



Climate Station Maintenance in the Arctic Network

2016 Summary

Natural Resource Data Series NPS/ARCN/NRDS—2018/1143



ON THE COVER

Chimney Lake weather station, Gates of the Arctic National Park and Preserve.
NPS/Pam Sousanes

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Abstract

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

In an attempt to better understand climate variation as well as long-term changes in park ecosystems, seventeen I&M climate stations have been installed in the five ARCN parks. The objective of the climate monitoring program is to monitor and record weather conditions at representative locations throughout ARCN in order to identify long and short-term trends, provide reliable climate data to other researchers, and to participate in large scale climate monitoring and modeling efforts beyond park boundaries. Seventeen existing 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 2016 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. Additional support was provided by pilots (Curtis Cebulski, Katrine Halgren, Russel Rowe, John Carney, Scott Sample) and aviation staff (Alaska Regional Communication Center and Dave Rosser).

List of Acronyms

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

List of Acronyms (continued)

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

Climate Station Locations

For the 2016 field season, the Arctic Network (ARCN) continued its climate monitoring program by maintaining seventeen existing stations in the network (Figure 1, Table 1). These 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.

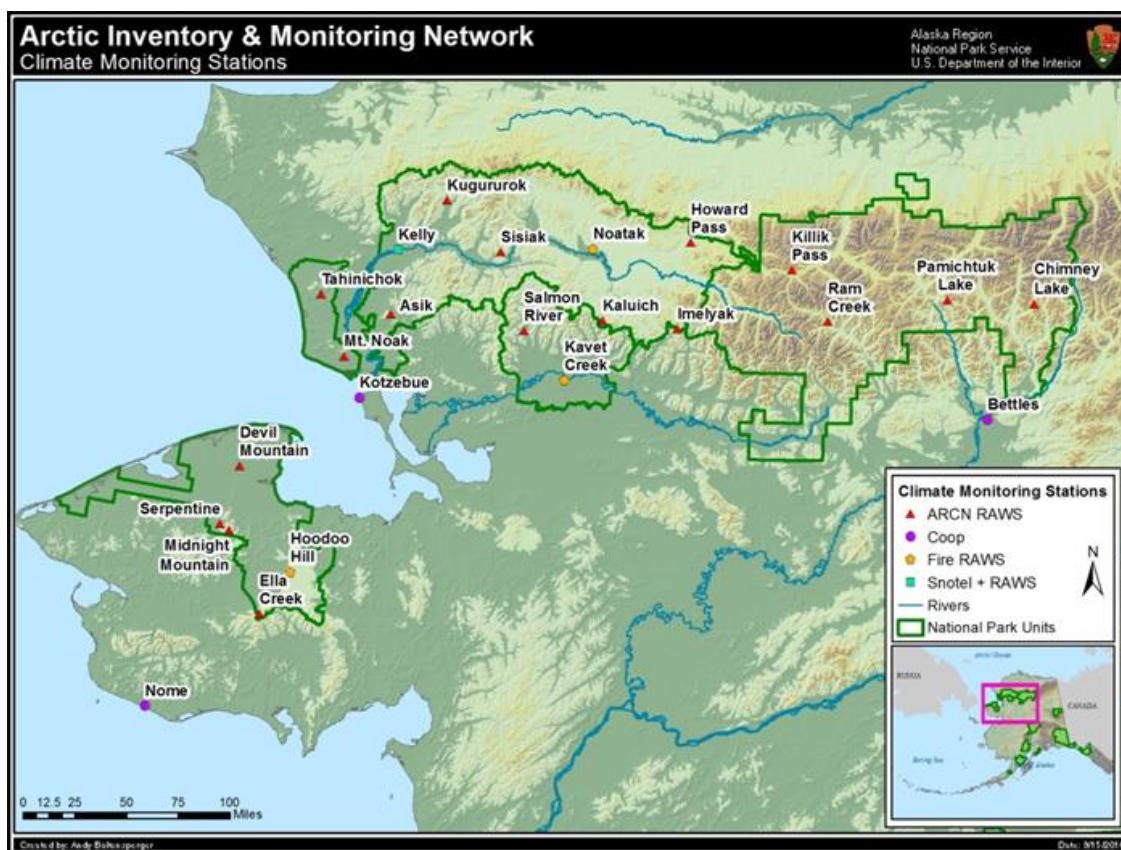


Figure 1. Locations of ARCN climate stations.

Table 1. Locations of ARCN climate stations maintained in 2016 field season.

Station Name	Station Type	Latitude (N)	Longitude (W)	Elevation (ft)	Park
Chimney Lake	I&M	67° 42.853'	150° 35.100'	3780	GAAR
Killik Pass	I&M	67° 59.007'	155° 00.782'	4355	GAAR
Pamichtuk Lake	I&M	67° 45.977'	152° 09.854'	3294	GAAR
Ram Creek	I&M	67° 37.458'	154° 20.678'	4110	GAAR
Asik	I&M	67° 28.493'	162° 15.986'	1329	NOAT
Howard Pass	I&M	68° 09.361'	156° 53.749'	2062	NOAT
Imelyak	I&M	67° 32.689'	157° 04.646'	3620	NOAT
Kaluich	I&M	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	I&M	68° 19.003'	161° 29.518'	908	NOAT
Noatak RAWS	Fire RAWS	68° 04.222'	158° 42.224'	1040	NOAT
Salmon River	I&M	67° 27.594'	159° 50.475'	1262	KOVA
Sisiak	I&M	67° 59.702'	160° 23.739'	1823	NOAT
Tahinichok	I&M	67° 33.009'	163° 34.031'	966	CAKR
Mt. Noak	I&M	67° 08.486'	162° 59.672'	809	CAKR
Devil Mountain	I&M	66° 16.553'	164° 31.851'	285	BELA
Ella Creek	I&M	65° 16.289'	163° 48.681'	2258	BELA
Hoodoo Hills RAWS	Fire RAWS	65° 35.711'	163° 24.671'	1550	BELA
Midnight Mountain	I&M	65° 49.220'	164° 32.565'	2267	BELA
Quartz Creek RAWS	Fire RAWS	65° 24.429'	164° 39.444'	276	BELA
Serpentine	I&M	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 Central Alaska Network (CAKN) climate vital sign protocols (Sousanes 2006). The ARCN protocol implementation plan and standard operating procedures are currently in review (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.

Nome Base

Inventory and monitoring 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 via commercial airline to Nome and based out of Nome and Quartz Creek for the station maintenance. A Bering Air R-44 helicopter was used to reach the site locations from Quartz Creek. Staff stayed at the NPS bunkhouse in Nome and the DOT cabin in Quartz Creek. An NPS vehicle was used for transport to Quartz Creek and within Nome.

Devil Mountain

Date: June 1, 2016

Time of visit: 1250-1450

Personnel: Ken Hill, Pam Sousanes

Mode of transport: R44 helicopter – Bering Air – N776BH – Russell Rowe

Purpose of trip: Annual Maintenance

Weather: 53°F, 25-35 mph winds, clear

Sensors replaced:

AT (109 probe added)

AT-RH

RG-TB

The Devil Mountain station (Figure 2) was accessed from Quartz Creek by helicopter. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) sensor was replaced for routine calibration. Upon arrival, the RG-TB sensor was found dangling and damaged, which was replaced and secured with tape. All data were downloaded and a new program (Devil2016.CR1) was sent to the datalogger. The new program switched elements #8 and #9 (edited and corrected by RAWS in the Wildland Fire Management Information system (WFMI) on 6/6/2016). The height of the snow depth sensor was measured and entered into the public table at 84 inches. The cumulative rainfall was reset to 0.00 inches. The electric fence was repaired. 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. High-precision GPS coordinates were taken with a Trimble unit.



Figure 2. Devil Mountain climate station, June 1, 2016 before (left) and after (right) maintenance and repairs.

Midnight Mountain

Date: June 1, 2016

Time of visit: 1400-1500

Personnel: Ken Hill, Pam Sousanes

Mode of transport: R44 helicopter – Bering Air – N776BH – Russell Rowe

Purpose of trip: Annual Maintenance

Weather: 35°F, 20-25 mph winds, mostly sunny

Sensors replaced/repaired:

Battery Cable

Midnight Mountain (Figure 3) was accessed by helicopter from Quartz Creek. Because of heavy rime ice buildup in winter months, only air and soil temperature sensors are installed at this site. All data were downloaded from the datalogger. After troubleshooting, it was determined that the power cable from the battery to the datalogger was damaged by either wildlife or icing. Data were only being collected when the solar panel was charging the station directly. A new battery cable was installed to fix the problem. The same problem occurred in 2015. The air temperature radiation shields were bent to 90 degrees horizontal, presumably due to icing. *During the next field visit, it is advised to reconfigure the station with a 10 watt solar panel and small, internal battery to eliminate cables outside the enclosure. The large solar panel, battery box, and large battery could be removed.*

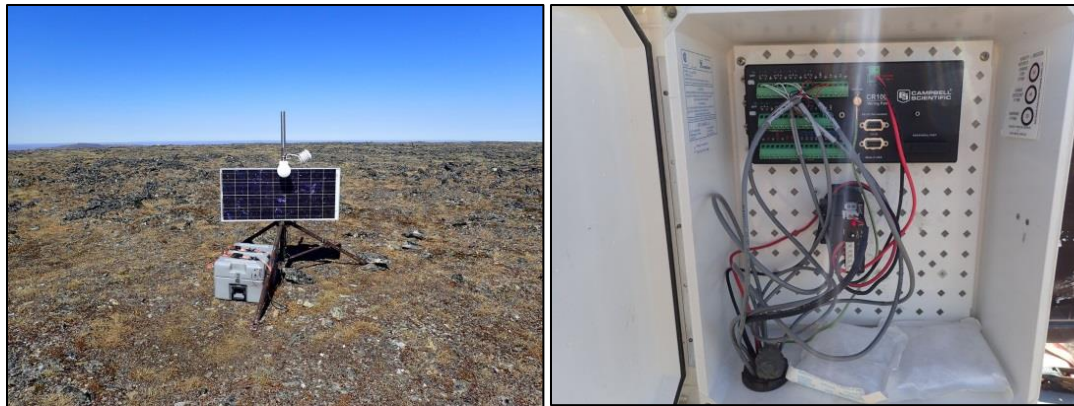


Figure 3. Midnight Mountain climate station, June 1, 2016.

Serpentine Hot Springs

Date: June 1, 2016

Time of visit: 1600-1730

Personnel: Ken Hill, Pam Sousanes

Mode of transport: R44 helicopter – Bering Air – N776BH – Russell Rowe

Purpose of trip: Annual Maintenance

Weather: 55°F, 12-25 mph winds, clear

Sensors replaced:

AT (109 probe added)

AT-RH (HMP155)

SD (SR50a new model)

ST3 (spliced)

The Serpentine station (Figure 4) was accessed from Quartz Creek by helicopter. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP155) was replaced for routine calibration. The SR50a snow depth sensor was damaged (corrosion) and replaced with a new, upgraded model acquired from Campbell Scientific. The 50-cm soil temperature sensor (ST3) was damaged by wildlife and repaired by splicing. The SD card in the CC5MPX phenology camera was exchanged and all photos were downloaded to the field laptop. All data were downloaded and a new program (Serpentine2016.CR1) was sent to the datalogger. The new program switched elements #8 and #9 (edited and corrected by RAWs in WFMI 6/6/2016). The height of the snow depth sensor was measured and entered into the public table at 88.5 inches. The cumulative rainfall was reset to 0.96 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. High-precision GPS coordinates were taken with a Trimble unit.



Figure 4. Serpentine climate station, June 1, 2016.

Quartz Creek Fire RAWS

Date: June 1, 2016

Time of visit: 1900-2000

Personnel: Ken Hill, Pam Sousanes

Mode of transport: NPS vehicle

Purpose of trip: Annual Maintenance

Weather: 45°F, 25-30 mph winds, mostly sunny

Sensors replaced:

AT-RH

RG-TB

SR

The Quartz Creek fire RAWS station (Figure 5) was accessed from the airstrip. The station looked good upon arrival. All data were downloaded from the datalogger. The AT-RH, RG-TB, and SR sensors were replaced for routine calibration. All sensors were scanned and functioning. All bolts and guy wires were tightened.



Figure 5. Quartz Creek fire RAWS station, June 1, 2016.

Hoodoo Hills fire RAWS

Date: June 2, 2016

Time of visit: 1100-1300

Personnel: Ken Hill, Pam Sousanes

Mode of transport: R44 helicopter – Bering Air – N776BH – Russell Rowe

Purpose of trip: Annual Maintenance

Weather: 44°F, 20-22 mph winds, mostly sunny

Sensors replaced:

AT-RH

RG-TB

SR

Datalogger

Transmitter

GPS

GPS Cable

The Hoodoo Hills fire RAWS station (Figure 6) was accessed via helicopter from Quartz Creek. The site was not transmitting upon arrival. The transmitter, GPS, and GPS cable were exchanged. The RG-TB, AT-RH, and SR sensors were replaced. The rain gage was reset to 0.00 inches. The electric fence was repaired using existing posts on site. The new posts at the site have not been used. The

fence charger was affixed to the post with strapping tape and mechanic's wire. The old batteries remain at the site and should be removed by the NPS radio shop. 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 6. Hoodoo Hills fire RAWS station, June 2, 2016.

Ella Creek

Date: June 2, 2016

Time of visit: 1500-1620

Personnel: Ken Hill, Pam Sousanes

Mode of transport: R44 helicopter – Bering Air – N776BH – Russell Rowe

Purpose of trip: Annual Maintenance

Weather: 38°F, 15-25 mph winds, mostly sunny

Sensors replaced:

AT (109 probe added)

AT-RH (HMP45)

SR

WS-WD (5108 Alpine HD)

The Ella Creek station (Figure 7) was accessed from Quartz Creek by helicopter. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. The 5103 WS-WD sensor was damaged and replaced with a 5108 Alpine HD model. The AT-RH radiation shield was replaced. All data were downloaded and a new program (Ella2016.CR1) was sent to the datalogger. The new program switched elements #8 and #9 (edited and corrected by RAWs in WFMI 6/6/2016). The height of the snow depth sensor was

measured and entered into the public table at 74 inches. The cumulative rainfall was reset to 2.35 inches. Seven antenna tines were missing and 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. High-precision GPS coordinates were taken with a Trimble unit.

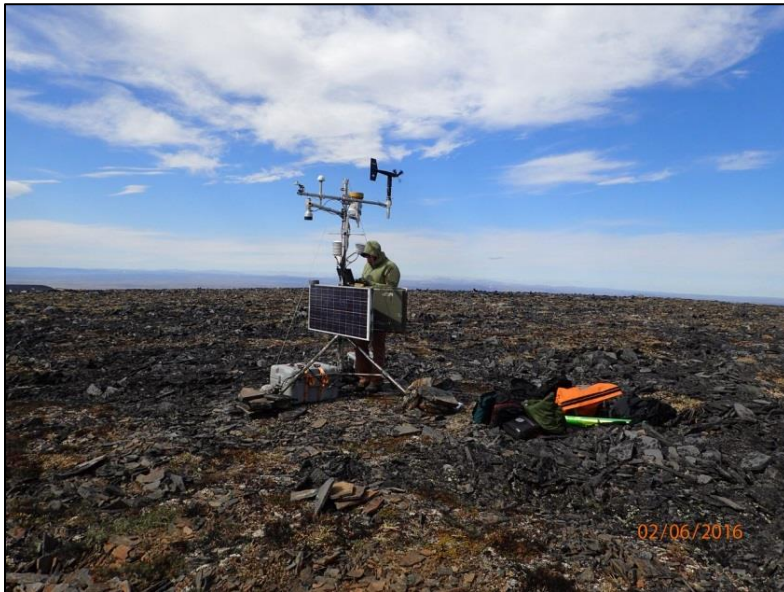


Figure 7. Ella Creek climate station, June 2, 2016 after station maintenance.

Kotzebue Base

Inventory and Monitoring 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 commercially from Fairbanks to Kotzebue. All sites were accessed via R44 Bering Air helicopter from Kotzebue. NRCS SNOTEL staff accessed the Kelly River site with fixed wing aircraft flown by Northwestern Aviation (C-185 on floats). All staff were housed at the Bureau of Land Management bunkhouse in Kotzebue.

Kugururok

Date: July 12, 2016

Time of visit: 1130-1330

Mode of transport: R44 helicopter – Pollux – N4237W – Katrina Halgren

Purpose of trip: Annual Maintenance

Weather: 65°F, 5-10 mph winds, clear

Sensors Replaced:

AT (109 probe added)

AT-RH (HMP45)
SR

The Kugururok station (Figure 8) was accessed from Kotzebue by helicopter. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. All data were downloaded and a new program (Kugururok2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 80.4 inches. The cumulative rainfall was reset to its observed value of 2.82 inches. Dave Swanson completed a soil profile at the site. The desiccant packets were replaced in the enclosure. The SD card in the CC digital camera was exchanged. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 8. Kugururok climate station, July 12, 2016.

Sisiak

Date: July 12 and July 14, 2016

Time of visit: 1100-1300

Mode of transport: R44 helicopter – Pollux – N4237W – Katrina Halgren

Purpose of trip: Annual Maintenance

Weather: 68°F, 5-15 mph winds, clear

Sensors Replaced:

AT (109 probe added)

AT-RH (HMP45)

SR

RG-TB

The Sisiak station (Figure 9) was accessed from Kotzebue by helicopter. The station had been damaged, presumably by a bear. The solar panel was bent and the glass was shattered. The panel was still functional, but the charging wires had been disconnected. Both crossarms were out of level on arrival and the RG-TB was dangling and missing the funnel. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. The damaged RG-TB was replaced. All data were downloaded and a new program (Sisiak2016.CR1) was sent to the datalogger. The crossarms were releveled. The solar panel wires were reconnected. The yagi antenna was adjusted. The bolts to set the azimuth are a bit stripped, but still working. *Check elevation of antenna next year and replace if it shows sign of slipping.* The charging regulator was not working and was replaced. The height of the snow depth sensor was entered into the public table at 87.8 inches. The cumulative rainfall was reset to 0.00 inches. Dave Swanson completed a soil profile at the site. The desiccant packets were replaced in the enclosure. There was a red fox on a nearby rock outcrop during the site visit. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. Note: staff returned to the station on 7/14/2016 and replaced the solar panel (no photo). High-precision GPS coordinates were taken with a Trimble unit.



Figure 9. Sisiak climate station, July 12, 2016. Upon arrival at the site the crossarms were out of level, the tipping bucket was dangling, and the solar panel was damaged (left, middle). Site after maintenance (right). Note that the solar panel pictured was replaced on July 14, 2016.

Asik

Date: July 12, 2016

Time of visit: 1330-1530

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: R44 helicopter – Pollux – N4237W – Katrina Halgren

Purpose of trip: Annual maintenance

Weather: 65°F, 10-15 mph winds, mostly sunny

Sensors replaced:

AT (109 probe added)

AT-RH (HMP45)

SR

The Asik station (Figure 10) was accessed from Kotzebue by helicopter. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. The RG-TB and SD sensor were out of level on arrival, and releveled during the station maintenance. All data were downloaded and a new program (Asik2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 72.8 inches. The cumulative rainfall was reset to its observed value of 2.42 inches. Dave Swanson completed a soil profile 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.

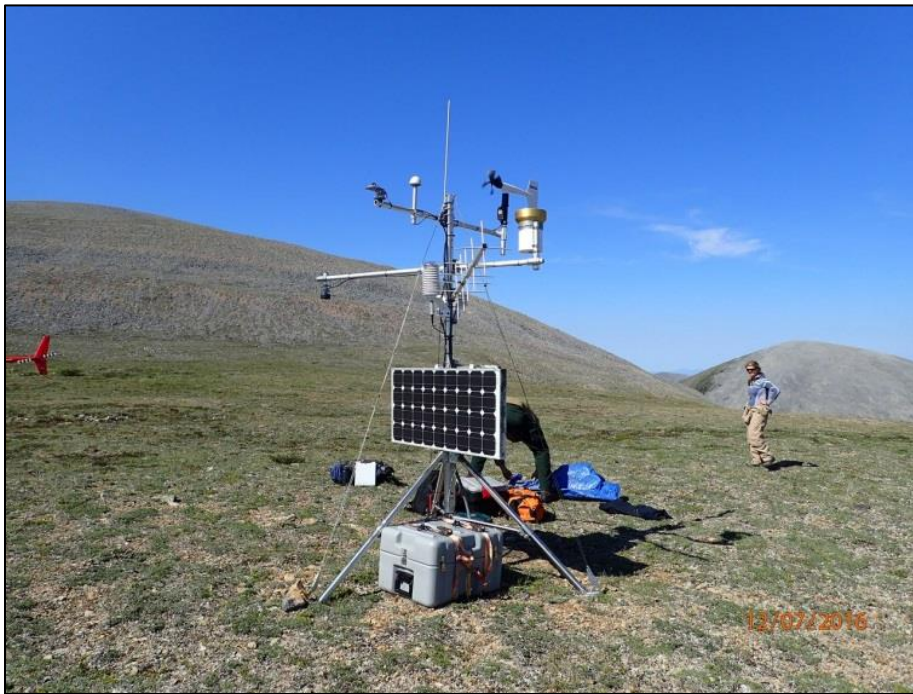


Figure 10. Asik climate station, July 12, 2016.

Kelly fire RAWS

Date: July 12, 2016

Time of visit: 1700-1800

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: R44 helicopter – Pollux – N4237W – Katrina Halgren

Purpose of trip: Annual maintenance

Weather: 76°F, Light winds, clear

Sensors replaced:

AT-RH

RG-TB

The Kelly fire RAWS station (Figure 11) was accessed via helicopter. The station looked good upon arrival. All data were downloaded from the datalogger. The AT-RH and RG-TB sensors were replaced for routine calibration. The RG-TB was tested and reset. 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. High-precision GPS coordinates were taken with a Trimble unit.



Figure 11. Kelly fire RAWS station, July 12, 2016.

Tahinichok

Date: July 13, 2016

Time of visit: 1700-1915

Mode of transport: R44 helicopter – Pollux – N4237W – Katrina Halgren

Purpose of trip: Annual Maintenance

Weather: 66°F, 5-10 mph winds, clear

Sensors Replaced:

AT (109 probe added)

AT-RH (HMP45)

SD

The Tahinichok station (Figure 12) was accessed from Kotzebue by helicopter. The station had some damage: the solar panel cables were pulled out, the snow depth (SD) cable was chewed, and the AT-RH cable was chewed. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) sensor was replaced for routine calibration. The HMP45 cable was repaired by splicing. The SR50a snow depth sensor cable was replaced. The crossarm holding the snow depth and tipping bucket sensors was releveled. All data were downloaded and a new program (Tahinichok2016.CR1) was sent to the datalogger. The height of the snow depth sensor height was measured and entered into the public table. The cumulative rainfall was reset to its observed value of 0.38 inches. The electric fence was repaired. *The polywire should be replaced during the next field visit.* Two antenna tines were missing and replaced. Dave Swanson completed a soil profile at the site. The desiccant packets were replaced in the enclosure. The SD card in the phenology camera was exchanged. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. High-precision GPS coordinates were taken with a Trimble unit.



Figure 12. Tahinichok climate station July 13, 2016 shown before (left) and after (right) repairs. Upon arrival at the station, the AT-RH sensor and cable were damaged, the snow depth cable was damaged, and the tipping bucket and snow depth sensors were out of level.

Mt. Noak

Date: July 14, 2016

Time of visit: 930-1200

Mode of transport: R44 helicopter – Pollux – N4237W – Katrina Halgren

Purpose of trip: Annual Maintenance

Weather: 60°F, 8-12 mph winds, clear

Sensors Replaced:

AT (109 probe added)

AT-RH (HMP45)

The Mt. Noak station (Figure 13) was accessed from Kotzebue by helicopter. The AT-RH sensor and shield were damaged and on the ground upon arrival. The RG-TB and SD sensor were out of level upon arrival, and releveled during the station maintenance. The shield for the ThermX sensor is bent. Two antenna tines were missing from Yagi, and were replaced. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP45) sensor and shield was installed. All data were downloaded and a new program (Noak2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 73 inches. The cumulative rainfall was reset to its observed value of 0.09 inches. Dave Swanson completed a soil profile at the site. The desiccant packets were replaced in the enclosure. The SD card in the phenology camera was exchanged, and the images were downloaded. The camera was releveled and re-focused. *During the next field visit, it is worth considering moving the camera to the tripod mast, since the cross bar on this station has been found out of level on a few occasions.* There were approximately 12-15 muskoxen grazing nearby during the station visit. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 13. Mt. Noak climate station, July 14, 2016. The AT-RH sensor and shield were damaged and on the ground upon arrival (left). The radiation shield for the ThermX sensor (middle) was bent horizontally and not replaced in 2016. Photo after maintenance (right).

Kelly SNOTEL

Date: July 26-27, 2016

Personnel: Tony DeMarco (NRCS) Daniel Fisher (NRCS)

Mode of transport: Northwestern Aviation – Cessna 185 on Floats – Jim Kincaid

Purpose of trip: Annual maintenance

Sensors replaced: as needed by NRCS

Tony DeMarco and Daniel Fisher completed the annual maintenance at the Kelly SNOTEL site on July 26. The snow pillow had been damaged and was replaced. 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.

Bettles Base

Stations maintained from Bettles include: Chimney Lake, Killik Pass, Pamichtuk Lake, and Ram Creek.

Logistics: The Western Area Fire contract A-star helicopter (N6015S) was used to access the sites. Climate staff combined Bettles and Dahl Creek field trips in 2016. Hill and Sousanes flew with all equipment from Fairbanks to Bettles via helicopter (N6015S) on 7/25/2016. Chimney Lake and Pamichtuk Lake stations were maintained on 7/25. John Brecher from NBC News joined Hill and Sousanes for field visits at Chimney and Pamichtuk (report [here](#)). All personnel were housed at the NPS/FWS bunkhouse at Bettles on 7/25. Ram Creek, and Killik Pass were maintained on 7/26. After maintenance at Killik, staff transitioned directly to Dahl Creek for station visits in NOAT and KOVA.

Chimney Lake

Date: July 25, 2016

Time of visit: 1430-1600

Personnel: Ken Hill, Pam Sousanes, John Brecher (NBC News)

Mode of transport: Helicopter from Bettles - N6015S - John Carney

Purpose of trip: Annual Maintenance

Weather: 53°F, 5-10 mph, partly cloudy

Sensors replaced:

AT (109 probe exchanged)

AT-RH (HMP45)

SR

The Chimney Lake station (Figure 14) was accessed by helicopter from Bettles. The station was in good condition. All data were downloaded from the datalogger. The HMP45 air temperature/relative humidity (AT-RH) and solar radiation (SR) sensors were replaced for routine calibration. The 109 air temperature (AT) probe was exchanged for a newly calibrated sensor. The RG-TB was re-taped. The 14-plate radiation shield had damage on the bottom two plates, but was in ok condition overall. *Consider replacing shield next field visit.* A new datalogger program (Chimney2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 79 inches. The cumulative rainfall was reset to its observed value of 3.9 inches. The electric fence was in overall decent condition and repaired as needed. 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.

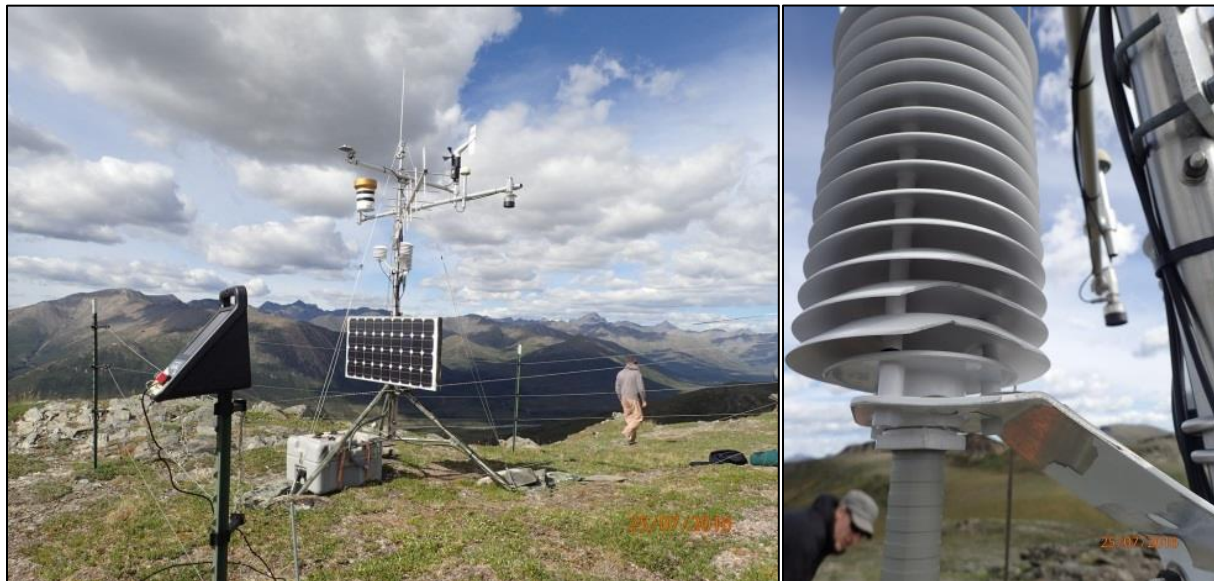


Figure 14. Chimney Lake climate station, July 25, 2016 (left). The damaged 14-plate radiation shield (right).

Pamichtuk

Date: July 25, 2016

Time of visit: 1630-1800

Personnel: Ken Hill, Pam Sousanes, John Brecher (NBC News)

Mode of transport: Helicopter from Bettles - N6015S - John Carney

Purpose of trip: Annual Maintenance

Weather: 60°F, 5-10 mph, partly cloudy

Sensors replaced:

AT (109 probe exchanged)

AT-RH (HMP45)

WS-WD

The Pamichtuk Lake station (Figure 15) 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 and wind speed-wind direction (WS-WD) sensors were replaced for routine calibration. The 109 air temperature (AT) probe was exchanged for a newly calibrated sensor. The RG-TB was re-taped. A new datalogger program (Pamichtuk2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 79.9 inches. The cumulative rainfall was reset to its observed value of 3.59 inches. The electric fence was repaired as needed. The images from the phenology camera were downloaded and the SD card 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 15. Pamichtuk climate station, July 25, 2016.

Ram Creek

Date: July 26, 2016

Time of visit: 1000-1115

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Bettles – N6015S – John Carney

Purpose of trip: Annual Maintenance

Weather: 51°F, 5-10 mph, mostly cloudy

Sensors replaced:

AT (109 probe exchanged)

AT-RH (HMP45)

SR

Ram Creek climate station (Figure 16) was accessed by helicopter from Bettles. All data were downloaded from the datalogger. The AT-RH and SR sensors were replaced for routine calibration. The 109 AT probe was exchanged for a newly calibrated sensor. The RG-TB was re-taped. A new datalogger program (Ram2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 79.4 inches. The cumulative rainfall was reset to its observed value of 1.90 inches. One guy wire was tightened. The lithium battery voltage in the datalogger was a little low (3.04 Volts), but not replaced. The electric fence was repaired as needed by replacing two insulators and tightening the polywire. 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 16. Ram Creek climate station, July 26, 2016.

Killik Pass

Date: July 26, 2016

Time of visit: 1200-1400

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Bettles – N6015S – John Carney

Purpose of trip: Annual Maintenance

Weather: 50°F, 8-12 mph, mostly cloudy

Sensors replaced:

AT (109 probe exchanged)

AT-RH (HMP45)

SR

Killik Pass climate station (Figure 17) was accessed by helicopter from Bettles via Ram Creek. All data were downloaded from the datalogger. The AT-RH and SR sensors were replaced for routine calibration. The 109 AT probe was exchanged for a newly calibrated sensor. The RG-TB was re-taped. One antenna tine was missing and replaced. The ThermX shield was slightly bent, but not replaced. There was some corrosion on the HMP45 sensor. The cable was sealed with mastic tape. A new datalogger program (Killik2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 77 inches. Some rocks on the tripod legs were moved which accounts for the change in the height of the sensor. The cumulative rainfall was reset to its observed value of 5.69 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.

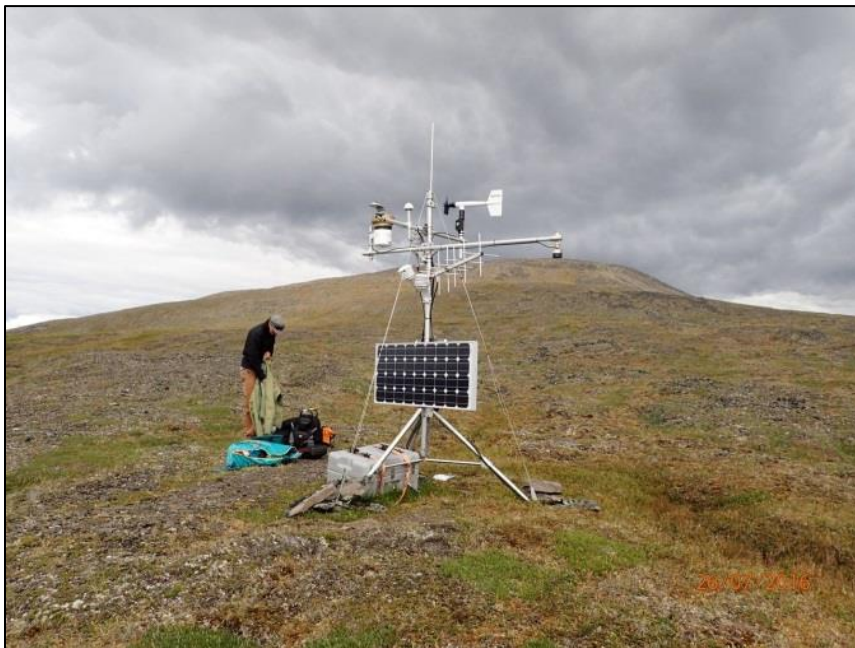


Figure 17. Killik Pass climate station, July 26, 2016.

Dahl Creek Base

Inventory and Monitoring stations maintained from Dahl Creek include: Howard Pass, Imelyak, Kaluich, and Salmon River. Additionally, Kavet Creek and Noatak fire RAWs stations were maintained.

Logistics: The Western Area Fire contract A-star helicopter (N6015S) was used to access the sites. Climate staff combined Bettles and Dahl Creek field trips in 2016. The helicopter flew to Dahl Creek via maintenance at Ram Creek and Killik Pass stations *en route*. All staff stayed in the NPS bunkhouse at Dahl Creek on July 26, 2016.

Imelyak

Date: July 26, 2016; August 12, 2016

Time of visit: 1530-1630

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual Maintenance

Weather: 55°F, 15-25 mph, partly cloudy

Sensors replaced:

AT (109 probe added)

AT-RH (HMP155 on 8/12/2016)

WS-WD (5103-45 Alpine)

The Imelyak climate station site (Figure 18) was accessed by helicopter from Dahl Creek. The WS-WD sensor had been blown off (detached at the shaft) by wind. The sensor was found damaged 100 meters to the north. A replacement, calibrated WS-WD sensor was installed (5103-45 Alpine model). Two antenna tines were missing. One was replaced, and the second was stripped and cannot be replaced. The lightning rod was detached and re-attached with cable ties. A new AT probe (Campbell 109) was added as the primary sensor. All data were downloaded and a new program (Imelyak2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 104.5 inches. The cumulative rainfall was reset to its observed value of 9.21 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.

Note: During the 7/26/2016 visit, the 14-plate radiation shield was blown apart by wind and missing all of its “gills.” A replacement shield was not available during the July visit. Instead, the AT-RH sensor (HMP155) and shield were replaced while returning from the Noatak RAWs visit on 8/12/2016. All other replacement and maintenance was completed during the 7/26/2016 visit as described above.



Figure 18. Imelyak climate station, July 26, 2016. Upon arrival, the WS-WD sensor (left) and 14-plate radiation shield (middle) were missing. The WS-WD sensor was replaced on 7/26/2016 (right). The radiation shield was replaced on 8/12/2016.

Howard Pass

Date: July 26, 2016

Time of visit: 1700-1800

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual maintenance

Weather: 58°F, 25-30 mph, mostly sunny

Sensors replaced:

AT (109 probe added)

AT-RH (HMP155)

WS-WD (5108 Alpine HD)

ST3

The Howard Pass climate station (Figure 19) was accessed from Dahl Creek by helicopter via Imelyak. The WS-WD sensor was updated with a new 5108 Alpine-HD model. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH sensor (HMP155) was replaced for routine calibration. The ST3 (-75 cm) soil temperature sensor was damaged and replaced. The RG-TB was re-taped. All data were downloaded and a new program (Howard2016.CR1) was sent to the datalogger. The cumulative rainfall was reset to its observed value of 6.01 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 19. Howard Pass climate station, July 26, 2016.

Noatak fire RAWS (1 of 2)

Date: July 26, 2016

Time of visit: 1830-1930

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual Maintenance

Weather: 65°F, calm, mostly sunny

Sensors replaced:

None at this visit (see visit 2 of 2 on August 12)

The Noatak fire RAWS station (Figure 20) was accessed via helicopter. The station has been severely damaged by a bear. Most of the sensors had been damaged. The solar panel was damaged beyond repair and the battery was dead. All replacement sensors were left on site inside the enclosure (RG-TB, AT-RH, SR) for a later re-installation. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 20. Noatak fire RAWS station, July 26, 2016. Clockwise from top: damaged solar panel, damaged sensors, damaged cables, replacement sensors left in enclosure at departure.

Kaluich

Date: July 27, 2016

Time of visit: 1000-1130

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual maintenance

Weather: 50°F, 30-35 mph, partly cloudy

Sensors replaced:

AT (109 probe added)

AT-RH (HMP155)

SR

The Kaluich climate station (Figure 21) was accessed from Dahl Creek by helicopter. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP155) and SR sensors were replaced for routine calibration. The RG-TB was re-taped and a screen was added. All data were downloaded and a new program (Kaluich2016.CR1) was sent to the datalogger. 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 5.38 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 21. Kalaich climate station, July 27, 2016.

Salmon River

Date: July 27, 2016

Time of visit: 1000-1130

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual maintenance

Weather: 55°F, 15-20 mph, mostly cloudy

Sensors replaced:

AT (109 probe added)

AT-RH (HMP155)

The Salmon River station (Figure 22) was accessed from Dahl Creek by helicopter. The station was in good condition upon arrival. A new AT probe (Campbell 109) was added as the primary sensor. The AT-RH (HMP155) was replaced for routine calibration. The RG-TB was re-taped and the hose clamp tightened. All data were downloaded and a new program (SalmonRiver2016.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 84.7 inches. The cumulative rainfall was reset to its observed value of 5.43 inches. The electric fence was

repaired including a replacement of the solar charger and polywire. The NE fence post was on the ground upon arrival, and this occurred in May according to the camera images (unconfirmed bear). The SD card in the phenology camera was exchanged. The grounding wire from the tripod to the datalogger was re-connected (it was not connected upon arrival to the station). The light on the charging regulator was not on, although the power measured at the solar panel seemed ok. After initial connection to the station, computer would no longer connect. So, the charging regulator was replaced and this seemed to solve the connection issues. 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 22. Salmon River climate station, July 27, 2016.

Kavet Creek fire RAWS

Date: July 27, 2016

Time of visit: 1300-1430

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual Maintenance

Weather: 65°F, calm, mostly sunny

Sensors replaced:

AT-RH

RG-TB

The Kavet Creek fire RAWS station (Figure 23) was accessed via helicopter on July 27. Upon arrival, the tipping bucket was out of level and on its side. All data were downloaded from the datalogger. The AT-RH and rain gage (RG-TB) sensors were replaced and leveled for routine calibration. The RG-TB was leveled, tested, and reset. All sensors were scanned and operational. There was some evidence of a bear visit; bite marks on coax cable and mud on the enclosure. The helicopter pilot cleared some brush around the landing zone which will allowed continued safe access for future visits.



Figure 23. Kavet Creek fire RAWS station. Photo from July 27, 2016.

Noatak Fire RAWS (2 of 2)

Date: August 12, 2016

Time of visit: 1230 -1400

Personnel: Ken Hill, Pam Sousanes

Mode of transport: Helicopter from Dahl Creek – N6015S – John Carney

Purpose of trip: Annual Maintenance

Weather: 68°F, 4 mph, clear

Sensors replaced:

Solar Panel

Battery

AT-RH

RG-TB

SR

The Noatak fire RAWS station (Figure 24) was accessed via helicopter. The station was severely damaged by a bear before the first visit in July. Most of the sensors had been damaged, presumably by a bear in early October 2015 and/or in mid-May 2016. The battery and solar panel were replaced. The AT-RH, SR, and RG-TB sensors were replaced. The SDI expansion cable was inoperable and no replacement was available. The soil temperature sensors remain disconnected. *A new SDI expansion needs to be installed during the 2017 maintenance visit.* Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 24. Noatak fire RAWS station, August 12, 2016 showing the damaged SDI expansion port that needs to be replaced at the next site visit (left) and the station after maintenance and repairs (right).

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.

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Appendix A. Base Logistics Summary 2016

Nome Logistics May 31 – June 3, 2016

Pam Sousanes and Ken Hill traveled to Nome on Alaska Airlines, arriving the evening of May 31. All equipment was transported on Alaska Airlines. The radio shop shipped equipment to Nome which was picked up by local staff. A taxi was used for transport from the airport to NPS housing (previously reserved through Nome staff). Sousanes had reserved an NPS vehicle in Nome for the intended dates of travel to Quartz Creek. The morning of June 1, Sousanes and Hill drove to Quartz Creek. The vendor helicopter (R44 – Bering Air – N776BH, Russell Rowe) met Sousanes and Hill at Quartz Creek on June 1. NPS staff stayed at the Quartz Creek DOT cabin, the pilot returned to Nome that evening. Devil Mountain, Midnight Mountain, and Serpentine Hot Springs stations were serviced the afternoon/evening of June 1. Hoodoo Hills RAWS, Ella Creek, and Quartz Creek RAWS were serviced on June 2. High winds and cool temperatures were persistent throughout the trip. Sousanes and Hill drove back to Nome on June 2 and stayed at the NPS bunkhouse. Sousanes and Hill returned to Fairbanks on June 3 via commercial air.

Kotzebue Logistics July 11-15, 2016

Pam Sousanes and Dave Swanson traveled from Fairbanks to Kotzebue on a commercial flight arriving the evening of July 11. All gear was transported on the commercial flight (total of 7 items as checked baggage, \$75 charge). Local staff (expediter Ashley Dow) provided transportation to the BLM bunkhouse, and the I&M cache at the NPS warehouse. The NPS radio shop had shipped fire RAWS equipment to WEAR and the equipment was at the main office with Val Atkinson. The vendor R44 helicopter (Pollux – N4237W – Katrina Halgren) arrived on July 12. The Asik and Kugururok stations were maintained on July 12. Sisiak and Tahinichok were maintained on July 13. Mt. Noak was maintained on July 14. A return trip to Sisiak was also completed on July 14 to replace the solar panel. The solar panel was shipped (Goldstreak) from Fairbanks by Ken Hill on July 13. The helicopter contract was at a wet rate, so the fuel and the helicopter were based at the Bering Air hangar; staff walked to the hangar each day from the bunkhouse. Currently (as of October 2016), an antenna and a fence charger are being stored in the I&M cache (DUMP1 – lock combo) of the Kotzebue warehouse. On July 15, Sousanes and Swanson returned to Fairbanks via Alaska Airlines.

Bettles Logistics July 25-26, 2016

Ken Hill and Pam Sousanes met helicopter N6015S (Temsco/Western area fire helicopter contract) and pilot John Carney at the east ramp temporary parking of Fairbanks International Airport on July 25. John, Ken, and Pam flew from Fairbanks to Bettles with all gear needed for GAAR station maintenance. John Brecher from NBC news also arrived in Bettles on the morning of July 25 via commercial air. All staff visited Chimney and Pamichtuk stations on July 25. Total flight time on July 25 was 3.8 hours (INR-FAI-BTT-Chimney-Pamichtuk-BTT) On July 26, Ken and Pam completed maintenance at Ram Creek and Killik Pass. Instead of returning to Bettles, staff flew directly to Dahl Creek (see below). Fuel was purchased from Brooks Range Aviation.

Dahl Creek Logistics July 26-27, 2016; August 12, 2016

Ken Hill and Pam Sousanes arrived in Dahl Creek the afternoon of July 26 from Killik Pass (see above). Equipment and sensors for scheduled maintenance were previously delivered to Dahl Creek by NPS fleet top cub aircraft (Scott Sample) in mid-July. Howard Pass, Noatak RAWS, and Imelyak station maintenance was completed on July 26. The Noatak RAWS site was severely damaged and left unfinished because the station could not be repaired without a new battery and solar panel. Total flight time on July 26 was 3.8 hours (BTT-Ram Creek-Killik Pass-DCK-Imelyak-Howard Pass-Noatak RAWS-DCK). Staff cooked in the Dahl Creek cabin and slept in tents on July 26. Kaluich, Salmon River, and Kavet Creek RAWS station maintenance was completed on July 27. All staff returned to Fairbanks on July 27 after refueling in Dahl Creek and Bettles. Approximately 210 gallons of JetA was used from the Dahl Creek tank. Total flight time on July 27 was approximately 4.4 hours (DCK-Kaluich-Salmon River-Kavet Creek-DCK-BTT-FAI).

On August 12, Ken Hill and Pam Sousanes returned with John Carney and helicopter N6015S to Noatak RAWS station for repairs. On the return trip, the AT-RH sensor at Imelyak was replaced. The round trip was completed in one day from Fairbanks.

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/HMP 60Temperature 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 I&M Components by Climate Station

Table C1. Metadata for Asik I&M 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	7/12/2016
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	Asik2016	7/12/2016
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	7/12/2016
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	WSWD	5103	6/6/2015

Table C2. Metadata for Chimney Lake I&M climate station.

Station Name	Item	Model	Start Date
Chimney Lake	Antenna	25316 YAGI	8/7/2012
Chimney Lake	AT	109	7/25/2016
Chimney Lake	AT	ThermX	5/27/2013
Chimney Lake	AT-RH	HMP45	7/25/2016
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	Chimney2016	7/25/2016
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	8/7/2012
Chimney Lake	Solar Panel	75 W	8/7/2012
Chimney Lake	SR	Li200x	7/25/2016
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	WSWD	5103	7/1/2015

Table C3. Metadata for Devil Mountain I&M 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	6/1/2016
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	Devil2016	6/1/2016
Devil Mountain	Electric Fence	T-post, poly-wire solar charger	8/23/2012
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	8/6/2013
Devil Mountain	Solar Panel	75 W	8/18/2011
Devil Mountain	SR	Li200x	8/18/2011
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	6/2/2015

Table C4. Metadata for Ella Creek I&M climate station.

Station Name	Item	Model	Start Date
Ella Creek	Antenna	25316 YAGI	8/7/2013
Ella Creek	AT	109	6/2/2016
Ella Creek	AT	ThermX	9/18/2012
Ella Creek	AT-RH	HMP45	6/2/2016
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	Ella2016	6/2/2016
Ella Creek	Enclosure	ENC 16/18	9/18/2012
Ella Creek	GPS	17992 GPS	9/18/2012
Ella Creek	RG-TB	TE525	8/7/2013
Ella Creek	SD	SR50a	8/7/2013
Ella Creek	Solar Panel	75 W	9/18/2012
Ella Creek	SR	Li200x	6/2/2016
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	WSWD	5108-Alpine-HD	6/2/2016

Table C5. Metadata for Howard Pass I&M climate station.

Station Name	Item	Model	Start Date
Howard Pass	Antenna	25316 YAGI	7/7/2011
Howard Pass	AT	109	7/26/2016
Howard Pass	AT	ThermX	7/7/2011
Howard Pass	AT-RH	HMP155	7/26/2016
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	7/7/2011
Howard Pass	DLP	Howard2016	7/26/2016
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	7/20/2015
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	WSWD	5108-Alpine-HD	7/26/2016

Table C6. Metadata for Imelyak I&M 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	8/12/2016
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	Imelyak2016	7/26/2016
Imelyak	Enclosure	ENC 16/18	7/6/2011
Imelyak	GPS	17992 GPS	7/6/2011
Imelyak	RG-TB	TE525	7/6/2011
Imelyak	SD	SR50a	7/6/2011
Imelyak	Solar Panel	75 W	7/6/2011
Imelyak	SR	Li200x	7/20/2015
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	5103-45 Alpine	7/26/2016

Table C7. Metadata for Kaluich I&M 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	7/27/2016
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	Kaluich2016	7/27/2016
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	7/27/2016
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	5103-alpine	7/21/2015

Table C8. Metadata for Killik Pass I&M 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	7/26/2016
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	Killik2016	7/26/2016
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	8/8/2012
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	WSWD	5103	6/24/2015

Table C9. Metadata for Kugururok I&M 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	7/12/2016
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	Kugururok2016	7/12/2016
Kugururok	Enclosure	ENC 16/18	7/18/2014
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	7/12/2016
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	7/18/2014

Table C10. Metadata for Midnight Mountain I&M 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_2013_ThermX_6	8/6/2013
Midnight Mountain	Enclosure	ENC 16/18	7/8/2011
Midnight Mountain	Solar Panel	75 W	7/8/2011
Midnight Mountain	ST -10 cm	ThermX	8/6/2013
Midnight Mountain	ST -20 cm	ThermX	8/6/2013
Midnight Mountain	ST -50 cm	ThermX	8/6/2013
Midnight Mountain	Tripod	CM106	7/8/2011

Table C11. Metadata for Mt. Noak I&M climate station.

Station Name	Item	Model	Start Date
Mt. Noak	Antenna	25316 YAGI	7/11/2011
Mt. Noak	AT	109	7/14/2016
Mt. Noak	AT	ThermX	7/11/2011
Mt. Noak	AT-RH	HMP45	7/14/2016
Mt. Noak	Battery	100 AH (x2)	7/11/2011
Mt. Noak	Camera	CC5MPX	6/29/2013
Mt. Noak	Camera battery/solar panel	12 V - 100 AH/10 W solar panel	6/4/2015
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	Noak2016	7/14/2016
Mt. Noak	Enclosure	ENC 16/18	7/11/2011
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	6/4/2015
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	WSWD	5103	7/15/2014

Table C12. Metadata for Pamichtuk I&M climate station.

Station Name	Item	Model	Start Date
Pamichtuk	Antenna	25316 YAGI	8/6/2012
Pamichtuk	AT	109	7/25/2016
Pamichtuk	AT	ThermX	5/29/2013
Pamichtuk	AT-RH	HMP45	7/25/2016
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	Pamichtuk2016	7/25/2016
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	6/22/2015
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	WSWD	5103	7/25/2016

Table C13. Metadata for Ram Creek I&M climate station.

Station Name	Item	Model	Start Date
Ram Creek	Antenna	25316 YAGI	8/7/2012
Ram Creek	AT	109	7/26/2016
Ram Creek	AT	ThermX	5/28/2013
Ram Creek	AT-RH	HMP45	7/26/2016
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	Ram2016	7/26/2016
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	6/10/2014
Ram Creek	SD	SR50a	8/7/2012
Ram Creek	Solar Panel	75 W	8/7/2012
Ram Creek	SR	Li200x	7/26/2016
Ram Creek	ST -10 cm	107	8/7/2012
Ram Creek	ST -20 cm	107	8/7/2012
Ram Creek	ST -50 cm	107	8/7/2012
Ram Creek	Tripod	CM106	8/7/2012
Ram Creek	TX312	NESDIS ID 3961D29E	6/10/2014
Ram Creek	WSWD	5103	6/10/2014

Table C14. Metadata for Salmon River I&M 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	7/27/2016
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	Salmon2016	7/27/2016
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	6/5/2015
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	WSWD	5103	7/17/2013

Table C15. Metadata for Serpentine I&M climate station.

Station Name	Item	Model	Start Date
Serpentine	Antenna	25316 YAGI	8/18/2011
Serpentine	AT	109	6/1/2016
Serpentine	AT	ThermX	8/18/2011
Serpentine	AT-RH	HMP155	6/1/2016
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	Serpentine2016	6/1/2016
Serpentine	Enclosure	ENC 16/18	8/18/2011
Serpentine	GPS	17992 GPS	8/18/2011
Serpentine	RG-TB	TE525	8/18/2011
Serpentine	SD	SR50a	6/1/2016
Serpentine	Solar Panel	75 W	8/18/2011
Serpentine	SR	Li200x	6/2/2015
Serpentine	ST -10 cm	107	8/18/2011
Serpentine	ST -20 cm	107	8/18/2011
Serpentine	ST -50 cm	107	8/18/2011
Serpentine	Tripod	CM106	8/18/2011
Serpentine	TX312	NESDIS ID 3961C1E8	8/18/2011
Serpentine	WSWD	5103	9/3/2014

Table C16. Metadata for Sisiak I&M climate station.

Station Name	Item	Model	Start Date
Sisiak	Antenna	25316 YAGI	7/13/2011
Sisiak	AT	109	7/13/2016
Sisiak	AT	ThermX	7/13/2011
Sisiak	AT-RH	HMP45	7/13/2016
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	Sisiak2016	7/13/2016
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	7/13/2016
Sisiak	ST -10 cm	107	7/13/2011
Sisiak	ST -20 cm	107	7/13/2011
Sisiak	ST -50 cm	107	7/13/2011
Sisiak	ST -75 cm	107	7/1/2013
Sisiak	Tripod	CM106	7/13/2011
Sisiak	TX312	NESDIS ID 3961548A	7/13/2011
Sisiak	WS/WD	5103	7/18/2014

Table C17. Metadata for Tahinichok I&M climate station.

Station Name	Item	Model	Start Date
Tahinichok	Antenna	25316 YAGI	6/6/2015
Tahinichok	AT	109	7/13/2016
Tahinichok	AT	ThermX	7/10/2011
Tahinichok	AT-RH	HMP45	7/13/2016
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	Tahinichok2016	7/13/2016
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	6/6/2015
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	WSWD	5103	7/15/2014

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