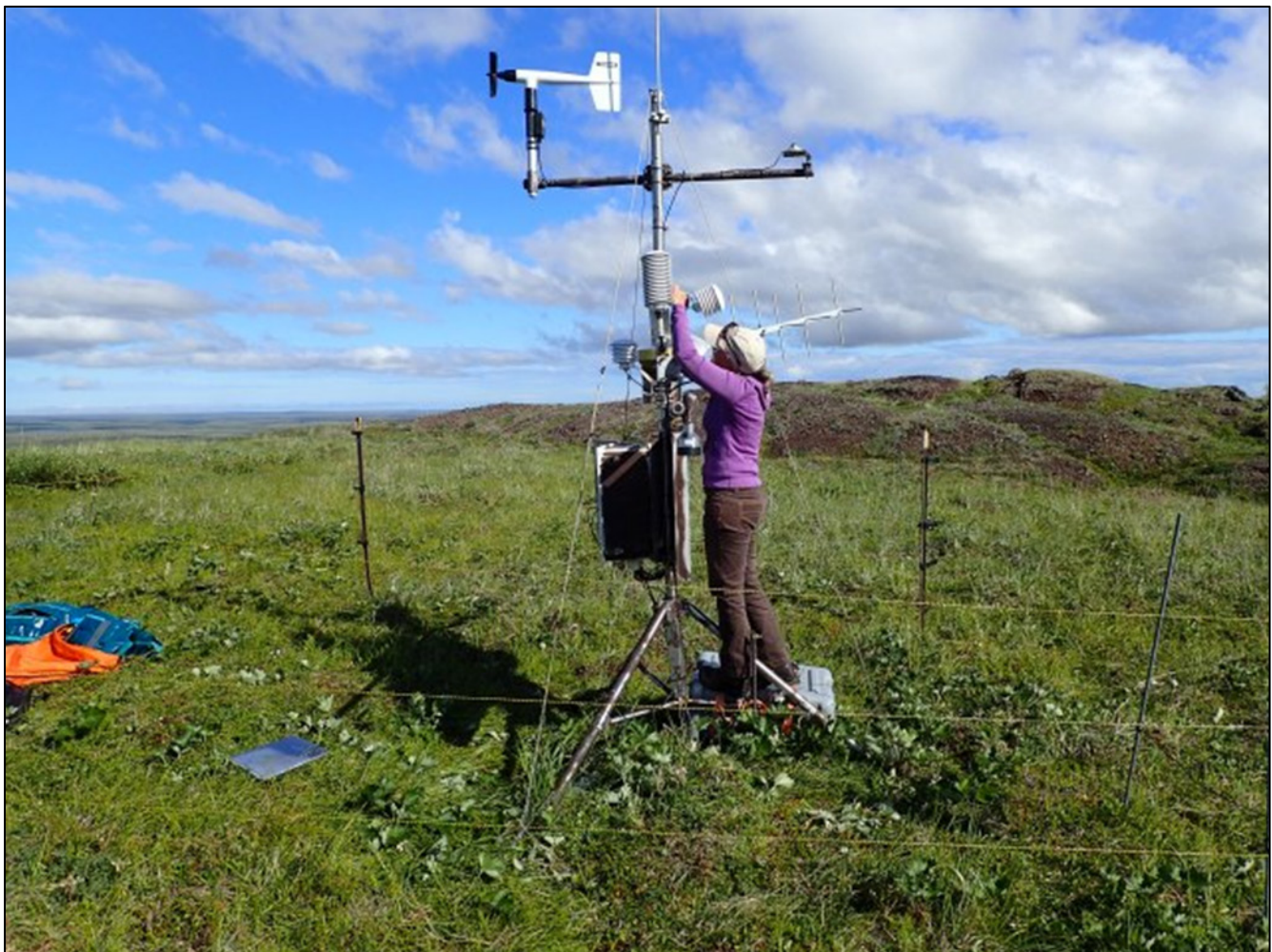




Climate Station Maintenance in the Arctic Network

2018 Summary

Natural Resource Data Series NPS/ARCN/NRDS—2021/1316



ON THE COVER

Devil Mountain weather station, Bering Land Bridge National Preserve.
NPS/Ken Hill

Climate Station Maintenance in the Arctic Network

2018 Summary

Natural Resource Data Series NPS/ARCN/NRDS—2021/1316

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March 2021

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

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Executive Summary

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 were maintained, five fire remote automated weather stations (RAWS) were maintained in cooperation with NPS staff in Anchorage, and the Kelly snow telemetry (SNOTEL) station was maintained by the Natural Resources Conservation Service (NRCS) staff. This report summarizes the 2018 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 helicopter pilot Tide Smid for safely, efficiently, and happily delivering us to each and every climate station this season.

List of Acronyms

Ah	Amp hour
AT-RH	Air Temperature-Relative Humidity
ARCN	Arctic Network
AS350	A-star 350 Helicopter
AT-RH	Air Temperature – Relative Humidity
BELA	Bering Land Bridge National Preserve
CAKR	Cape Krusenstern National Monument
DLP	Data Logger Program
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
NESDIS	National Environmental Satellite, Data, and Information Service
NOAT	Noatak National Park and Preserve
NPS	National Park Service
NRCS	Natural Resource Conservation Service
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
WEAR	Western Arctic National Parklands
WS-WD	Wind Speed – Wind Direction

Introduction

For the 2018 field season, the Arctic Network (ARCN) continued its climate monitoring program by maintaining seventeen stations in the network (Figure 1, Table 1). The park units 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 maintained annually, including 17 ARCN RAWS, 5 fire RAWS and 1 SNOTEL station.

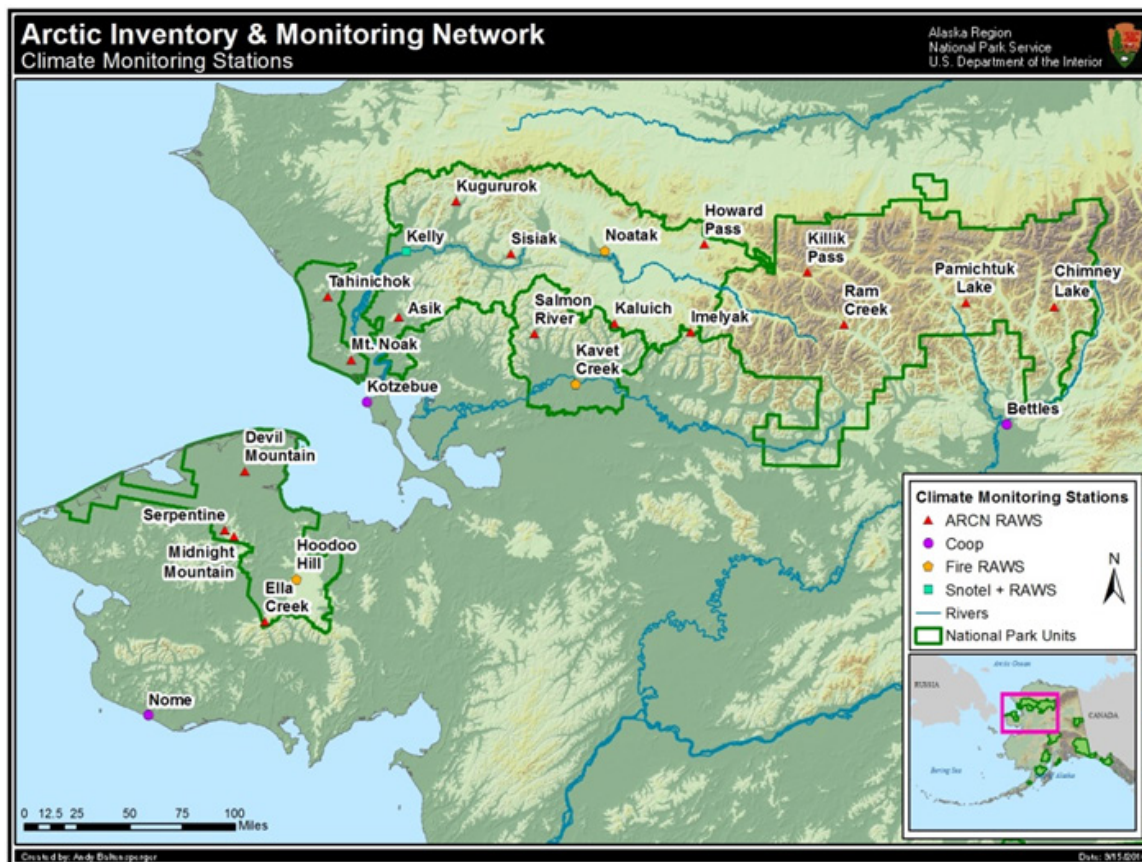


Figure 1. Locations of ARCN climate stations.

Table 1. Locations of ARCN climate stations maintained in 2018 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 base locations. This work is being implemented based on the ARCN climate vital sign protocol implementation plan (Sousanes et al. 2017).

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

Dahl Creek Base

ARCN climate stations maintained from Dahl Creek include: Howard Pass, Imelyak, Kaluich, and Salmon River. Additionally, Kavet Creek and Noatak fire RAWS stations were maintained.

Logistics: Fires in Noatak National Preserve encouraged an earlier-than-planned mission in order to repair the Noatak Fire RAWS station. The Western Area Fire contract A-star helicopter (N970TH) was used to access the sites. The helicopter ferried from Denali to Fairbanks to Bettles to Dahl Creek. All staff stayed in the NPS bunkhouse at Dahl Creek.

Noatak fire RAWS

Date: June 11, 2018

Time of visit: 1400–1600

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 42°F, 5–15 mph, cloudy

Sensors replaced:

AT-RH, GOES Cable

The Noatak fire RAWS station (Figure 2) was accessed via helicopter from Dahl Creek. The GOES cable had been damaged, presumably by wildlife. The AT-RH sensor was replaced for routine calibration. The GOES cable was replaced. The 20 cm and 50 cm soil temperature sensors were replaced and an SDI expansion cable was added for these sensors. All data were downloaded from the datalogger. The cumulative rainfall was reset to zero inches. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.

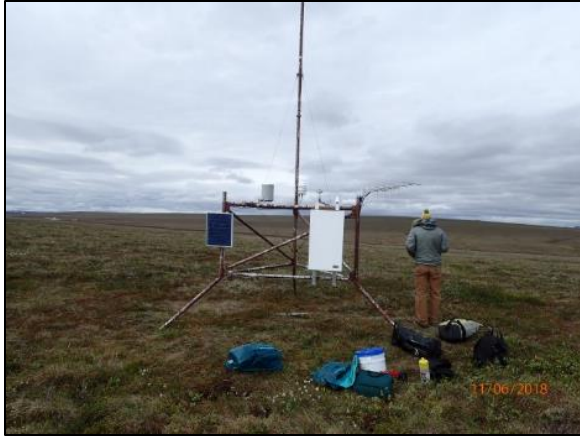


Figure 2. Noatak fire RAWS station June 11, 2018.

Howard Pass

Date: June 11, 2018

Time of visit: 1900–2100

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 30°F, 10–20 mph, cloudy

Sensors replaced:

AT-RH (HMP155), WS-WD (5108 Alpine HD)

The Howard Pass climate station (Figure 3) was accessed from Dahl Creek by helicopter. The station had been damaged in September 2017, possibly by either high winds and/or wildlife. The AT-RH radiation shield was damaged and the sensor cable was severed. The RNIN tipping bucket was out of level on arrival. The WS-WD sensor was destroyed. The damaged AT-RH and WS-WD sensors were replaced and the tipping bucket was re-leveled. All data were downloaded from the datalogger. The cumulative rainfall was reset to its observed value of 2.39 inches. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.

Note that a second field visit was made to Howard Pass on July 23, 2018 due to wildlife damage earlier in the month. See notes below from Kotzebue Base.



Figure 3. Howard Pass climate station before (left) and after (right) repairs June 21, 2018.

Imelyak

Date: June 12, 2018

Time of visit: 0945–1230 and 1800–1820

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual maintenance

Weather: 33°F, 5–15 mph, cloudy

Sensors replaced:

AT-RH (HMP155), WS-WD (5018 Alpine HD), RNIN

The Imelyak climate station site (Figure 4) was accessed by helicopter from Dahl Creek. The station had been damaged by a bear on May 11, 2018. The GOES cable, AT-RH cable, and RNIN cable had been severed. The solar panel cable was disconnected. The battery cable and conduit had been chewed and damaged. The YAGI antenna was bent. All data were downloaded from the datalogger. The solar panel cable was reconnected. The battery cable was replaced and the damaged conduit was removed. The AT-RH, WS-WD, and RNIN sensors were replaced. The antenna was realigned. The cumulative rainfall was reset to 0.00 inches. One driver element from the antenna is missing and a few elements are bent. At the next field visit, the power cable should be replaced with terminal ends prepared and pre-housed in 2 to 3 feet of conduit. Also, consider replacing the YAGI antenna and adding an electric fence. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. Note that the station was revisited in the evening to change the datalogger program (Imelyak_2018.CR1) and account for the 5108 Alpine HD WS_WD sensor.



Figure 4. Imelyak climate station shown before (left, middle) and after (right) repairs June 28, 2017.

Kaluich

Date: June 12, 2018

Time of visit: 1315–1500

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual maintenance

Weather: 45°F, 5–10 mph, partly cloudy

Sensors replaced:

AT-RH (HMP155), SR, WS-WD (5108 Alpine HD)

The Kaluich climate station (Figure 5) was accessed by helicopter. The station had been damaged by a bear. The solar panel wires were not connected at the panel. The coax cable was damaged and the wind vane was cracked and broken off. The AT-RH (HMP155), SR, and WS-WD (5108 Alpine HD) sensors were replaced for routine calibration. The coax cable was repaired by taping. All data were downloaded and a new program (Kaluich2018.CR1) was sent to the datalogger to account for the updated wind sensor. The height of the snow depth sensor was entered into the public table at 80.0 inches. The cumulative rainfall was reset to its observed value of 1.21 inches. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. At the next field visit, the coax cable should be replaced. Consider adding an electric fence.

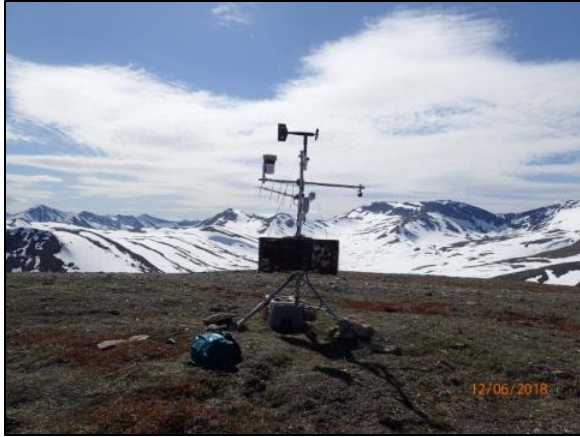


Figure 5. Kaluich climate station June 12, 2018.

Salmon River

Date: June 12, 2018

Time of visit: 1500–1600

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual maintenance

Weather: 54°F, 10–15 mph, partly sunny

Sensors replaced:

AT-RH (HMP155)

The Salmon River station (Figure 6) was accessed by helicopter. The station was in good condition upon arrival. The AT-RH sensor was replaced for routine calibration. All data were downloaded from the datalogger. The cumulative rainfall was reset to its observed value of 2.86 inches. The electric fence was in good condition and minor repairs were made by restringing the polywire and replacing one t-post mount. The SD card in the phenology camera was exchanged. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 6. Salmon River climate station June 12, 2018.

Kavet Creek fire RAWS

Date: June 12, 2018

Time of visit: 1700–1830

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 67°F, 5–10 mph, partly cloudy

Sensors replaced:

AT-RH

The Kavet Creek fire RAWS station (Figure 7) was accessed via helicopter. All data were downloaded from the datalogger. The AT-RH sensor was replaced and re-leveled for routine calibration. All sensors were scanned and operational. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 7. Kavet Creek fire RAWS station June 12, 2018.

Bettles Base

ARCN climate stations maintained from Bettles include: Chimney Lake, Killik Pass, Pamichtuk Lake, and Ram Creek.

Logistics: The Western Area Fire contract A-star helicopter (N970TH) was used to access the sites. Hill and Sousanes flew with all equipment from Fairbanks via helicopter (N970TH). Swanson flew on scheduled commercial service from Fairbanks to Bettles. All personnel were housed at the NPS/FWS bunkhouse while in Bettles.

Chimney Lake

Date: June 26, 2017

Time of visit: 1500–1630

Personnel: Ken Hill, Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 52°F, 5 mph, partly cloudy

Sensors replaced:

AT-RH (HMP45), SR (Li200x), WS-WD (5103), SD (SR50a)

The Chimney Lake station (Figure 8) was accessed by helicopter from Bettles. The station was in good condition. All data were downloaded from the datalogger. The AT-RH, SR, and WS-WD sensors were replaced for routine calibration. The SR50a sensor looked okay, but was returning -99.9 values since October 2017. The sensor was replaced and should be tested in the office. The cumulative rainfall was reset to its observed value of 3.83 inches and the snow depth sensor height was changed from 79 to 78 inches. The electric fence was in good condition and maintained as needed. Dave Swanson completed a soil characterization at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 8. Chimney Lake climate station June 26, 2018.

Pamichtuk Lake

Date: June 26, 2018

Time of visit: 1750–1900

Personnel: Ken Hill, Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 50°F, 5–10 mph, partly cloudy

Sensors replaced:

AT-RH (HMP45)

The Pamichtuk Lake station (Figure 9) was accessed by helicopter from Bettles via Chimney Lake. The station was in good condition. All data were downloaded from the datalogger. The AT-RH sensor was replaced for routine calibration. The cumulative rainfall was reset to its observed value of 3.88 inches. The electric fence was repaired by replacing five T-post connectors and replacing the polywire. The ST1 (10 cm) soil temperature sensor had heaved out 2–3 cm and was pushed back into place. This is a persistent problem. Consider re-installing sensor horizontally (?) and/or burying cable completely. The images from the phenology camera were downloaded and the SD card was exchanged. The desiccant packets were replaced in the enclosure. Dave Swanson completed a soil characterization at the site. High precision GPS coordinates were obtained with the Trimble unit. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 9. Pamichtuk climate station June 26, 2018.

Ram Creek

Date: June 27, 2017

Time of visit: 1000–1200

Personnel: Ken Hill, Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 48°F, 5–10 mph, mostly cloudy

Sensors replaced:

AT-RH (HMP45), SR, ST1, ST2, ST3, RNIN, AT (109)

Ram Creek climate station (Figure 10) was accessed by helicopter from Bettles. All data were downloaded from the datalogger. The station had been damaged, presumably by a bear on October 11, 2017. Cables were damaged on the 109 air temperature sensor, all three soil temperature sensors, the solar radiation sensor, and the tipping bucket. These sensors were all replaced. Additionally, the AT-RH sensor was replaced for routine calibration. The radiation shield for the 109 sensor was damaged and replaced. The electric fence was heavily damaged with bent posts, missing connectors, and a damaged charger. Repairs were completed and the charger and polywire were both replaced. The long crossarm with the tipping bucket and snow depth sensor was re-leveled. The red solar panel cable was reconnected to the charging regulator. The solar panel voltage was reading 13.5 volts. The battery was reading 11.7 volts on arrival and increased to 12.2 volts by time of departure. The cumulative rainfall was reset to zero inches. Dave Swanson completed a soil characterization at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 10. Ram Creek climate station before (left, middle) and after (right) repairs June 27, 2018.

Killik Pass

Date: June 27, 2018

Time of visit: 1400–1530

Personnel: Ken Hill, Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 52°F, 10–15 mph, partly cloudy

Sensors replaced:

AT-RH (HMP45), WS-WD (05103), SD (SR50a-3165S)

Killik Pass climate station (Figure 11) was accessed by helicopter from Bettles via Ram Creek. The station was in good condition. All data were downloaded from the datalogger. The AT-RH and WS-WD sensors were replaced for routine calibration. The station had recorded many erroneous values in snow depth measurements over the winter and therefore the SR50a sensor was replaced with a newer

SR50a-3165S model. The cumulative rainfall was reset to its observed value of 2.34 inches. Dave Swanson completed a soil characterization at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *Note: the SR sensor was scheduled to be replaced but was not because spare sensors were used for emergency repairs at other sites. The SR sensor should be replaced in 2019.*



Figure 11. Killik Pass climate station June 27, 2018.

Killik Pass

Date: September 18, 2018

Time of visit: 1430–1530

Personnel: Ken Hill

Mode of transport: US Fish and Wildlife Service Fleet Super Cub on floats - N232L – Brandon Bosch

Purpose of trip: Repair

Weather: 34°F, 5–10 mph, cloudy

Sensors replaced:

AT-RH

Killik Pass climate station (Figure 12) was accessed by fixed wing and hiking ~1.5 miles from a nearby lake. All data were downloaded from the datalogger. The AT-RH sensor was damaged and both the sensor head and the sensor cable were replaced. The new cable is a 7-wire version and a new program was uploaded to reflect the change in wiring. The cumulative rainfall was reset to its observed value of 11.13 inches. The ground wire on the WS-WD sensor was reconnected which resolved the erroneous wind direction readings. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 12. Killik Pass climate station September 18, 2018.

Kotzebue Base

ARCN climate stations maintained from Kotzebue include: Asik, Kugururok, Mt. Noak, Sisiak, and Tahinichok. The Kelly fire RAWs and Kelly SNOTEL stations were also maintained.

Logistics: NPS climate staff flew by commercial seat fare from Fairbanks to Kotzebue. The Western Area Fire contract A-star helicopter (N970TH) was used to access the sites. A western area fire crew was working at cabin sites on the Noatak River and shared the helicopter with climate staff. NRCS SNOTEL staff accessed the Kelly River site on 7/24 with fixed wing aircraft flown by NPS fleet (C-185 on wheels). All staff stayed at either the NPS or FWS bunkhouses in Kotzebue.

Sisiak

Date: July 21, 2018

Time of visit: 1245–1415

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 63°F, 8–12 mph, cloudy

Sensors Replaced:

AT-RH (HMP45), SR

The Sisiak station (Figure 13) was accessed from Kotzebue by helicopter. The station had been damaged, presumably by a bear. The long crossarm (RNIN, SDI) was out of level and the rain gage funnel was on the ground and damaged. The soil temperature sensors had been pulled on and were loose, but not damaged. The funnel was repaired in the field and the crossarm was re-leveled. One white nut on the AT-RH shield was tightened. The mast remains slightly damaged, but was not replaced at this visit. The AT-RH and SR sensors were replaced for routine calibration. All data were downloaded from the datalogger. The height of the snow depth sensor is 82.2 inches. The cumulative rainfall was reset to 0.00 inches. An electric fence was installed at the station. The desiccant packets

were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 13. Sisiak climate station July 21, 2018. Upon arrival at the site the long crossarm was out of level, the tipping bucket funnel was missing (left). The soil temperature cables have been pulled on, but not damaged (middle). The station was repaired, and an electric fence was installed (right).

Kugururok

Date: July 21, 2018

Time of visit: 1500–1630

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 63°F, 10–15 mph, cloudy

Sensors Replaced:

AT-RH (HMP45), SR, WS-WD

The Kugururok station (Figure 14) was accessed by helicopter from Kotzebue. The station had been damaged by a bear on July 19, just two days prior to the field visit. The bear completely toppled the station and it was lying flat on the ground. After righting the station, the only damaged sensor was the WS-WD sensor. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. The damaged WS-WD sensor was replaced. The ST1 sensor had either heaved out of the ground or was pulled out as a result of the damage. All data were downloaded from the datalogger. The height of the snow depth sensor is 81 inches. The cumulative rainfall was reset to its observed value of 5.55 inches. The desiccant packets were replaced in the enclosure. The guy wires were tightened and the station was leveled. The SD card in the CC5MPX digital camera was exchanged. An electric fence was installed. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. A moose and calf were seen near the site on departure.



Figure 14. Kugururok climate station had been damaged by a bear (left). The station was repaired on July 21, 2018, only two days after the damage occurred (right).

Kelly fire RAWS

Date: July 21, 2018

Time of visit: 1700–1800

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual maintenance

Weather: 70°F, Light winds, clear

Sensors replaced:

AT-RH

The Kelly fire RAWS station (Figure 15) was accessed via helicopter. The helispot was cleared by the fire crew. The station looked good upon arrival. The AT-RH sensor was replaced for routine calibration. All sensors were scanned and confirmed to be working. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 15. Kelly fire RAWS station July 21, 2018.

Kelly SNOTEL

Date: July 24, 2018

Personnel: Tony DeMarco (NRCS)

Mode of transport: NPS Fleet– Cessna 185 on wheels – Rick Dolan

Purpose of trip: Annual maintenance

Sensors replaced: as needed by NRCS

Tony DeMarco completed the annual maintenance at the Kelly SNOTEL site on July 24. The precipitation gauges were flushed and 10 gallons of fresh antifreeze liquid added for the winter. The electric fences were repaired. The sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015). The sensors were tested and the site was working on departure. Extra five-gallon containers of fluid are stored in the locked shelter on site for future visits.

Asik

Date: July 22, 2018

Time of visit: 1120–1315

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual maintenance

Weather: 61°F, 15–20 mph

Sensors replaced:

AT-RH (HMP45), SR

The Asik station (Figure 16) was accessed from Kotzebue by helicopter. The station had been damaged, presumably by a bear on May 18th. All soil sensors were damaged. ST1 and ST2 sensors were cut and repaired by splicing. ST3 sensor was intact, but near the surface. ST3 was reinstalled at 50 cm. The SDI and RNIN sensors were re-leveled. There were teeth marks on the battery box and one guy wire was detached. An electric fence was installed at the station. The AT-RH and SR sensors were replaced for routine calibration. All data were downloaded from the datalogger. The height of the snow depth sensor was measured at 73.5 inches after re-leveling the crossarm. The cumulative rainfall was reset to its observed value of 1.29 inches. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *Note: the WS-WD sensor had been scheduled for replacement, but due to the emergency replacement at Kugururok, no additional sensors were available. The Asik WS-WD sensor should be replaced at the next field visit. Also, field notes indicate that a white screw/nut is missing from the AT-RH radiation shield and should be replaced at the next visit.*

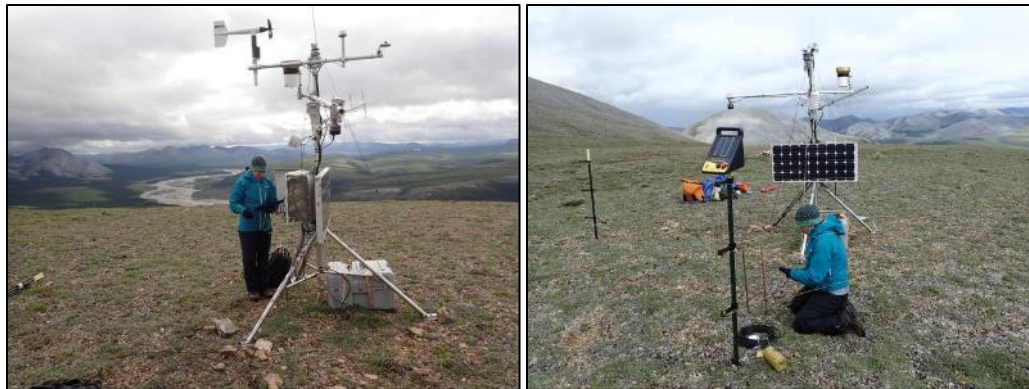


Figure 16. Asik climate station before (left) and after (right) maintenance July 22, 2018.

Tahinichok

Date: July 22, 2018

Time of visit: 1715–1930

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 58°F, 10–15 mph

Sensors Replaced:

AT-RH (HMP45)

The Tahinichok station (Figure 17) was accessed from Kotzebue by helicopter. The station had some damage: both crossarms were out of level, the wind sensor was pegged against the tipping bucket, and the HMP45 AT-RH sensor was damaged and not functioning. The damaged AT-RH sensor was replaced with a new cable and sensor. The lower crossarm holding the snow depth and tipping bucket sensors was moved down to rest on the solar panel, and releveled. All data were downloaded from the datalogger. The electric fence was repaired by re-stringing polywire and replacing two post connectors. The height of the snow depth sensor height was measured and entered into the public table at 49.5 inches. The antenna was realigned and damaged elements were replaced. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.

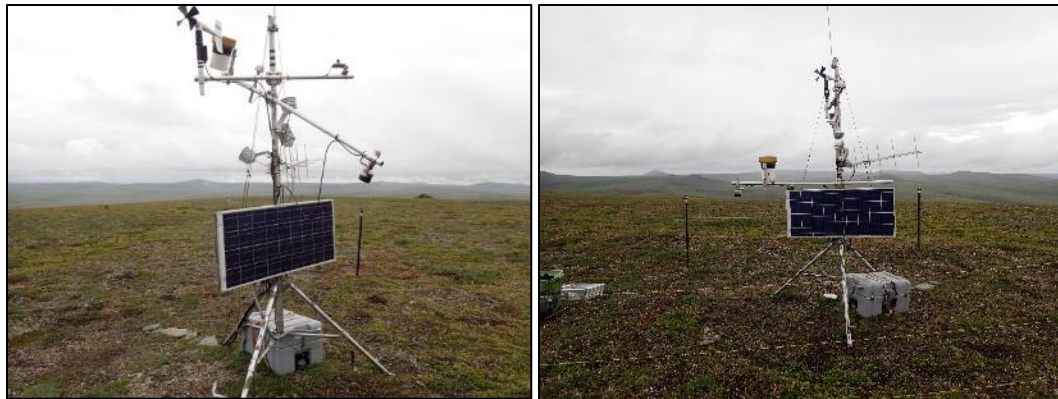


Figure 17. Tahinichok climate station July 22, 2018 shown before (left) and after (right) repairs.

Mt. Noak

Date: July 22, 2018

Time of visit: 1410–1630

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 64°F, 10–15 mph

Sensors Replaced:

AT-RH (HMP45)

The Mt. Noak station (Figure 18) was accessed from Kotzebue by helicopter. The station had minor damage: the RNIN and SDI sensors were out of level, four antenna elements were damaged, and there were teeth/claw marks on the battery box and enclosure. The lower crossarm (RG-TB, SD) was moved down to rest on top of the solar panel and the rain gage was moved next to the snow depth sensor. The AT-RH sensor was replaced for routine calibration. All data were downloaded from the datalogger. The height of the snow depth sensor was entered into the public table at 44.9 inches. The cumulative rainfall was left at its value of 4.45 inches. The YAGI antenna was replaced. The desiccant packets were replaced in the enclosure. A new 100 amp-hour battery was installed for the CC5MPX camera. After installation, the camera was tested and oriented. An electric fence was installed at the station. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 18. Mt. Noak climate station July 22, 2018 before (left) and after (right) repairs.

Howard Pass

Date: July 23, 2018

Time of visit: 1200–1500

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 69°F, 0–10 mph

Sensors replaced:

CR1000

AT-RH (HMP155 replaced with HMP45)

AT (109 replaced)

SR

WS-WD (5108 Alpine HD Cable only).

ST1, ST2, and ST3 (cables ok, re-installed)

The Howard Pass climate station (Figure 19) was accessed from Kotzebue by helicopter for a repair visit. The station had been damaged, presumably by a bear on June 19. Almost all cables were severed. The datalogger was damaged and unable to connect to the field computer. The HMP155 was replaced with an HMP45 along with a new 10-plate radiation shield. The program was updated accordingly. The SR and AT (109) sensors were replaced. The cable for the WS-WD sensor was replaced, but the sensor was undamaged. The coax cable had pulled out at the antenna end, but was intact and repaired by re-inserting and adding mastic. The YAGI antenna was replaced. The soil temperature sensors were reinstalled to the appropriate depths at 10, 20, and 50 cm. The solar panel charging box had been ripped off of the back of the panel. The panel connection was repaired by wiring the cables from the black box back into the solar panel. The station should be monitored leading up to the next field visit, particularly the battery voltage and GOES transmissions. *Consider adding an electric fence, replacing the solar panel, and/or replacing the coax cable at the next visit. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.*

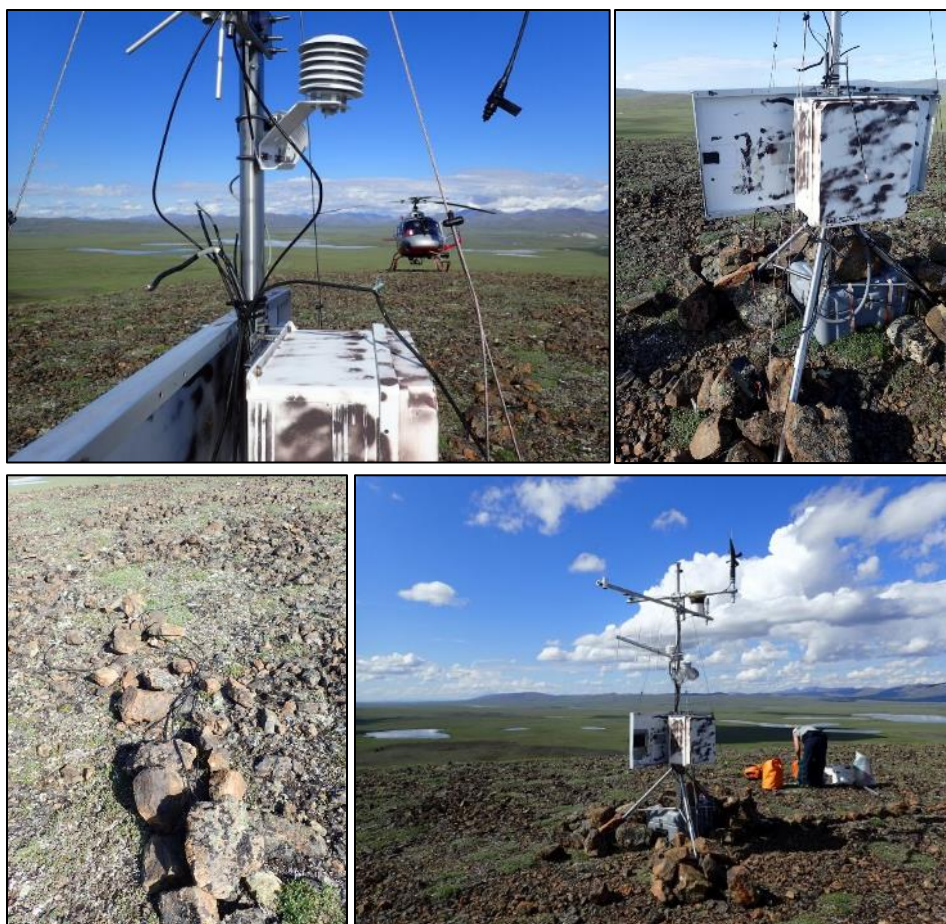


Figure 19. Howard Pass climate station: severed cables (upper left), damaged solar panel (upper right), displaced soil temperature sensors (bottom left), and post-repairs (bottom right) on July 23, 2018.

Nome Base

ARCN climate stations maintained from Nome include: Devil Mountain, Ella Creek, Midnight Mountain, and Serpentine Hot Springs. Fire RAWS stations at Hoodoo Hills and Quartz Creek were also maintained.

Logistics: NPS staff flew from Kotzebue to Nome in the Western Area Fire Helicopter (N70TH) on July 24. Staff stayed at the NPS bunkhouse in Nome. Staff returned to Fairbanks by commercial jet service on Alaska Airlines.

Ella Creek

Date: July 24, 2018

Time of visit: 1550–1750

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 60°F, 2–10 mph winds, cloudy

Sensors replaced:

AT-RH (HMP45 sensor + cable), SR, SD (sensor head), YAGI Antenna

The Ella Creek station (Figure 20) was accessed from by helicopter in transit from Kotzebue – Hoodoo Hills. The station had been damaged, presumably by icing. Transmissions ended in April 2018. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. The YAGI antenna was broken at the mast connection, pointing northwest towards the ground, and twisted around the station. The replacement antenna was in Nome, and therefore staff returned to the station on July 25 to replace the antenna. The tipping bucket funnel was missing and replaced. There was some corrosion on the HMP45 sensor cable and therefore it was replaced. The SD sensor was not recording and therefore it was replaced. The new height of the snow depth sensor was measured as 76.5 inches. All data were downloaded from the datalogger. The cumulative rainfall was reset to its previous value of 8.68 inches, but data previous to the field visit is suspect and may need to be removed. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 20. Ella Creek climate station July 24, 2018 before (left, middle) and after (right) station maintenance.

Hoodoo Hills fire RAWS

Date: July 24, 2018

Time of visit: 1300–1530

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 62°F, 10–15 mph winds, cloudy

Sensors replaced:

AT-RH

The Hoodoo Hills fire RAWS station (Figure 21) was accessed via helicopter while transiting from Kotzebue to Nome. The AT-RH sensor was replaced for scheduled calibration. The ST1 and ST2 sensors were not working and therefore replaced. There was not visible damage on these sensors or

other indications of failure. The electric fence was repaired and the polywire was replaced. An additional 3-to-1 SDI cable was added for sensor connections. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. The station is slightly out of level and possibly sinking. Future site visits should consider addressing this problem. All bolts and guy wires were tightened.



Figure 21. Hoodoo Hills fire RAWS station July 24, 2018.

Midnight Mountain

Date: July 25, 2018

Time of visit: 1145–1215

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 60°F, Light winds

Sensors replaced/repared:

None

Midnight Mountain (Figure 22) was accessed by helicopter. Because of heavy rime ice buildup in winter months, only air temperature is measured at this site and data are not transmitted. The station was in good condition. All data were downloaded from the datalogger. The AT-RH shield was moved so that both are now on the south side of the mast. The solar panel is damaged and the frame is pulling away from the panel. It was field repaired with bailing wire. *Consider replacing the solar panel at the next field visit.* Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 22. Midnight Mountain climate station July 25, 2018.

Devil Mountain

Date: July 25, 2018

Time of visit: 1640–1800

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Weather: 62°F, 10–15 mph winds

Sensors replaced:

AT-RH, WS-WD

The Devil Mountain station (Figure 23) was accessed by helicopter. The station had some damage: both crossarms were out of level, the wind sensor was broken with the nu-rail connection facing downwards, the nu-rail connection for the tipping bucket was also twisted and the funnel was on the ground. The AT-RH (HMP45) and WS-WD (05103) sensors were replaced for routine calibration. The lower crossarm with the GPS antenna, snow depth sensor, and rain gage was reset to rest on the solar panel in order to minimize seasonal damage by icing. The ThermX sensor was repositioned to face south and avoid direct solar heating. The electric fence was repaired by straightening the T-posts, installing a new charger, and replacing the polywire. All data were downloaded from the datalogger. The height of the snow depth sensor was measured and entered into the public table at 50.5 inches. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 23. Devil Mountain climate station before (left) and after (right) maintenance July 25, 2018.

Serpentine Hot Springs

Date: July 25, 2018

Time of visit: 1315–1530

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 68°F, 2–10 mph winds

Sensors replaced:

AT-RH (HMP155), YAGI antenna

SD (on August 8 return visit)

The Serpentine station (Figure 24) was accessed by helicopter. The station was in good condition with a few notable exceptions: ST1 and ST2 were at the same depth on arrival, the snow depth sensor was corroded (copper film damaged), and the battery for the camera had drained to 11.3 volts. The AT-RH sensor (HMP155) was replaced for routine calibration. The ST2 soil temperature sensor was re-inserted to 20 cm depth. The remainder of the copper film on the SR50a snow depth sensor was removed and the sensor stopped recording any values (before removal the sensor was returning the height of the sensor). The sensor was removed and replaced by Dave Swanson at a later visit on August 8. The previously damaged (see 2017 report) YAGI antenna was replaced. The tipping bucket was re-leveled.

Camera images ceased in early June, presumably due to power supply issues. After connecting to the camera the CC5MPX software indicated a mandatory reset due to either 1) power fluctuation resulting in a firmware crash, 2) power switching on and off frequently causing the device to switch to safe mode, 3) failure during firmware update, or 4) power down during firmware update. Besides the low voltage measured on the battery supply, there were no indications of power disruption. It appears that the camera was “stuck on” and required a manual reset. After resetting the camera, the Blue River battery (power supply for camera) was swapped with a Sun Extender battery from the

climate station. The camera firmware was updated from version 16 to version 25. There was some condensation on the inside of the camera lens. The lens was removed for drying during the field visit and the desiccant was replaced. The SD memory card in the camera was exchanged. The tipping bucket was repaired, leveled, and a rubber gasket was added. The camera cable and the desiccant in the camera was replaced and the camera was realigned. A subsequent visit by Dave Swanson in August indicated that the camera was functioning properly.

All data were downloaded from the datalogger. The cumulative rainfall was reset to 4.63 inches. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *Note: Dave Swanson re-visited the site on 8/8/2018. He installed a new snow depth sensor and confirmed good battery voltages for both the climate station and camera. The camera was functioning properly. The power supply for the station is now the Blue River and Sun Extender batteries connected in parallel. As of September 2018, the station power supply appears to be adequate and stable.*



Figure 24. Serpentine climate station July 25, 2018.

Quartz Creek Fire RAWS

Date: July 25, 2018

Time of visit: 1800–2000

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N970TH – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 74°F, 10–15 mph winds

Sensors replaced:

AT-RH, Datalogger

The Quartz Creek fire RAWS station (Figure 25) was accessed by helicopter. The station looked good upon arrival. All data were downloaded from the datalogger. The AT-RH sensor and the datalogger were replaced. The new datalogger is an F6 model (combination datalogger and transmitter). All data were downloaded from the logger. All sensors were scanned and functioning.

[illegible]

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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., K. R. Hill, W. F. Johnson, and S. D. Miller. 2017. Protocol implementation plan for monitoring weather and climate in the Arctic Network. Natural Resource Report NPS/ARC/NRR— 2017/1537. National Park Service, Fort Collins, Colorado.

Appendix A. Base Logistics Summary 2018

Dahl Creek Logistics June 11–12, 2018

Ken Hill and Pam Sousanes met helicopter N970TH (Temsco/Western area fire helicopter contract) and pilot Tide Smid at the east ramp transient helicopter parking area of Fairbanks International Airport on June 11. The Western Area Fire contract A-star helicopter (N970TH) was used to access the sites. The helicopter ferried from Denali to Fairbanks to Bettles to Dahl Creek. All staff stayed in the NPS bunkhouse at Dahl Creek. Noatak RAWS and Howard Pass were visited on June 11. Imelyak, Kaluich, Salmon River, and Kavet Creek were visited on June 12. Fuel from the NPS Jet A tank was used at Dahl Creek. Fuel was purchased from Bettles Lodge on the return flight to Fairbanks.

Bettles Logistics June 26–27, 2018

Ken Hill and Pam Sousanes met helicopter N970TH (Temsco/Western area fire helicopter contract) and pilot Tide Smid at the east ramp transient helicopter parking area of Fairbanks International Airport on June 26. Tide, Ken, and Pam flew from Fairbanks to Bettles with all gear needed for station maintenance. Dave Swanson met climate staff in Bettles after flying on commercial seat fare with Wright Air Service. Chimney Lake and Pamichtuk Lake stations were visited on June 26. Ram Creek and Killik Pass were visited on June 27 before returning to Fairbanks. Fuel was purchased from Bettles Lodge and Brooks Range Aviation.

Kotzebue and Nome Logistics July 20–26, 2018

Ken Hill and Pam Sousanes traveled from Fairbanks to Kotzebue on Alaska Airlines on July 20. The helicopter (Temsco – N970TH – Tide Smid) was working in WEAR with the fire crew for cabin maintenance earlier in the week. Sisiak, Kugururok, and Kelly RAWS were visited on July 21. One fire crew member was evacuated from Kelly Ranger Station at the end the day due to a minor ankle injury. On July 22, Asik, Tahinichok, and Mt. Noak were visited and the fire crew was moved from Kelly Ranger station to a new cabin. On July 23, Howard Pass was visited for unscheduled repairs. Tony DeMarco (NRCS) arrived by commercial air in Kotzebue. On July 24, Hill and Sousanes transited to Nome, stopping at Hoodoo Hills and Ella Creek en route. Also on July 24, Tony DeMarco utilized NPS fleet aircraft (C185 with Rick Dolan) to maintain the Kelly SNOTEL station. On July 25 maintenance was completed at Midnight Mountain, Devil Mountain, Serpentine Hot Springs, and Quartz Creek RAWS. Hill and Sousanes returned to Fairbanks via commercial air on July 26 and the helicopter ferried back to its base at McKinley Park. Excess equipment was transported back to Denali by the helicopter and retrieved in August.

Excess equipment was shipped in advance to Kotzebue and Nome with Northern Air Cargo. The helicopter transported excess gear back to Denali at the end of the trip. Housing was arranged in advance with local staff. USFWS generously provided housing at their Kotzebue bunkhouse and housing in Nome was at the NPS bunkhouse. Vehicle reservations were also arranged in advance with local staff. Helicopter parking in Kotzebue was at the USFWS hangar. Helicopter parking in Nome was generously supplied by Bering Air. Fuel was purchased from Crowley Air in Kotzebue

and from Bering Air in Nome. Kotzebue housing was arranged in advance at the USFWS bunkhouse and at the NPS bunkhouse in Nome.

A spare electric fence charger and a spare station mast are stored at the Kotzebue warehouse. Two spare fence chargers and one 100 aH 12-volt battery are stored at the Nome warehouse.

Appendix B. ARCN I&M Station Specifications

Table B1. Sensor specifications.

Measurements	Model/Manufacturer/Item#	Purchased from:
Air Temperature 1/Relative Humidity	HMP-45C/HMP155a 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	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 High Data rate 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	HMP45	7/22/2018
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	Asik2017	7/27/2017
Asik	GPS	17992 GPS	7/13/2012
Asik	RG-TB	TE525	7/13/2012
Asik	SD	SR50a	7/13/2012
Asik	Solar Panel	75 W	7/13/2012
Asik	SR	Li200x	7/22/2018
Asik	ST -10 cm	107	7/13/2012
Asik	ST -20 cm	107	7/13/2012
Asik	ST -50 cm	107	7/13/2012
Asik	Tripod	CM106	7/13/2012
Asik	TX312	NESDIS ID 3961A40E	7/13/2012
Asik	WS/WD	5103	6/6/2015

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	6/26/2018
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	6/26/2018
Chimney Lake	Solar Panel	75 W	8/7/2012
Chimney Lake	SR	Li200x	6/26/2018
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	6/26/2018

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	HMP45	7/25/2018
Devil Mountain	Battery	100 AH (x2)	8/18/2011
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	Devil2017	8/10/2017
Devil Mountain	Electric Fence	T-post, poly-wire solar charger	7/25/2018
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	8/10/2017
Devil Mountain	ST -10 cm	107	8/18/2011
Devil Mountain	ST -20 cm	107	8/18/2011
Devil Mountain	ST -50 cm	107	8/18/2011
Devil Mountain	Tripod	CM106	8/18/2011
Devil Mountain	TX312	NESDIS ID 3961221A	8/18/2011
Devil Mountain	WS/WD	5103	7/25/2018

Table C4. Metadata for Ella Creek climate station.

Station Name	Item	Model	Start Date
Ella Creek	Antenna	25316 YAGI	7/25/2018
Ella Creek	AT	109	6/2/2016
Ella Creek	AT	ThermX	9/18/2012
Ella Creek	AT-RH	HMP45	7/24/2018
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	8/9/2017
Ella Creek	SD	SR50a	7/24/2018
Ella Creek	Solar Panel	75 W	9/18/2012
Ella Creek	SR	Li200x	7/24/2018
Ella Creek	ST -10 cm	107	9/18/2012
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	TX312	396182E2	8/7/2013
Ella Creek	WS/WD	5108-Alpine-HD	6/2/2016

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	HMP45	7/23/2018
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	Howard2017	6/28/2017
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	7/17/2013
Howard Pass	Solar Panel	75 W	7/7/2011
Howard Pass	SR	Li200x	7/23/2018
Howard Pass	ST -10 cm	107	7/7/2011
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	TX312	NESDIS ID 39617266	7/7/2011
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	7/6/2011
Imelyak	AT	109	7/26/2016
Imelyak	AT	ThermX	7/6/2011
Imelyak	AT-RH	HMP155	6/12/2018
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	Imelyak2017	6/27/2017
Imelyak	Enclosure	ENC 16/18	7/6/2011
Imelyak	GPS	17992 GPS	7/6/2011
Imelyak	RG-TB	TE525	6/12/2018
Imelyak	SD	SR50a	7/6/2011
Imelyak	Solar Panel	75 W	7/6/2011
Imelyak	SR	Li200x	6/27/2017
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	TX312	NESDIS ID 3961316C	7/20/2012
Imelyak	WS/WD	5108 Alpine HD	6/12/2018

Table C7. Metadata for Kaluich climate station.

Station Name	Item	Model	Start Date
Kaluich	Antenna	25316 YAGI	7/20/2012
Kaluich	AT	109	7/27/2016
Kaluich	AT	ThermX	7/20/2012
Kaluich	AT-RH	HMP155	6/12/2018
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	Kaluich2017	6/28/2017
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	7/20/2012
Kaluich	Solar Panel	75 W	7/20/2012
Kaluich	SR	Li200x	6/12/2018
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	TX312	NESDIS ID 39617266	7/20/2012
Kaluich	WS/WD	5108 Alpine HD	6/12/2018

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	7/26/2016
Killik Pass	AT	ThermX	5/29/2013
Killik Pass	AT-RH	HMP45	9/18/2018
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	7/26/2016
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	6/27/2018

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	HMP45	7/21/2018
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	Kugururok2017	7/26/2017
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	7/21/2018
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	Tripod	CM106	7/18/2014
Kugururok	TX312	NESDIS ID 396203F8	7/18/2014
Kugururok	WS/WD	5103	7/21/2018

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	75 W	7/8/2011
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	HMP45	7/22/2018
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	Noak2017	7/27/2017
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	7/11/2011
Mt. Noak	SD	SR50a	6/29/2013
Mt. Noak	Solar Panel	75 W	7/11/2011
Mt. Noak	SR	Li200x	7/27/2017
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	TX312	NESDIS ID 39616110	7/15/2014
Mt. Noak	WS/WD	5103	7/27/2017

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	6/26/2018
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	8/6/2012
Pamichtuk	Solar Panel	75 W	8/6/2012
Pamichtuk	SR	Li200x	6/27/2017
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	7/25/2016

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	6/27/2018
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	8/7/2012
Ram Creek	Solar Panel	75 W	8/7/2012
Ram Creek	SR	Li200x	6/27/2018
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	6/27/2017

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	HMP155	6/12/2018
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	7/21/2015
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	Salmon2017	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	7/17/2013
Salmon River	SR	Li200x	6/28/2017
Salmon River	ST -10 cm	107	7/17/2013
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	TX312	NESDIS ID 3960F688	7/24/2014
Salmon River	WS/WD	5103	6/28/2017

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	HMP155	7/25/2018
Serpentine	Battery	100 AH (x2)	8/18/2011
Serpentine	Camera	CC5MPX	8/7/2013
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	Serpentine2017	8/10/2017
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	8/8/2018
Serpentine	Solar Panel	75 W	8/18/2011
Serpentine	SR	Li200x	8/10/2017
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	TX312	NESDIS ID 3961C1E8	8/18/2011
Serpentine	WS/WD	5103	8/10/2017

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	HMP45	7/21/2018
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	Sisiak2017	7/26/2017
Sisiak	Enclosure	ENC 16/18	7/13/2011
Sisiak	GPS	17992 GPS	7/13/2011
Sisiak	RG-TB	TE525	7/13/2016
Sisiak	SD	SR50a	7/13/2011
Sisiak	Solar Panel	75 W	7/13/2016
Sisiak	SR	Li200x	7/21/2018
Sisiak	ST -10 cm	107	7/26/2017
Sisiak	ST -20 cm	107	7/13/2011
Sisiak	ST -50 cm	107	7/13/2011
Sisiak	ST -75 cm	107	End 2017
Sisiak	Tripod	CM106	7/13/2011
Sisiak	TX312	NESDIS ID 3961548A	7/13/2011
Sisiak	WS/WD	5103	7/26/2017

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	HMP45	7/22/2018
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	Tahinichok2017	7/27/2017
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	6/6/2015
Tahinichok	Solar Panel	75 W	7/10/2011
Tahinichok	SR	Li200x	7/27/2017
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	7/27/2017

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