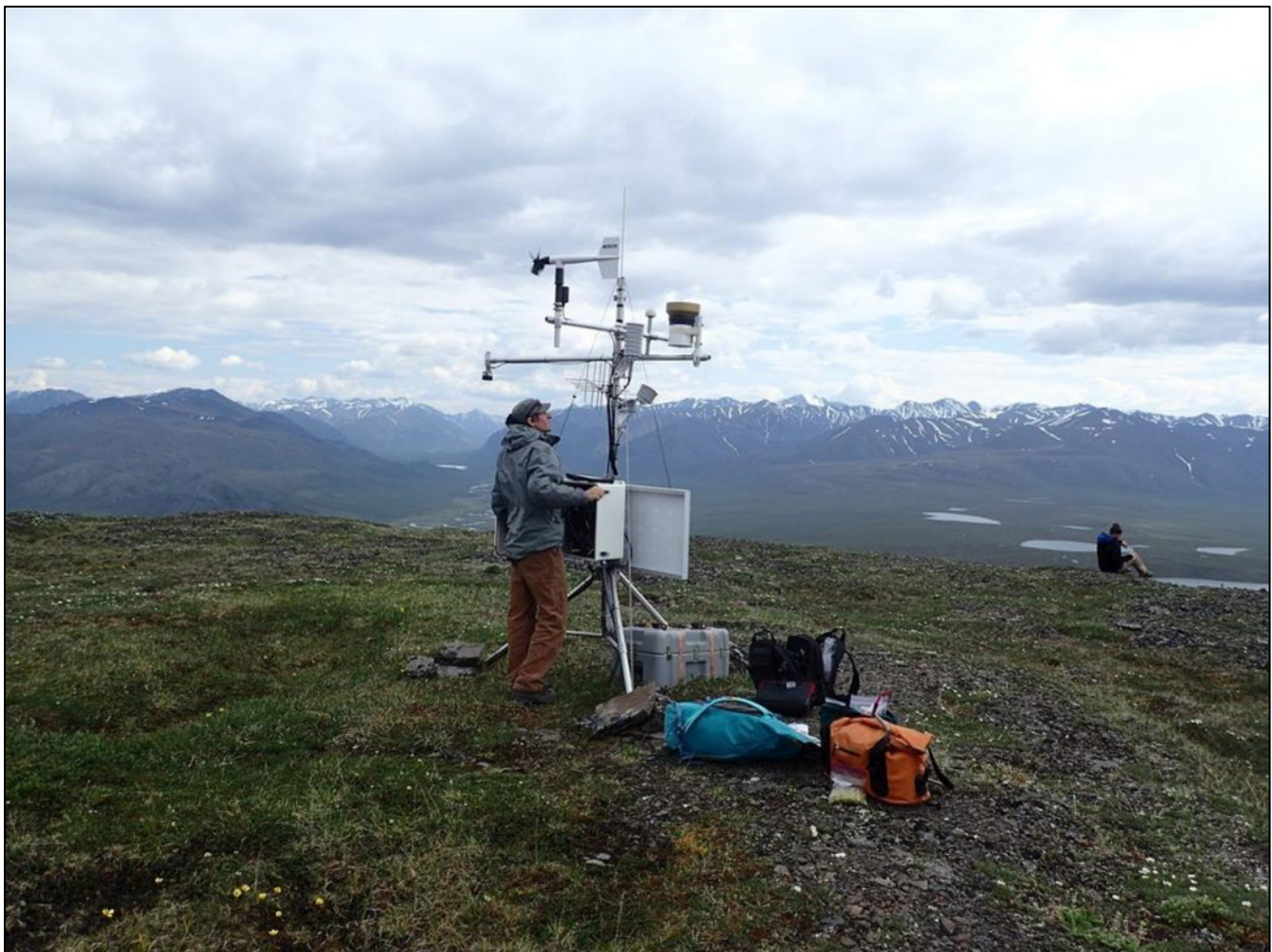




Climate Station Maintenance in the Arctic Network

2017 Summary

Natural Resource Data Series NPS/ARCN/NRDS—2021/1315



ON THE COVER

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

Climate Station Maintenance in the Arctic Network

2017 Summary

Natural Resource Data Series NPS/ARCN/NRDS—2021/1315

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

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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.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Contents

	Page
Figures.....	v
Tables.....	vi
Appendices.....	vii
Abstract.....	viii
Acknowledgments.....	viii
List of Acronyms	ix
Introduction.....	1
Climate Station Maintenance Summaries.....	3
Bettles Base	3
Chimney Lake	3
Pamichtuk Lake.....	4
Ram Creek.....	5
Killik Pass.....	6
Dahl Creek Base.....	7
Imelyak.....	7
Howard Pass	8
Noatak fire RAWS	9
Kaluich	10
Kavet Creek fire RAWS.....	11
Salmon River.....	12
Kotzebue Base.....	13
Sisiak	13
Kugururok	14
Kelly fire RAWS.....	15
Kelly SNOTEL.....	16
Asik	16

Contents (continued)

	Page
Tahinichok.....	17
Mt. Noak.....	18
Nome Base.....	19
Ella Creek.....	19
Hoodoo Hills fire RAWS	20
Midnight Mountain.....	21
Devil Mountain.....	22
Serpentine Hot Springs.....	23
Quartz Creek Fire RAWS.....	24
Literature Cited	26

Figures

	Page
Figure 1. Locations of ARCN climate stations.	1
Figure 2. Chimney Lake climate station, June 27, 2017.	4
Figure 3. Pamichtuk climate station, June 27, 2017.	5
Figure 4. Ram Creek climate station, June 27, 2017.	6
Figure 5. Killik Pass climate station, June 27, 2017.	7
Figure 6. Imelyak climate station, June 27, 2017.	8
Figure 7. Howard Pass climate station, June 28, 2017.	9
Figure 8. Noatak fire RAWS station, June 28, 2017.	10
Figure 9. Kaluich climate station, June 28, 2017.	11
Figure 10. Kavet Creek fire RAWS station.	12
Figure 11. Salmon River climate station, June 28, 2017.	13
Figure 12. Sisiak climate station, July 26, 2017.	14
Figure 13. Kugururok climate station, July 26, 2017.	15
Figure 14. Kelly fire RAWS station, July 26, 2017.	16
Figure 15. Asik climate station before and after maintenance, July 27, 2017.	17
Figure 16. Tahinichok climate station July 27, 2017 shown before and after repairs.	18
Figure 17. Mt. Noak climate station, July 27, 2017.	19
Figure 18. Ella Creek climate station, August 9, 2017 before and after station maintenance.	20
Figure 19. Hoodoo Hills fire RAWS station, August 9, 2017 showing the damaged RG- TB and AT-RH sensors.	21
Figure 20. Midnight Mountain climate station, August 10, 2017.	22
Figure 21. Devil Mountain climate station, August 10, 2017.	23
Figure 22. Serpentine climate station on July 3, 2017 and August 10, 2017.	24
Figure 23. Quartz Creek fire RAWS station, August 10, 2017.	25

Tables

	Page
Table 1. Locations of ARCN climate stations maintained in 2017 field season.	2
Table B1. Sensor specifications.	29
Table B2. Datalogger specifications.	29
Table B3. Satellite communication specifications.	29
Table B4. Power specifications.	30
Table B5. Hardware specifications.	30
Table B6. Electric fence specifications.	30
Table C1. Metadata for Asik climate station.	31
Table C2. Metadata for Chimney Lake climate station.	32
Table C3. Metadata for Devil Mountain climate station.	33
Table C4. Metadata for Ella Creek climate station.	34
Table C5. Metadata for Howard Pass climate station.	35
Table C6. Metadata for Imelyak climate station.	36
Table C7. Metadata for Kaluich climate station.	37
Table C8. Metadata for Killik Pass climate station.	38
Table C9. Metadata for Kugururok climate station.	39
Table C10. Metadata for Midnight Mountain climate station.	40
Table C11. Metadata for Mt. Noak climate station.	41
Table C12. Metadata for Pamichtuk climate station.	42
Table C13. Metadata for Ram Creek climate station.	43
Table C14. Metadata for Salmon River climate station.	44
Table C15. Metadata for Serpentine climate station.	45
Table C16. Metadata for Sisiak climate station.	46
Table C17. Metadata for Tahinichok climate station.	47

Appendices

	Page
Appendix A. Base Logistics Summary 2017	27
Appendix B. ARCN I&M Station Specifications	29
Appendix C. ARCN RAWs Components by Climate Station	31

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 2017 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, Tide Smid, Rick Dolan, Patrik Toerdal) and aviation staff (Alaska Regional Communication Center and Dave Rosser).

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 2017 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, five fire RAWS and one SNOTEL station.

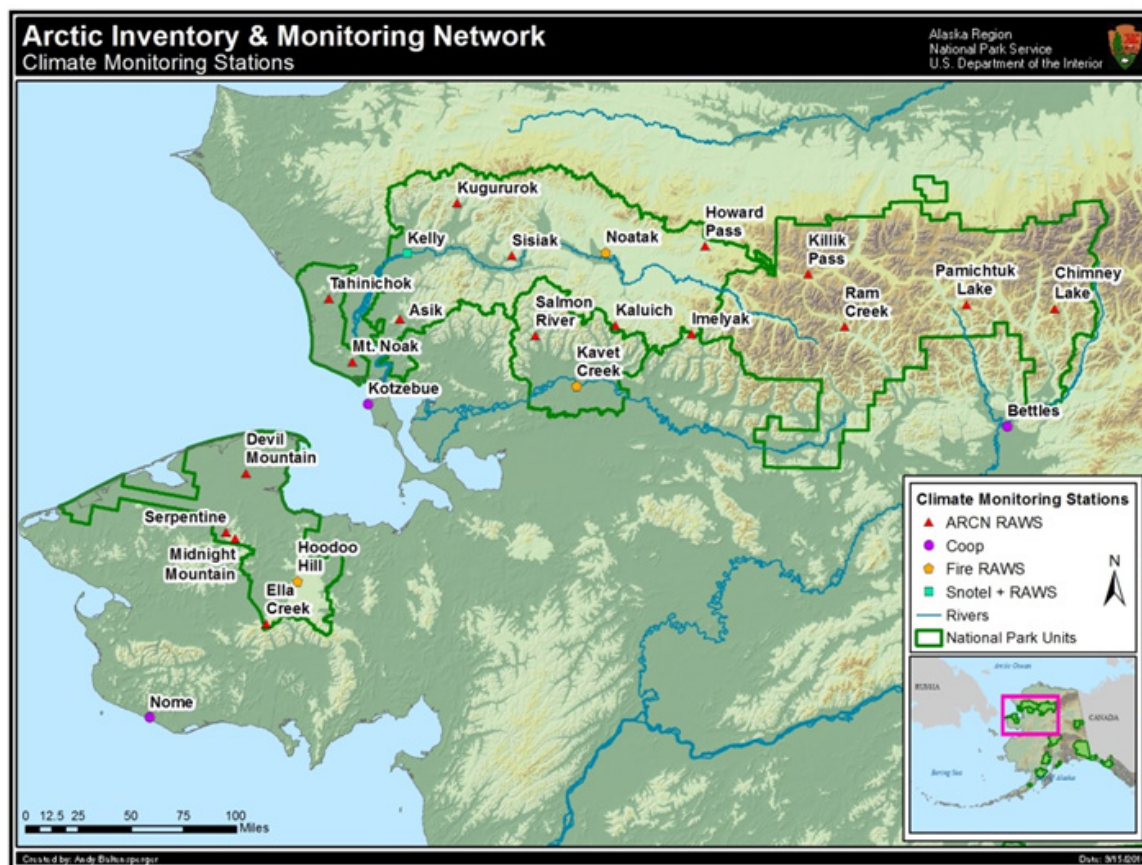


Figure 1. Locations of ARCN climate stations.

Table 1. Locations of ARCN climate stations maintained in 2017 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 ARCEN organized by base locations. This work is being implemented based on the Central Alaska Network (CANK) climate monitoring protocol (Sousanes 2018) and the ARCEN weather and climate 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.

Bettles Base

ARCEN climate 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 the Bettles and Dahl Creek field trips in 2017. Hill and Sousanes flew with all equipment from Fairbanks via helicopter (N6015S). All personnel were housed at the NPS/FWS bunkhouse while in Bettles. After maintenance at Killik Pass, staff transitioned directly to Dahl Creek for station visits in eastern NOAT and KOVA.

Chimney Lake

Date: June 27, 2017

Time of visit: 0930–1030

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 54°F, 5–10 mph, partly cloudy

Sensors replaced:

AT-RH (HMP45)

The Chimney Lake station (Figure 2) was accessed by helicopter from Bettles. The station was in good condition. All data were downloaded from the datalogger. The AT-RH sensor was replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. Replaced damaged 14-plate radiation shield with new 10-plate radiation shield. A new datalogger program (Chimney2017.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 2.35 inches. The electric fence was in good condition and maintained 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 2. Chimney Lake climate station, June 27, 2017.

Pamichtuk Lake

Date: June 27, 2017

Time of visit: 1100–1230

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 62°F, 5–10 mph, partly cloudy

Sensors replaced:

AT-RH (HMP45)

SR

The Pamichtuk Lake station (Figure 3) 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 SR sensors were replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. A new datalogger program (Pamichtuk2017.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 80.5 inches. The cumulative rainfall was reset to its observed value of 1.66 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.

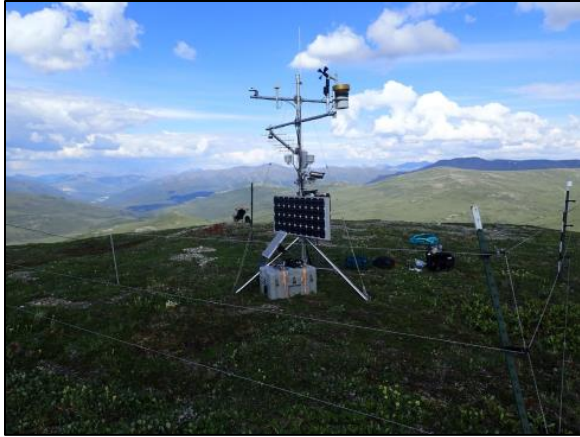


Figure 3. Pamichtuk climate station, June 27, 2017.

Ram Creek

Date: June 27, 2017

Time of visit: 1445–1540

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 56°F, 15–20 mph, mostly cloudy

Sensors replaced:

AT-RH (HMP45)

SR

Ram Creek climate station (Figure 4) was accessed by helicopter from Bettles. All data were downloaded from the datalogger. The AT-RH and WS-WD sensors were replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. A new datalogger program (Ram2017.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 1.07 inches. One guy wire was tightened. The polywire on the electric fence was tightened. 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 4. Ram Creek climate station, June 27, 2017.

Killik Pass

Date: June 27, 2017

Time of visit: 1200–1400

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 55°F, 10–15 mph, mostly cloudy

Sensors replaced:

AT-RH (HMP45)

Killik Pass climate station (Figure 5) was accessed by helicopter from Bettles via Ram Creek. All data were downloaded from the datalogger. The AT-RH sensor was replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. A new datalogger program (Killik2017.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 77 inches. The cumulative rainfall was reset to its observed value of 1.73 inches. The declination of the antenna was adjusted. 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 5. Killik Pass climate station, June 27, 2017.

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: 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 2017. 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.

Imelyak

Date: June 27, 2017

Time of visit: 1750–1830

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 53°F, 8–20 mph, showers

Sensors replaced:

AT-RH (HMP155)

SR

The Imelyak climate station site (Figure 6) was accessed by helicopter from Bettles via Ram Creek and Killik Pass. All data were downloaded and a new program (Imelyak2017.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 2.73 inches. Two antenna tines were missing from the YAGI antenna and replaced. A rubber gasket was added to the RG-TB funnel. The AT-RH sensor was sealed with mastic tape. There was limited evidence of wildlife: hair on the station and soil temperature sensor cables pulled out of the box, but undamaged. 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. Imelyak climate station, June 27, 2017.

Howard Pass

Date: June 28, 2017

Time of visit: 0945–1045

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual maintenance

Weather: 55°F, 5–15 mph, cloudy

Sensors replaced:

AT-RH (HMP155)

SR

The Howard Pass climate station (Figure 7) was accessed from Dahl Creek by helicopter. The AT-RH and SR sensors were replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. All data were downloaded and a new program (Howard2017.CR1) was sent to the datalogger. The cumulative rainfall was reset to its observed value of 1.37 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 7. Howard Pass climate station, June 28, 2017.

Noatak fire RAWS

Date: June 28, 2017

Time of visit: 1100–1400

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 60°F, 15–20 mph, showers

Sensors replaced:

AT-RH

WS-WD

The Noatak fire RAWS station (Figure 8) was accessed via helicopter. The AT-RH and WS-WD sensors were replaced for routine calibration. All data were downloaded from the datalogger. The cumulative rainfall was not reset. The 20 cm soil temperature sensor was repaired. The 10 cm and 50 cm soil temperature sensors were not able to be repaired and no extra sensors were available for replacement. *These two soil temperature sensors should be reinstalled at the next field visit.* Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 8. Noatak fire RAWS station, June 28, 2017.

Kaluich

Date: June 28, 2017

Time of visit: 1505–1535

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual maintenance

Weather: 51°F, 25–30 mph, showers

Sensors replaced:

AT-RH (HMP155)

The Kaluich climate station (Figure 9) was accessed by helicopter. The AT-RH sensor was replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. All data were downloaded and a new program (Kaluich2017.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 1.80 inches. The desiccant packets were replaced in the enclosure. A sow and two cubs were seen downhill and west from the station. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 9. Kaluich climate station, June 28, 2017.

Kavet Creek fire RAWS

Date: June 28, 2017

Time of visit: 1700–1830

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 63°F, 5–10 mph, mostly cloudy

Sensors replaced:

AT-RH

WS-WD

SR

The Kavet Creek fire RAWS station (Figure 10) was accessed via helicopter. All data were downloaded from the datalogger. The AT-RH, WS-WD, and SR sensors were replaced and releveled 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 10. Kavet Creek fire RAWS station. Photo from June 28, 2017.

Salmon River

Date: June 28, 2017

Time of visit: 1850–2010

Personnel: Ken Hill, Pam Sousanes

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual maintenance

Weather: 55°F, 10–20 mph, mostly cloudy

Sensors replaced:

AT-RH (HMP155)

WS-WD

SR

The Salmon River station (Figure 11) was accessed by helicopter. The station was in good condition upon arrival. The AT-RH, WS-WD, and SR sensors were replaced for routine calibration. A rubber gasket was added to the RG-TB funnel. All data were downloaded and a new program (SalmonRiver2017.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 2.12 inches. The electric fence was repaired by tightening the polywire. The SD card in the phenology camera was exchanged. The AT-RH radiation shield was tightened. One tine from the YAGI antenna was replaced. The ground wire from the tripod to the enclosure was re-secured. 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 11. Salmon River climate station, June 28, 2017.

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 and fire ecology staff flew by Alaska Fire Service charter from Fairbanks to Kotzebue. The Western Area Fire contract A-star helicopter (N6015S) was used to access the sites. The two groups (climate and fire ecology) shared the Temsco helicopter for project work and based out of Kelly Ranger Station. Four 50-gallon fuel drums were transported by Golden Eagle aviation from Kotzebue to Kelly bar in advance of the project. NRCS SNOTEL staff accessed the Kelly River site with fixed wing aircraft flown by NPS fleet (C-185 on wheels). All staff camped at Kelly Ranger station while in the field and stayed at the NPS bunkhouse while in transit to/from Kotzebue.

Sisiak

Date: July 26, 2017

Time of visit: 1130–1430

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 54°F, 10–15 mph winds, clear

Sensors Replaced:

AT-RH (HMP45)

WS-WD

ST1 (replaced)

ST3 (repaired)

RG-TB

The Sisiak station (Figure 12) was accessed from Kelly Ranger Station by helicopter. The station had been damaged, presumably by a bear. The station was not transmitting on arrival. The mast was bent slightly. The soil temperature sensors were damaged. The SD cable was damaged and the RG-TB

was detached and hanging from the crossbar. The YAGI antenna was damaged, missing most tines, and was out of alignment. Some guy wires were loose. The tripod, mast, and all sensors were leveled by adjusting the tripod legs. The ST1 10 cm soil temperature sensor was replaced. The ST2 20 cm soil temperature sensor was okay. The ST3 50 cm soil temperature sensor was repaired by splicing. The ST4 75 cm soil temperature sensor was removed. The RG-TB was replaced and a rubber gasket was added to the funnel. The AT-RH and WS-WD sensors were replaced for routine calibration. All data were downloaded and a new program (Sisiak2017.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 82.2 inches. The cumulative rainfall was reset to 0.00 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.

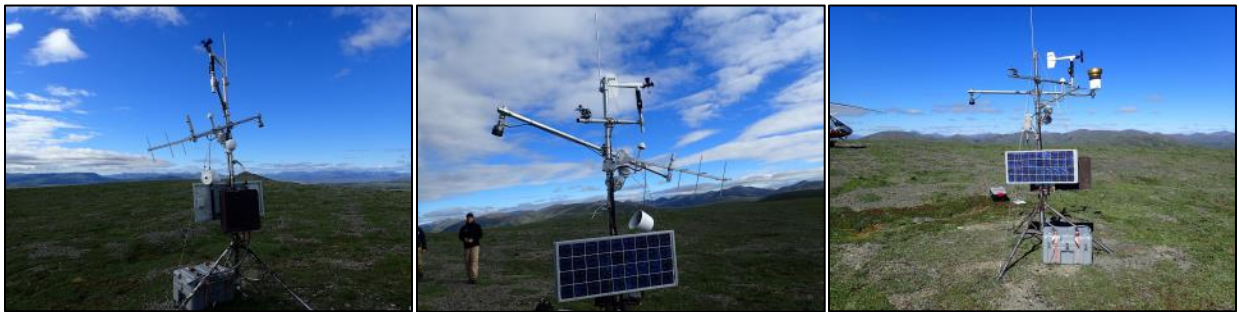


Figure 12. Sisiak climate station, July 26, 2017. Upon arrival at the site the tripod was out of level, the tipping bucket was dangling, and some sensors were damaged (left, middle). Site after maintenance (right).

Kugururok

Date: July 26, 2017

Time of visit: 1550–1700

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 64°F, 5–10 mph winds, clear

Sensors Replaced:

AT-RH (HMP45)

WS-WD

The Kugururok station (Figure 13) was accessed from Kelly Ranger Station. The AT-RH (HMP45) and WS-WD sensors were replaced for routine calibration. All data were downloaded and a new program (Kugururok2017.CR1) was sent to the datalogger. The height of the snow depth sensor was entered into the public table at 81 inches. The cumulative rainfall was reset to its observed value of 4.71 inches. The desiccant packets were replaced in the enclosure. The guy wires were tightened. A rubber gasket was added to the RG-TB funnel. The SD card in the CC5MPX digital camera was exchanged. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. Two bears were seen near the site (sow and cub).

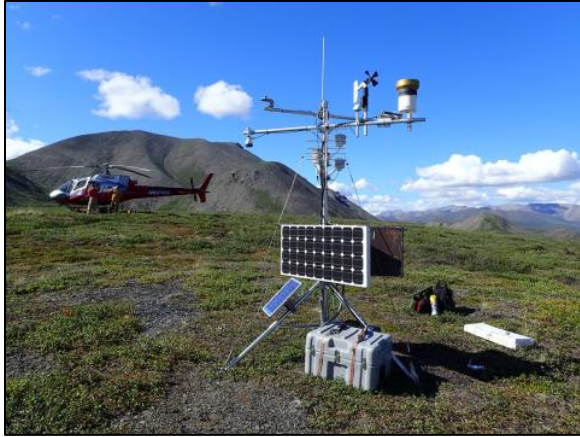


Figure 13. Kugururok climate station, July 26, 2017.

Kelly fire RAWS

Date: July 26, 2017

Time of visit: 1800–1900

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual maintenance

Weather: 70°F, Light winds, clear

Sensors replaced:

AT-RH

SR

WS-WD

The Kelly fire RAWS station (Figure 14) was accessed via helicopter. The landing zone was brushed, but could use additional brushing in the next few years. The station looked good upon arrival. The AT-RH, WS-WD, and SR sensors were 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.

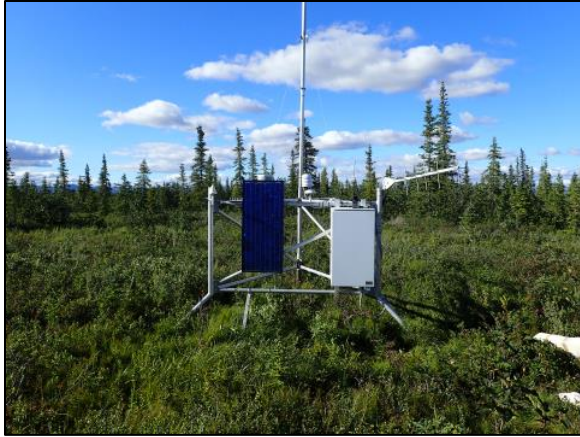


Figure 14. Kelly fire RAWS station, July 26, 2017.

Kelly SNOTEL

Date: July 27, 2017

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 27. 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. Four five-gallon containers of fluid are stored in the locked shelter on site for future visits.

Asik

Date: July 27, 2017

Time of visit: 1120–1330

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual maintenance

Weather: 58°F, 10–15 mph winds, mostly sunny

Sensors replaced:

AT-RH (HMP45)

The Asik station (Figure 15) was accessed from Kelly Ranger Station by helicopter. The station had been damaged by a bear. The solar panel and enclosure had been twisted 45 degrees, both crossarms were out of level, the solar panel cables were disconnected, and the soil temperature sensors were disturbed. The AT-RH (HMP45) sensor was replaced for routine calibration. The soil temperature sensors were repaired and reinstalled. The solar panel charging cable was reconnected. All data were

downloaded and a new program (Asik2017.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 0.00 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 15. Asik climate station before (left) and after (right) maintenance, July 27, 2017.

Tahinichok

Date: July 27, 2017

Time of visit: 1300–1600

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 60°F, 15–20 mph winds, cloudy

Sensors Replaced:

AT-RH (HMP45)

SD

The Tahinichok station (Figure 16) was accessed from Kelly Ranger Station by helicopter. The station had some damage: three electric fence posts were bent, the YAGI antenna was missing most tines and was out of alignment, the solar panel and enclosure were twisted out of alignment, the lower crossarm was out of level (upper crossarm was ok), the AT ThermX sensor was damaged, the AT-RH sensor was destroyed, and the SD sensor cable was damaged. The AT-RH, WS-WD, and SR sensors were replaced for routine calibration. The HMP45 6-wire cable was replaced with a 7-wire cable. The SR50a snow depth sensor cable was replaced. The ThermX air temperature sensor was replaced. The lower crossarm holding the snow depth and tipping bucket sensors was releveled. All data were downloaded and a new program (Tahinichok2017.CR1) was sent to the datalogger. The height of the snow depth sensor height was measured and entered into the public table at 80.5 inches. The cumulative rainfall was reset to 0.00 inches. The electric fence was repaired and the polywire was replaced. The antenna was realigned and damaged tines 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.

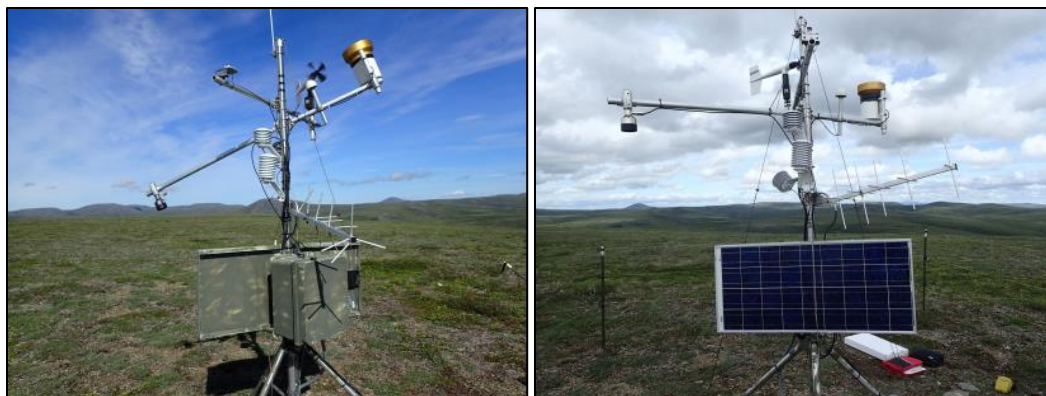


Figure 16. Tahinichok climate station July 27, 2017 shown before (left) and after (right) repairs.

Mt. Noak

Date: July 27, 2017

Time of visit: 1620–1900

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N6015S – Tide Smid

Purpose of trip: Annual Maintenance

Weather: 62°F, 15–20 mph winds, showers

Sensors Replaced:

AT-RH (HMP45)

WS-WD

SR

The Mt. Noak station (Figure 13) was accessed from Kelly Ranger Station by helicopter. The station had been damaged by wildlife. The lower crossarm (RG-TB, SD, Camera) was out of level, the RG-TB was dangling, and the WS-WD had been knocked off the station and was destroyed. The shield for the ThermX sensor is bent. Two antenna tines were missing from the Yagi antenna and were replaced. The AT-RH, WS-WD- and SR sensors were replaced for routine calibration. All data were downloaded and a new program (Noak2017.CR1) was sent to the datalogger. The crossarms and sensors were releveled. The height of the snow depth sensor was entered into the public table at 77.4 inches. The cumulative rainfall was reset to 0.00 inches. The desiccant packets were replaced in the enclosure. The external 100 amp-hour battery for the CC5MPX phenology camera was drained to 4.0 V. The battery was removed from the site and needs to be replaced at the next field visit. The camera casing was corroded and the cover could not be removed in the field. Therefore, the camera was replaced and reinstalled on the top of the mast instead of the crossarm. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



Figure 17. Mt. Noak climate station, July 27, 2017. Pre-visit station damage is shown (left). A new phenology camera was installed at the site (middle). Photo after maintenance (right).

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 via commercial airline to Nome and based out of Nome and Quartz Creek for the station maintenance. A Bering Air Hughes MD500 helicopter was used to reach the site locations from Quartz Creek. Staff stayed at the NPS bunkhouse in Nome and camped on the airstrip at Quartz Creek. An NPS vehicle was used for transport to Quartz Creek and within Nome.

Ella Creek

Date: August 9, 2017

Time of visit: 1340–1530

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: Hughes MD500 helicopter – Bering Air – N907BH – Patrik Toerdal

Purpose of trip: Annual Maintenance

Weather: 57°F, 5–10 mph winds, showers

Sensors replaced:

AT-RH (HMP45)

RG-TB

The Ella Creek station (Figure 18) was accessed from Quartz Creek by helicopter. The station had been damaged, presumably by icing. The station had not transmitted since May 12. The AT-RH (HMP45) sensor was replaced for routine calibration. The YAGI antenna, coax cable, RG-TB, and SR50a cable were damaged and replaced. The AT-RH radiation shield (new 2016) was damaged again for the second continuous year and should be replaced at the next field visit. Dave Swanson completed a soil profile and vegetation classification at the site. A rubber gasket was added to the new RG-TB funnel. All data were downloaded and a new program (Ella2017.CR1) was sent to the datalogger. The height of the snow depth sensor was measured and entered into the public table at 74 inches. The cumulative rainfall was reset to 0.00 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 18. Ella Creek climate station, August 9, 2017 before (left) and after (right) station maintenance.

Hoodoo Hills fire RAWS

Date: August 9, 2017

Time of visit: 1600–1800

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: Hughes MD500 helicopter – Bering Air –N907BH – Patrik Toerdal

Purpose of trip: Annual Maintenance

Weather: 65°F, 5–10 mph winds, mostly sunny

Sensors replaced:

AT-RH

RG-TB

SR

WS-WD

The Hoodoo Hills fire RAWS station (Figure 19) was accessed via helicopter from Quartz Creek. Upon arrival the RG-TB was knocked off the base and the AT-RH sensor was broken. The RG-TB, AT-RH, and SR sensors were replaced. The electric fence was repaired and the polywire was replaced. Dave Swanson completed a soil profile and vegetation classification at the site. Two old batteries were backhauled to Nome and recycled. 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 19. Hoodoo Hills fire RAWS station, August 9, 2017 showing the damaged RG-TB (left) and AT-RH sensors (middle). The right photo shows the site after repairs and maintenance.

Midnight Mountain

Date: August 9, 2017

Time of visit: 0930–1030

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: Hughes MD500 helicopter – Bering Air – N907BH – Patrik Toerdal

Purpose of trip: Annual Maintenance

Weather: 50°F, Light winds

Sensors replaced/repared:

100 aH battery replaced with 12V internal battery

Soil temperature sensors (removed)

CR1000

Midnight Mountain (Figure 20) was accessed by helicopter from Quartz Creek. Because of heavy rime ice buildup in winter months, only air temperature is measured at this site and data are not transmitted. Upon arrival at the site, the soil temperature sensors had all been damaged and the external battery cable was severed. The soil sensors were all removed due to excessive damage on multiple visits. All data were downloaded from the datalogger. The internal lithium battery on the CR1000 datalogger was only reading 1.5 volts. The datalogger was replaced. The 100 aH external battery was removed from the site and replaced with a small, internal battery. The external battery enclosure was also removed. Dave Swanson did not do a soil profile at the site since the soil sensors were being removed. A new program was sent to the datalogger (Midnight_2017_ThermX_Air.CR1). Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *During the next field visit, it is advised to reconfigure the station with a 10 watt solar panel with multiple u-bolt connections.*



Figure 20. Midnight Mountain climate station, August 10, 2017.

Devil Mountain

Date: August 10, 2017

Time of visit: 1130–1330

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: Hughes MD500 helicopter – Bering Air – N907BH – Patrik Toerdal

Weather: 52°F, 5–10 mph winds

Sensors replaced:

AT-RH

SR

The Devil Mountain station (Figure 21) was accessed from Quartz Creek by helicopter. The AT-RH (HMP45) and SR sensors were replaced for routine calibration. There was some corrosion on the coax cable, nuts, and snow depth sensor mounts. The snow depth sensor was not returning a distance and was replaced. Mastic tape was added to the bottom of the AT-RH sensor to prevent corrosion. A few antenna tines were missing and were replaced. The polywire on the electric fence was missing upon arrival. The polywire was replaced and the fence was repaired. The electric fence charger was placed on the ground due to a broken plastic mount. Dave Swanson completed a soil profile and vegetation classification at the site. All data were downloaded and a new program (Devil2017.CR1) was sent to the datalogger. The height of the snow depth sensor was measured and entered into the public table at 84 inches. A rubber gasket was added to the tipping bucket funnel. 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. Devil Mountain climate station, August 10, 2017.

Serpentine Hot Springs

Date: August 10, 2017

Time of visit: 1445–1700

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: Hughes MD500 helicopter – Bering Air – N907BH – Patrik Toerdal

Purpose of trip: Annual Maintenance

Weather: 65°F, 10–15 mph winds

Sensors replaced:

AT-RH (HMP155)

SR

WS-WD

The Serpentine station (Figure 22) was accessed from Quartz Creek by helicopter. Based on interpretations from data and field validation by Matt Nolan, the station blew over on October 30, 2016. Nolan visited Serpentine Hot Springs on July 3, 2017 and righted the station. Nolan notified NPS after the August 10 site visit. On arrival at the site on August 10, the wind sensor was damaged causing the station to shake violently. The tipping bucket was out of level and missing the funnel. Many antenna elements were missing. The cable for the phenology camera was sheared off. The soil sensors were lying on top of the ground (10 cm was on the surface, 50 cm was jacked out to 30 cm depth). The AT-RH (HMP155), SR (Li200x), and WS-WD (05103) sensors were replaced for routine calibration. The tipping bucket was repaired, leveled, and a rubber gasket was added. The camera cable and the dessicant in the camera was replaced and the camera was realigned. The soil temperature sensors were reinstalled to proper depths at 10, 20, and 50 cm below the surface. The lightning rod was sheared off and not replaced. Dave Swanson completed a soil profile and vegetation classification at the site. All data were downloaded and a new program (Serpentine2017.CR1) was sent to the datalogger. The height of the snow depth sensor was measured and entered into the public table at 88 inches. The cumulative rainfall was reset to 2.06 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. *A new YAGI antenna should be installed during the next field visit. The station tripod should be anchored with rocks and pegs.*



Figure 22. Serpentine climate station on July 3, 2017 (upper left; photo Matt Nolan) and August 10, 2017. The upper right photo shows the station before repairs, the lower left photo shows the soil temperature sensors as found before reinstallation on August 10. The bottom right photo shows the station after repairs and annual maintenance.

Quartz Creek Fire RAWS

Date: August 10, 2017

Time of visit: 1800–2000

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: NPS vehicle

Purpose of trip: Annual Maintenance

Weather: 60°F, 10–15 mph winds, showers

Sensors replaced:

AT-RH

RG-TB
WS-WD
Datalogger
Transmitter

The Quartz Creek fire RAWS station (Figure 23) was accessed from the airstrip. The station looked good upon arrival. All data were downloaded from the datalogger. The AT-RH, RG-TB, and WS-WD sensors were replaced for routine calibration. The 12S datalogger and G5 transmitter were replaced with a new F6 model (combination datalogger and transmitter). All sensors were scanned and functioning. All bolts and guy wires were tightened.



Figure 23. Quartz Creek fire RAWS station, August 10, 2017.

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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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 2017

Bettles and Dahl Creek Logistics June 26–29, 2017

Ken Hill and Pam Sousanes met helicopter N6015S (Temsco/Western area fire helicopter contract) and pilot Tide Smid at the east ramp temporary parking of Fairbanks International Airport on June 26. Tide, Ken, and Pam flew from Fairbanks to Bettles with all gear needed for station maintenance. All staff visited Chimney, Pamichtuk, Ram Creek, Killik Pass, and Imelyak stations on June 27. On June 28, Ken and Pam completed maintenance at Howard Pass, Noatak fire RAWS, Kaluich, Kavet Creek, and Salmon River. All staff returned to Fairbanks on June 29. Fuel was purchased/attained from Brooks Range Aviation in Bettles and from the NPS Jet-A tank at Dahl Creek. The Jet-A tank had been filled in September of 2016 with ARCN climate funds.

Kotzebue Logistics July 24–28, 2017

Ken Hill and NPS fire ecology staff traveled from Fairbanks to Kotzebue on an Alaska Fire Service chartered flight arriving midday July 24. All gear, including fire RAWS equipment was transported on the charter flight. A NPS vehicle was parked at the hangar for use, and arranged in advance. Hill visited the I&M cache at the NPS warehouse. The helicopter (Temsco – N6015S – Tide Smid) arrived from Denali with helicopter manager Ryan Tucker on July 24. Weather delayed departure from Kotzebue until the evening of July 25. Hill, and Tucker traveled from Kotzebue to Kelly Ranger Station on July 25. The rest of the fire ecology crew traveled by fixed wing charter with Golden Eagle aviation. Four 50-gallon Jet-A barrels were transported earlier in the week by Golden Eagle to Kelly bar. On July 26, NRCS staff (DeMarco) arrived by NPS fleet fixed wing for maintenance at Kelly SNOTEL. The maintenance was completed as a day trip. Hill maintained ARCN climate stations at Sisiak and Kugururok while the fire ecology staff worked near the Noatak River. The Kelly fire RAWS was also maintained the evening of July 26. On July 27, Hill maintained ARCN climate stations at Asik, Tahinichok, and Mt. Noak before returning to Kotzebue. Hill returned to Fairbanks by commercial service on July 28. One electric fence charger and one dead battery are being stored at the I&M cache (DUMPI – lock combo) at the NPS Kotzebue warehouse. The battery needs to be disposed of during the next visit to Kotzebue.

Nome Logistics August 8–11, 2017

Pam Sousanes and Dave Swanson traveled to Nome on Alaska Airlines, arriving the evening of August 8. All equipment was transported on Alaska Airlines. The radio shop shipped equipment to Nome which was stored at the NPS warehouse. Mick from the maintenance staff picked up Pam and Dave from the airport and brought them 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 August 9, Sousanes and Swanson drove to Quartz Creek. Two 55-gallon drums of Jet A were transported to Quartz Creek from Bering Air. The vendor helicopter (Hughes MD500– Bering Air – N907BH, Patrik Toerdal) met Sousanes and Swanson at Quartz Creek on August 9. NPS staff camped on the airstrip. Ella Creek and the Hoodoo Hill stations were serviced the afternoon/evening of August 9. Devil Mountain, Midnight Mountain, Serpentine Hot Springs, and Quartz Creek were serviced on August 10. Sousanes and Swanson drove back to Nome on August 10 and stayed at the

NPS bunkhouse. Sousanes and Swanson returned to Fairbanks on August 11 via commercial air. Two electric fence chargers and one 12-volt battery are stored in 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/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 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	7/27/2017
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	7/12/2016
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	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	6/27/2017
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	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	WS/WD	5103	7/1/2015

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	8/10/2017
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	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	8/10/2017
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	6/2/2015

Table C4. Metadata for Ella Creek climate station.

Station Name	Item	Model	Start Date
Ella Creek	Antenna	25316 YAGI	8/9/2017
Ella Creek	AT	109	6/2/2016
Ella Creek	AT	ThermX	9/18/2012
Ella Creek	AT-RH	HMP45	8/9/2017
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	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	8/9/2017
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	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	7/7/2011
Howard Pass	AT	109	7/26/2016
Howard Pass	AT	ThermX	7/7/2011
Howard Pass	AT-RH	HMP155	6/28/2017
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	Howard2017	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	6/28/2017
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	7/26/2016

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	6/27/2017
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	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	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	5103-45 Alpine	7/26/2016

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	6/28/2017
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	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 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	6/27/2017
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	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	WS/WD	5103	6/24/2015

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	7/26/2017
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	7/12/2016
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	7/26/2017

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	7/11/2011
Mt. Noak	AT	109	7/14/2016
Mt. Noak	AT	ThermX	7/11/2011
Mt. Noak	AT-RH	HMP45	7/27/2017
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	7/14/2016
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	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	6/27/2017
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	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	6/27/2017
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	7/26/2016
Ram Creek	AT	ThermX	5/28/2013
Ram Creek	AT-RH	HMP45	6/27/2017
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	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	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	6/28/2017
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	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	6/28/2017
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	8/18/2011
Serpentine	AT	109	6/1/2016
Serpentine	AT	ThermX	8/18/2011
Serpentine	AT-RH	HMP155	8/10/2017
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	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	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	7/26/2017
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	7/13/2016
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	7/26/2017
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	7/27/2017
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	7/13/2016
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	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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