

Measurements	Model/Manufacturer/Item#	Purchased from:
Air Temperature 1/Relative Humidity	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 (secondary beginning in 2022 – replaced Therm-X)	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, CS320	Campbell Scientific
Snow Depth	SR50A sonic ranging sensor	Campbell Scientific
Soil Temperature	107 or 109 Temperature Probe (3)	Campbell Scientific

Table B2. Datalogger specifications.

Datalogger	Purchased from:
CR1000-XT/CR1000X- XT Measurement and Control System	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/RES Fairbanks
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. CAKN RAWS Components by Climate Station

Tables C1 through C 13 provide metadata on each climate station.

Table C1. Metadata for Chicken Creek climate station.

Station Name	Item	Model	Start Date
Chicken Creek	Antenna	25316 YAGI	8/21/2004
Chicken Creek	AT	109	7/6/2016
Chicken Creek	AT (2)	109 (2)	7/29/2022
Chicken Creek	AT-RH	EE181	7/15/2024
Chicken Creek	Battery	100 AH (x2)	8/21/2004
Chicken Creek	Cross arm	CM204	8/21/2004
Chicken Creek	Datalogger	CR1000	6/19/2013
Chicken Creek	DLP	Chicken2022	7/29/2022
Chicken Creek	GPS	17992 GPS	7/3/2014
Chicken Creek	RG-TB	TE525	7/15/2024
Chicken Creek	SD	SR50a	6/19/2013
Chicken Creek	Solar Panel	75 W	8/21/2004
Chicken Creek	SR	Li200x	7/15/2024
Chicken Creek	ST -10 cm	107	7/7/2020
Chicken Creek	ST -20 cm	107	7/7/2020
Chicken Creek	ST -50 cm	107	7/7/2020
Chicken Creek	ST -100 cm	107	7/7/2020
Chicken Creek	Tripod	CM106	8/21/2004
Chicken Creek	TX321	NESDIS ID 39603396	7/12/2018
Chicken Creek	WS/WD	5103	7/25/2023

Table C2. Metadata for Chititu climate station.

Station Name	Item	Model	Start Date
Chititu	Antenna	25316 YAGI	8/20/2004
Chititu	AT	109	6/30/2016
Chititu	AT (2)	109 (2)	7/29/2022
Chititu	AT-RH	EE181	7/14/2024
Chititu	Battery	100 AH (x1)	7/8/2020
Chititu	Cross arm	CM204	8/20/2004
Chititu	Cross arm	CM206	8/20/2004
Chititu	Datalogger	CR1000X	7/25/2023
Chititu	DLP	Chititu_2023_CR1000X	7/25/2023
Chititu	Enclosure	ENC 16/18	8/20/2004
Chititu	GPS	17992 GPS	6/21/2013
Chititu	RG-TB	TE525	8/20/2004
Chititu	SD	SR50a	Out 2021
Chititu	Solar Panel	75 W	8/20/2004
Chititu	SR	Li200x	7/14/2024
Chititu	ST -10 cm	107	7/14/2024
Chititu	ST -20 cm	107	7/14/2024
Chititu	ST -50 cm	107	7/14/2024
Chititu	ST -100 cm	107	7/14/2024
Chititu	Tripod	CM106	8/20/2004
Chititu	TX325	NESDIS ID 396020E0	7/25/2023
Chititu	WS/WD	5103	7/14/2024

Table C3. Metadata for Coal Creek climate station.

Station Name	Item	Model	Start Date
Coal Creek	Antenna	25316 YAGI	9/16/2004
Coal Creek	AT	109	7/6/2016
Coal Creek	AT (2)	109 (2)	8/8/2022
Coal Creek	AT-RH	EE181	6/18/2024
Coal Creek	Battery	100 AH (x2)	6/18/2024
Coal Creek	Crossarm	3/4"	9/16/2004
Coal Creek	Crossarm	3/4"	9/16/2004
Coal Creek	Datalogger	CR1000	7/24/2013
Coal Creek	DLP	CoalCreek2022	8/8/2022
Coal Creek	Enclosure	ENC 16/18	6/18/2024
Coal Creek	GPS	17992 GPS	9/8/2012
Coal Creek	RG-TB	TE525	9/16/2004
Coal Creek	SD	SR50a	7/24/2013
Coal Creek	Solar Panel	75 W	9/16/2004
Coal Creek	SR	Li200x	9/7/2023
Coal Creek	ST1	107	9/16/2004
Coal Creek	ST2	107	9/16/2004
Coal Creek	ST3	107	9/16/2004
Coal Creek	STF1_2	107	8/8/2022
Coal Creek	STF2_2	107	8//2022
Coal Creek	STF3_2	107	8/8/2022
Coal Creek	Tripod	CM106	9/16/2004
Coal Creek	TX321	NESDIS ID 39605670	6/14/2018
Coal Creek	WS/WD	5103	6/18/2024

Table C4. Metadata for Dunkle Hills climate station.

Station Name	Item	Model	Start Date
Dunkle Hills	Antenna	25316 YAGI	8/1/2002
Dunkle Hills	AT	109	8/11/2016
Dunkle Hills	AT (2)	Therm-X	8/1/2002
Dunkle Hills	AT-RH	EE181	7/10/2024
Dunkle Hills	Battery	100 AH (x2)	8/1/2002
Dunkle Hills	3/4"	CM204	8/1/2002
Dunkle Hills	3/4"	CM206	8/1/2002
Dunkle Hills	Datalogger	CR1000	5/26/2015
Dunkle Hills	DLP	Dunkle2020	7/29/2020
Dunkle Hills	Enclosure	ENC 16/18	9/19/2011
Dunkle Hills	GPS	17992 GPS	8/1/2002
Dunkle Hills	RG-TB	TE525	8/1/2002
Dunkle Hills	SD	SR50a	7/10/2024
Dunkle Hills	Solar Panel	75 W	8/1/2002
Dunkle Hills	SR	Li200x	6/20/2023
Dunkle Hills	ST1	107	7/10/2024
Dunkle Hills	ST2	107	7/10/2024
Dunkle Hills	ST3	107	7/10/2024
Dunkle Hills	ST4 – 90 cm	107	removed
Dunkle Hills	Tripod	CM106	8/1/2002
Dunkle Hills	TX321	NESDIS ID 3960B582	7/29/2020
Dunkle Hills	WS/WD	5103	6/20/2023

Table C5. Metadata for Eielson Visitor Center climate station.

Station Name	Item	Model	Start Date
Eielson	Antenna	25316 YAGI	6/4/2005
Eielson	AT	109	9/8/2016
Eielson	AT (2)	109 (2)	8/16/2022
Eielson	AT-RH	EE181	8/13/2024
Eielson	Battery	100 AH (x2)	6/4/2005
Eielson	Crossarm	3/4"	6/4/2005
Eielson	Datalogger	CR1000	5/28/2014
Eielson	DLP	Eielson2022	8/16/2022
Eielson	Enclosure	ENC 16/18	6/4/2005
Eielson	GPS	17992 GPS	6/4/2005
Eielson	RG-TB	TE525	6/5/2019
Eielson	SD	SR50a	5/28/2014
Eielson	Solar Panel	75 W	6/4/2005
Eielson	SR	Li200x	6/20/2023
Eielson	Tripod	CM106	6/4/2005
Eielson	TX321	NESDIS ID 39604506	8/21/2018
Eielson	WS/WD	5103	6/20/2023

Table C6. Metadata for Gates Glacier climate station.

Station Name	Item	Model	Start Date
Gates Glacier	Antenna	25316 YAGI	7/6/2005
Gates Glacier	AT	109	6/29/2016
Gates Glacier	AT (2)	109 (2)	7/29/2022
Gates Glacier	AT-RH	EE181	7/14/2024
Gates Glacier	Battery	100 AH (x2)	7/6/2005
Gates Glacier	Camera	CC5MPX	6/21/2013
Gates Glacier	Camera Battery/Solar Panel	12 Volt – 100 AH / 10 W panel	8/19/2023
Gates Glacier	Crossarm	3/4"	7/6/2005
Gates Glacier	Crossarm	CM206	7/6/2005
Gates Glacier	Datalogger	CR1000	6/21/2013
Gates Glacier	DLP	GatesGl2022	7/29/2022
Gates Glacier	Enclosure	ENC 16/18	7/6/2005
Gates Glacier	GPS	17992 GPS	7/6/2005
Gates Glacier	RG-TB	TE525	7/6/2005
Gates Glacier	SD	SR50	8/19/2023
Gates Glacier	Solar Panel	75 W	7/7/2020
Gates Glacier	SR	Li200x	7/14/2024
Gates Glacier	ST1	107	6/27/2019
Gates Glacier	ST2	107	6/27/2019
Gates Glacier	ST3	107	6/27/2019
Gates Glacier	Tripod	CM106	6/21/2013
Gates Glacier	TX321	NESDIS ID 39608018	7/11/2018
Gates Glacier	WS/WD	5103	7/14/2024

Table C7. Metadata for Ruth Glacier climate station.

Station Name	Item	Model	Start Date
Ruth Glacier	Antenna	25316 YAGI	9/6/2008
Ruth Glacier	AT	109	6/21/2017
Ruth Glacier	AT (2)	Therm-X	9/6/2008
Ruth Glacier	AT-RH	EE181	7/11/2024
Ruth Glacier	Battery	100 AH (x2)	9/6/2008
Ruth Glacier	Battery Cable	Power Cable	6/13/2012
Ruth Glacier	Charging Regulator	CH-200	6/30/2023
Ruth Glacier	Datalogger	CR1000X	7/11/2024
Ruth Glacier	DLP	RUGA_2024	7/11/2024
Ruth Glacier	Enclosure	ENC 16/18	6/26/2019
Ruth Glacier	GPS	17992 GPS	9/6/2008
Ruth Glacier	RG-TB	TE525	9/6/2008
Ruth Glacier	SD	SR50a	7/11/2024
Ruth Glacier	Solar Panel	75 W	9/6/2008
Ruth Glacier	SR	Li200x	8/11/2020
Ruth Glacier	ST1	107	9/6/2008
Ruth Glacier	ST2	107	9/6/2008
Ruth Glacier	ST3	107	6/24/2014
Ruth Glacier	ST4 – 90 cm	107	6/26/2019
Ruth Glacier	Tripod	FTS RAWS Lunar Lander	9/6/2008
Ruth Glacier	TX325	NESDIS ID 396063EA	7/11/2024
Ruth Glacier	Yagi antenna	Coaxial Cable	8/11/2020
Ruth Glacier	WS/WD	5103 (30’)	6/20/2023

Table C8. Metadata for Stampede climate station.

Station Name	Item	Model	Start Date
Stampede	Antenna	YAGI	6/14/2021
Stampede	AT	109	8/11/2016
Stampede	AT (2)	109 (2)	6/23/2022
Stampede	AT-RH	EE181	7/10/2024
Stampede	Battery	100 AH (x2)	7/10/2024
Stampede	Crossarm	3/4"	8/1/2002
Stampede	Datalogger	CR1000X	7/10/2024
Stampede	DLP	SMPA_2024	7/10/2024
Stampede	Enclosure	ENC 16/18	5/18/2011
Stampede	GPS	17992 GPS	8/1/2002
Stampede	RG-TB	TE525	6/23/2022
Stampede	SD	SR50a	9/16/2014
Stampede	Solar Panel	75 W	8/1/2002
Stampede	SR	Li200x	6/22/2023
Stampede	ST1	109	8/8/2019
Stampede	ST2	109	8/8/2019
Stampede	ST3	109	8/8/2019
Stampede	ST4 – 90 cm	109	8/8/2019
Stampede	Tripod	CM106	6/14/2021
Stampede	TX325	NESDIS ID 3960A6F4	7/10/2024
Stampede	WS/WD	5103	7/10/2024

Table C9. Metadata for Tana Knob climate station.

Station Name	Item	Model	Start Date
Tana Knob	Antenna	25316 YAGI	7/5/2005
Tana Knob	AT	109	6/28/2016
Tana Knob	AT (2)	109 (2)	7/29/2022
Tana Knob	AT-RH	EE181	7/15/2024
Tana Knob	Battery	100 AH (x2)	7/5/2005
Tana Knob	Crossarm	CM204	7/5/2005
Tana Knob	Crossarm	CM206	7/5/2005
Tana Knob	Datalogger	CR1000	7/2/2014
Tana Knob	DLP	Tana2022	7/29/2022
Tana Knob	Enclosure	ENC 16/18	7/5/2005
Tana Knob	GPS	17992 GPS	7/5/2005
Tana Knob	RG-TB	TE525	6/28/2016
Tana Knob	SD	SR50	7/29/2022
Tana Knob	Solar Panel	75 W	7/5/2005
Tana Knob	SR	Li200x	7/15/2024
Tana Knob	ST1	107	6/24/2021
Tana Knob	ST2	107	7/10/2018
Tana Knob	ST3	107	7/5/2005
Tana Knob	Tripod	CM106	6/27/2012
Tana Knob	TX321	NESDIS ID 3960709C	7/10/2018
Tana Knob	WS/WD	5103	7/29/2022

Table C10. Metadata for Tebay climate station.

Station Name	Item	Model	Start Date
Tebay	Antenna	25316 YAGI	7/6/2020
Tebay	AT	109	7/15/2024
Tebay	AT (2)	109 (2)	7/15/2024
Tebay	AT-RH	EE181	7/15/2024
Tebay	Battery	100 AH (x1)	7/6/2020
Tebay	Crossarm	CM204	7/8/2005
Tebay	Crossarm	CM206	7/8/2005
Tebay	Datalogger	CR1000X	8/19/2023
Tebay	DLP	Tebay_2024_CR1000X	8/19/2023
Tebay	Enclosure	ENC 16/18	7/8/2005
Tebay	GPS	17992 GPS	7/8/2005
Tebay	RG-TB	TE525	7/15/2024
Tebay	SD	SR50a	7/15/2024
Tebay	Solar Panel	75 W	7/8/2005
Tebay	SR	Li200X	7/15/2024
Tebay	ST1	107	removed
Tebay	ST2	107	removed
Tebay	ST3	107	removed
Tebay	Tripod	CM106	7/3/2014
Tebay	TX325	NESDIS ID 3960936E	8/19/2023
Tebay	WS/WD	5103	7/14/2024

Table C11. Metadata for Toklat climate station.

Station Name	Item	Model	Start Date
Toklat	Antenna	25316 YAGI	6/16/2005
Toklat	AT	109	9/9/2016
Toklat	AT (2)	109 (2)	6/23/2022
Toklat	AT-RH	EE181	7/10/2024
Toklat	Battery	100 AH (x2)	6/5/2019
Toklat	Crossarm	3/4"	6/16/2005
Toklat	Datalogger	CR1000X	9/1/2023
Toklat	DLP	Toklat_2023_CR100X_TX325	9/1/2023
Toklat	Enclosure	ENC 16/18	6/16/2005
Toklat	GPS	17992 GPS	5/28/2014
Toklat	RG-TB	TE525	9/9/2016
Toklat	SD	SR50a	8/24/2021
Toklat	Solar Panel	75 W	6/16/2005
Toklat	SR	Li200x	7/10/2024
Toklat	ST1	107	6/16/2005
Toklat	ST2	107	6/16/2005
Toklat	ST3	107	6/16/2005
Toklat	Tripod	CM106	6/16/2005
Toklat	TX325	NESDIS ID 396063EA	9/1/2023
Toklat	WS/WD	5103	6/20/2023

Table C12. Metadata for Upper Charley climate station.

Station Name	Item	Model	Start Date
Upper Charley	Antenna	25316 YAGI	8/3/2005
Upper Charley	AT	109	8/8/2022
Upper Charley	AT (2)	109 (2)	8/8/2022
Upper Charley	AT-RH	EE181	6/18/2024
Upper Charley	Battery	100 AH (x2)	8/3/2005
Upper Charley	Camera	CC5MPX	7/23/2013
Upper Charley	Camera Battery/Solar Panel	12 Volt – 100 AH / 10 W panel	8/6/2015
Upper Charley	Crossarm	3/4"	8/3/2005
Upper Charley	Crossarm	CM206	8/3/2005
Upper Charley	Datalogger	CR1000	9/7/2012
Upper Charley	DLP	UCharley2022	8/8/2022
Upper Charley	Enclosure	ENC 16/18	8/3/2005
Upper Charley	GPS	17992 GPS	9/8/2012
Upper Charley	RG-TB	TE525	8/3/2005
Upper Charley	SD	SR50a	6/13/2017
Upper Charley	Solar Panel	75 W	8/3/2005
Upper Charley	SR	Li200x	6/18/2024
Upper Charley	ST1	107	7/23/2013
Upper Charley	ST2	107	7/23/2013
Upper Charley	ST3	107	7/23/2013
Upper Charley	ST4 – 75 cm	107	5/14/2019
Upper Charley	Tripod	CM206	8/3/2005
Upper Charley	TX321	NESDIS ID 3960D064	6/13/2018
Upper Charley	WS/WD	5103	5/25/2023

Table C13. Metadata for Wigand climate station.

Station Name	Item	Model	Start Date
Wigand	Antenna	25316 YAGI	8/3/2005
Wigand	AT	109	8/11/2016
Wigand	AT (2)	109 (2)	6/23/2022
Wigand	AT-RH	EE181	7/10/2024
Wigand	Battery	100 AH (x2)	8/13/2013
Wigand	Crossarm	3/4"	8/13/2013
Wigand	Crossarm	CM206	8/13/2013
Wigand	Datalogger	CR1000	8/13/2013
Wigand	DLP	Wigand2022	6/23/2022
Wigand	Enclosure	ENC 16/18	8/13/2013
Wigand	GPS	17992 GPS	8/13/2013
Wigand	RG-TB	TE525	8/13/2013
Wigand	SD	SR50a	8/13/2013
Wigand	Solar Panel	10W	6/21/2023
Wigand	SR	Li200x	7/10/2024
Wigand	ST1	107	8/19/2023
Wigand	ST2	107	8/19/2023
Wigand	ST3	107	8/19/2023
Wigand	ST4	107	removed
Wigand	ST5	107	removed
Wigand	Tripod	CM206	8/13/2013
Wigand	TX321	NESDIS ID 39600060C	8/8/2019
Wigand	WS/WD	5103	6/21/2023