National Park Service
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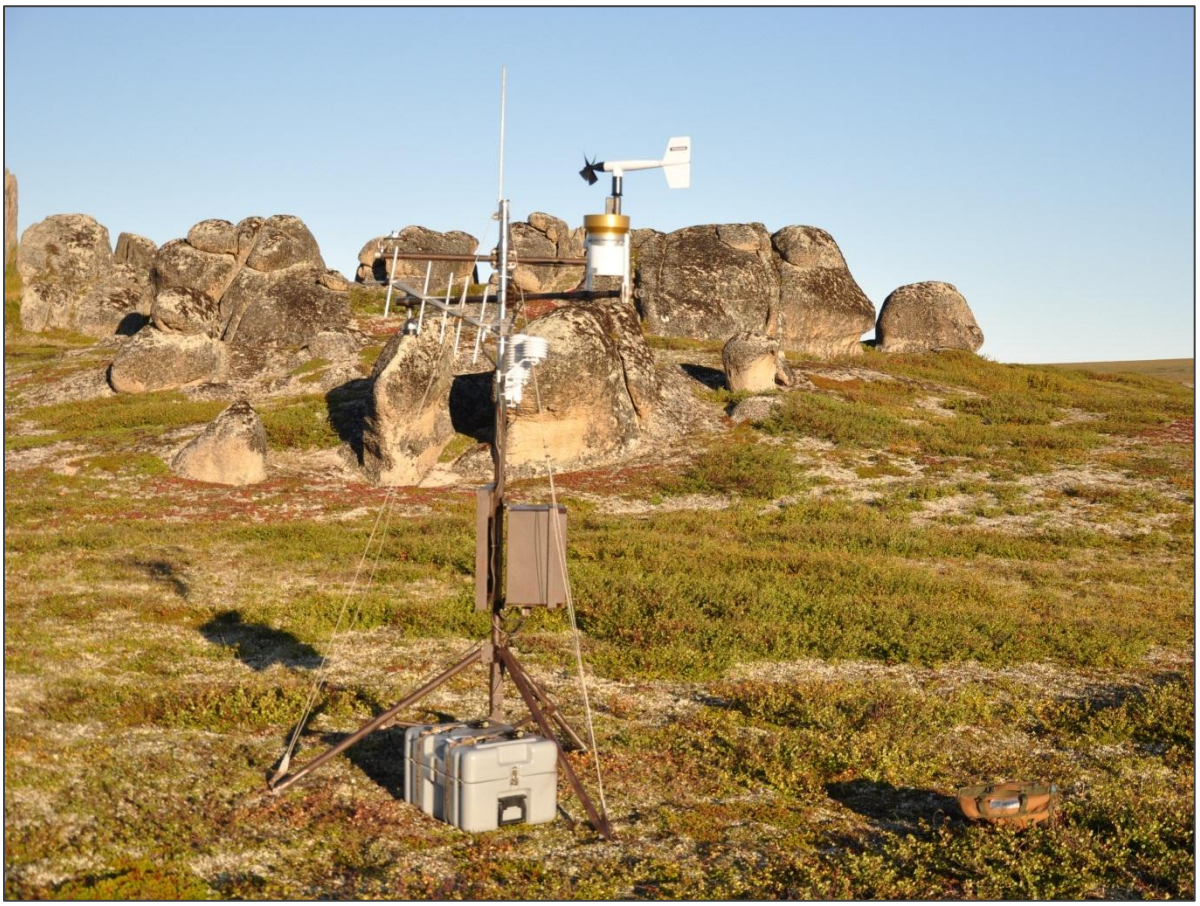
Natural Resource Stewardship and Science

Climate and Snowpack Monitoring Progress Report 2011

Arctic Network

Natural Resource Data Series NPS/ARCN/NRDS—2013/459



ON THE COVER
Climate Station near Serpentine Hot Springs in Bering Land Bridge National Preserve
Photograph by: NPS photo by Pam Sousanes

Climate and Snowpack Monitoring Progress Report 2011

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Natural Resource Data Series NPS/ARCN/NRDS—2013/459

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Natural Resource Stewardship and Science
Fort Collins, Colorado

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

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

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. 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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This report is available from the Arctic Inventory and Monitoring Network's Climate Vital Signs webpage (http://science.nature.nps.gov/im/units/arcn/index.cfm?rq=12&vsid=5) under the 'Documents' tab and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/).

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Abstract

The intent of this report is to briefly describe the progress of the climate and snowpack vital signs for the Arctic Network (ARCN). The objective of the climate monitoring vital sign is to monitor and record weather conditions at representative locations in order to identify long and short-term trends, provide reliable climate data to other researchers, and to participate in larger scale climate monitoring and modeling efforts beyond park boundaries. The objective of the snowpack vital sign is to determine long-term trends and variability in snow depth, phenology, and distribution in ARCN parks and track daily and annual snow accumulation at selected climate stations in and near ARCN and compare snow data with other weather and climate parameters. The foundation for the program commenced in 2011 with the installation of 9 of the 17 new climate stations in the five ARCN parks. The Environmental Assessment to place the stations within park lands was completed and signed in June 2011. This report will summarize the progress of the vital signs to date with specific details on the 2011 season's accomplishments.

Introduction

The National Park Service (NPS) Arctic Network (ARCN) coordinates inventory and monitoring of natural resources within Bering Land Bridge National Preserve (BELA), Cape Krusenstern National Monument (CAKR), Noatak National Preserve (NOAT), Kobuk Valley National Park (KOVA), and Gates of the Arctic National Park and Preserve (GAAR).

The summer of 2011 marked the beginning of the installation phase of the climate monitoring vital sign for ARCN. Nine of seventeen new climate stations were installed in Bering Land Bridge National Preserve (BELA), Noatak National Preserve (NOAT), Cape Krusenstern National Monument (CAKR), and Kobuk Valley National Park (KOVA). A brief timeline describing the development of the program is included since it has evolved over many years with many new personnel including two coordinators, multiple superintendents, multiple wilderness coordinators, and new project staff.

Climate and Snow Vital Sign Timeline

Scoping: 2006-2007

In December of 2006, a scoping meeting was convened involving climate experts from Alaska and the western U.S. as well as park superintendents, ARCN staff, and other NPS staff from Western Arctic Parklands and Gates of the Arctic. At this meeting suggestions were made as to how to develop this vital sign and where potential weather stations might be installed (Nolan 2007). The Western Regional Climate Center also completed a climate inventory report for the five ARCN parks (Davey et al. 2006) which described broad-scale climatic factors and zones important to ARCN park units, an inventory of existing sites, an initial evaluation of the adequacy of coverage for existing weather stations for climate modeling, and recommendations for improvements in monitoring weather and climate. These foundation documents guided the selection of sites to be evaluated in 2008 and 2009 for deployment of weather stations and snow monitoring instrumentation.

Staffing: 2008-2009

In 2008, the principal investigator for the two vital signs was assigned and in 2009 an assistant physical scientist was hired to help with both the Central Alaska Network (CAKN) and ARCN climate monitoring programs. The CAKN had developed a protocol for monitoring climate and snowpack and this document would be used as the foundation for developing the climate and snow vital signs for ARCN (Sousanes 2006).

Compliance and Permitting for Evaluation Phase: 2008-2009

In 2008 study plans were submitted to the Western Arctic Parklands (BELA, NOAT, CAKR, and KOVA) and Gates of the Arctic National Park and Preserve (GAAR) for the site evaluation phase of the program. Over the next several years there were several iterations of potential sites based on access, wilderness issues, and the spatial density of stations across 19 million acres.

Site Evaluations: 2008-2010

Over 30 sites were evaluated in the five parks and seventeen were selected as potential sites. The main criterion for locating sites was to: 1) locate representative locations in each park, 2) to

sample different ecoregions within each park, and 3) to get observations from high elevations within the mountainous areas of the ARCN parks. A site evaluation document was compiled that presented details of the proposed climate station locations (Sousanes 2009). The document included a description of each site, site maps, and photographs of the proposed locations. It also described the basic station design. The site photos and site documentation were presented to the National Weather Service staff, the staff of the Arctic Climate Research Center, University of Alaska (UAF) researchers and staff, and the Western Regional Climate Center staff for vetting and peer review by climatologists. There was overwhelming approval of the sites selected, the methods proposed for collecting data, and the objectives of the program.

Compliance: 2009-2011

The site evaluation process identified the preferred locations for new climate stations in ARCN. Due to the face that we were proposing to install weather stations within existing and potential wilderness areas, the National Environmental Policy Act (NEPA) action for the proposed new stations was an Environmental Assessment (EA). The scoping and writing for the EA was initiated in the spring of 2009. It was decided that one EA would be written for the five parks within the network and two alternatives would be evaluated (1) no action and, (2) up to 17 climate stations. Superintendents had the option to make individual decisions on the number of sites and preferred alternative for each park. The EA process was suspended once in 2009 for further clarification on how the sites were chosen and again in 2010 following the public comment period. The details of the proposed project were discussed on a national level.

In April of 2011, the ARCN climate monitoring EA was completed and signed. A Finding of No Significant Impact (FONSI) for the preferred alternative was signed by the park superintendents and the Alaska regional director. The preferred alternative included the installation of 17 new climate monitoring stations in four in GAAR, six in NOAT, one in KOVA, 2 in CAKR, and four in BELA (Figure 1). Thirty-five substantive comments received during the EA public comment period required NPS responses which were included within the final record of decision. A number of mitigating measures were included in the decision including the caveat that the climate monitoring protocols would be reviewed every 5 years to evaluate whether the methods and sampling design continue to meet the objectives of the monitoring program.

Equipment Testing: 2009-2010

Fifteen ARCN climate stations were tested at the National Weather Service field office in Fairbanks prior to being deployed in the remote ARCN parks. The testing phase was a valuable step in the program development as it allowed us to test sensors, validate the programming, troubleshoot design issues, and become familiar with the equipment operation before remote deployment.

Kelly Snow Site Installation: 2010

A snow telemetry station at Kelly Ranger Station in Noatak was upgraded with a new shelter, new sensors, and new data logging equipment. This was done in cooperation with the Natural Resources Conservation Service (NRCS). The site was originally installed in 1991, but has not been operational since 1996. The data from this station are transmitted via Iridium satellite phone and are available at http://www.ambcs.org/SiteViewer.shtml. This site provides year round precipitation measurements and includes a tipping bucket for summer rainfall, an all-weather

gage for mixed precipitation and snowfall, and a snow depth sensor. Together, these measurements provide a comprehensive picture of total precipitation. In addition to these measurements the site also measures and records air temperature and solar radiation.

Climate Station Installations 2011

Nine of the seventeen climate stations were installed in the summer of 2011 including three in BELA, two in CAKR, three in NOAT, and one in KOVA. We based out of three locations: Dahl Creek, Kotzebue, and Nome (Figure 1, Table 1). The new climate stations measure air temperature, relative humidity, wind speed and direction, solar radiation, snow depth, rainfall, and soil temperatures at 10, 20, and 50 cm. Real-time data are transmitted every hour via satellite and are available through the Western Regional Climate Center web site at http:/www.raws.dri.edu/wraws/akF.html. An additional eight stations will be installed in the summer of 2012, including four in GAAR, three in NOAT, and one in BELA.

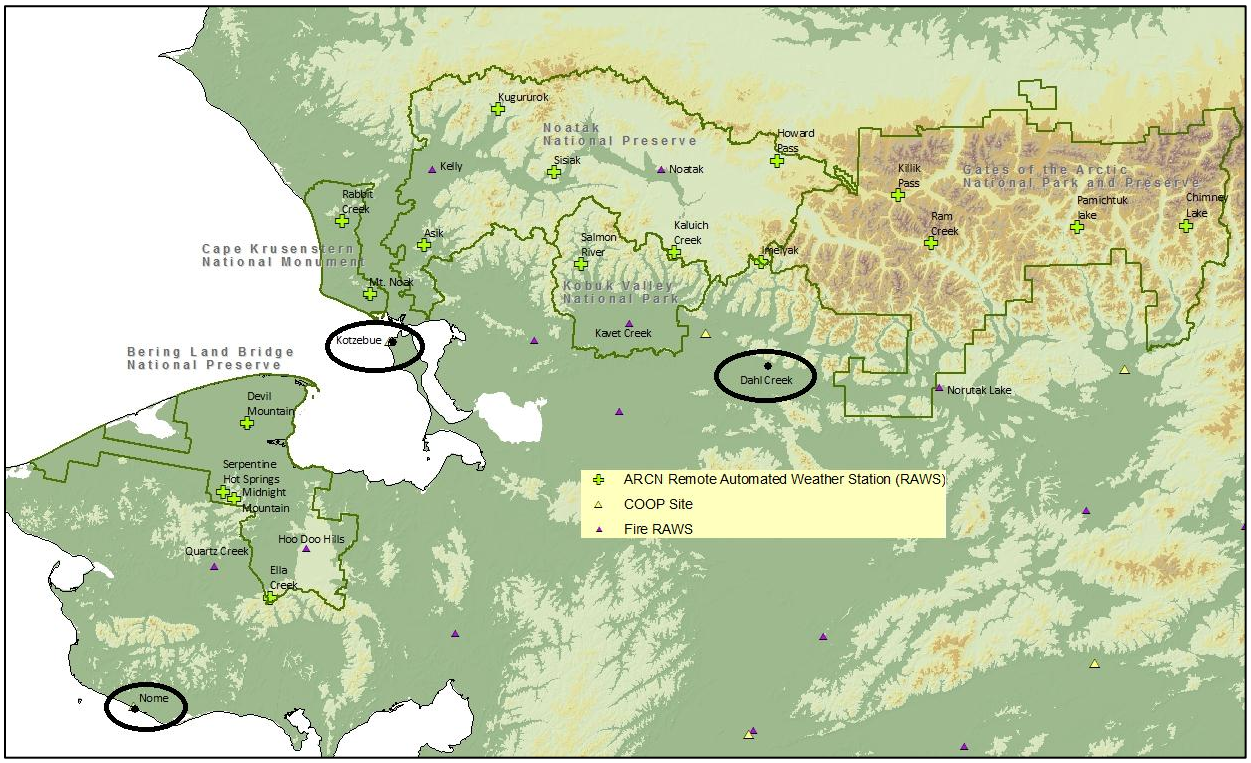

Figure 1. Locations of current and planned ARCN climate stations and the three locations used for base operations.

Table 1. Locations of new climate stations installed in 2011 in ARCN parks.

Park	Site Name	Elevation (ft)	Latitude DM_NAD83	Longitude DM_NAD83	Installation Date
NOAT	Imelyak	3,620	67°32.6890’	157° 04.6460’	July 6, 2011
NOAT	Howard Pass	2,062	68° 09.3610’	156° 53.7490’	July 7, 2011
NOAT	Sisiak	1,823	67° 59.7020’	160° 23.7390’	July 13, 2011
KOVA	Salmon River	1,262	67° 27.5940’	159° 50.4750’	July 8, 2011
CAKR	Mt. Noak	809	67° 08.4860’	162° 59.6720’	July 11, 2011

Table 2. Locations of new climate stations installed in 2011 in ARCN parks (continued).

Park	Site Name	Elevation (ft)	Latitude DM_NAD83	Longitude DM_NAD83	Installation Date
CAKR	Rabbit Creek	966	67° 33.0090'	163° 34.0310'	July 10, 2011
BELA	Midnight Mountain	2,267	65° 49.2200'	164° 32.5645'	August 17, 2011
BELA	Serpentine Hot Springs	518	65° 51.1380'	164° 42.4690'	August 17, 2011
BELA	Devil Mountain	285	66° 16.5530'	164° 31.851'	August 18, 2011

Installation Summaries

This next section describes the installation details and field notes for the nine new stations organized by base locations.

Base 1 - Dahl Creek

Stations installed from Dahl Creek include: Imelyak & Howard Pass (NOAT); Salmon River (KOVA).

Logistics: We contracted a Caravan C-208 aircraft with Wright Air Service to transport 2 field staff, personal gear, and field equipment from Fairbanks to Dahl Creek. Four 55 gallon barrels of fuel were delivered to Dahl Creek via Wright Air Service on a separate flight in conjunction with a fuel drop for the shallow lakes project. Quintin Slade, the pilot for Quicksilver, met us at Dahl Creek the evening of July 5th. We based out of the NPS cabin at Dahl Creek from July 5- 9, 2011. For each of the installations we ferried 2 staff and gear to the site and the helicopter returned to base for a second load of equipment.

Imelyak

Date: July 6, 2011
Time of visit: 0930
Personnel: Pam Sousanes, Davyd Betchkal, Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver
Purpose of trip: Installation
Weather: Partly cloudy, light winds, perfect flying conditions
NESDIS ID: 3961316C
Channel: 152
Transmission Time: 00:39:10

Narrative: This was the first ARCN station installation. The station build went smoothly and all sensors and equipment were installed as planned. After the wiring was complete we attempted to connect to the datalogger. The field laptop computer with the serial port/USB Campbell Scientific cable would not connect to the CR1000 datalogger. We manipulated the Pak Bus address and attempted to troubleshoot, but could not get it to connect. We had a PDA and that would not connect either. We also tried another cable set-up with two serial ends and a USB/serial port adapter – that did not work. We were able to use the CR1000KD keypad to access the datalogger and could verify that the correct program (ARCN_V1_2011) was running. We could also verify that the values from the sensors were correct and that the time on the

datalogger was correct. We entered the distance between the ground and the acoustic snow depth sensor (105 inches). We called the NOAA Wallops Island Satellite Data Center to verify the station transmissions. We painted the white enclosure camouflage green.

Figure 2. Imelyak I&M RAWS installed 6 July 2011.

Figure 3. Imelyak site looking southwest.

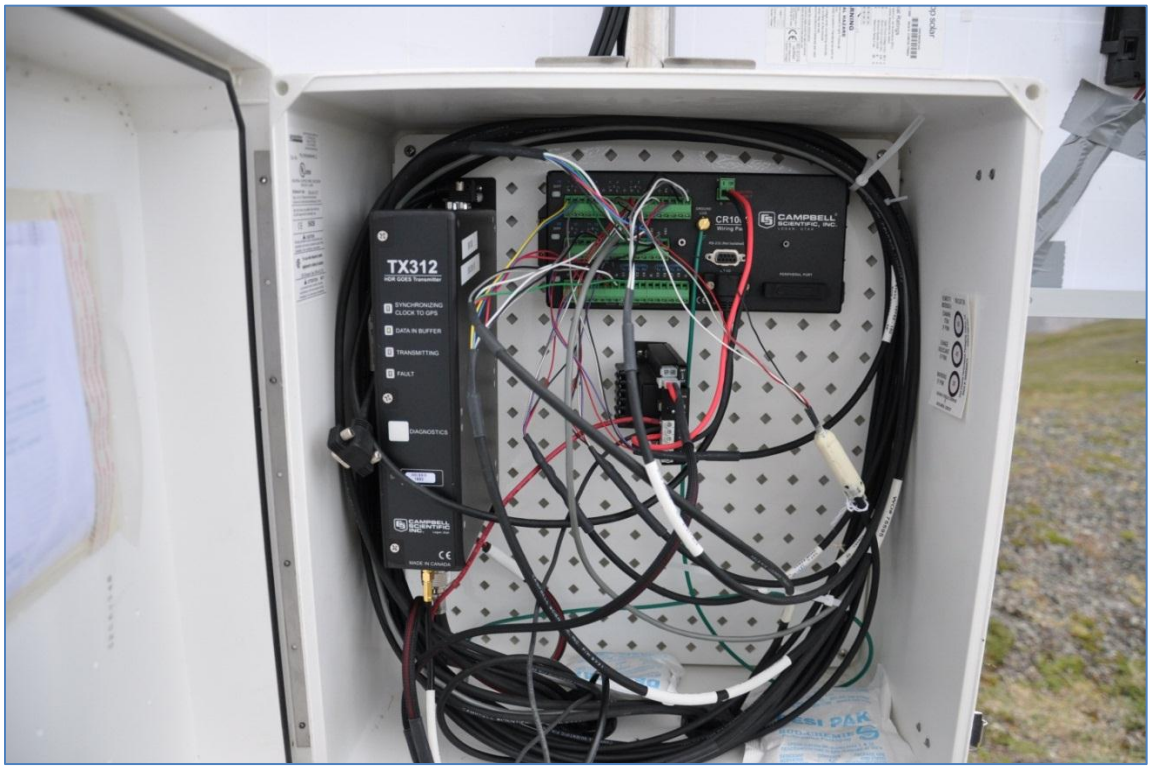

Figure 4. Imelyak datalogger inside enclosure.

Figure 5. Aerial view of Imelyak approaching from the north.

Howard Pass
Date: July 7, 2011
Time of visit: 9:30 – 3:00 pm
Personnel: Pam Sousanes, Davyd Betchkal, Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver
Purpose of trip: Installation
Weather: Partly cloudy, light winds, 62°F, isolated thunderstorms in area. We called in a new wildfire south of the Noatak River ~ 3:00 pm.
NESDIS ID: 39617266
Channel: 152
Transmission Time: 00:39:50

Narrative: The installation of the site went smoothly – there were thunderstorms surrounding the area, but we did not have any precipitation or lightning near the site. The bugs were thick even with a slight breeze. We had the same problem with connecting the laptop and PDA to the datalogger as at the Imelyak site, so we accessed the logger through the CR1000KD keypad. We verified that ARCN_V1_2011 program was running and we input the snow depth sensor height (93 inches). All values looked good upon departure. We called the National Oceanic and Atmospheric Administration's (NOAA) GOES Data Collection System (DCS) technicians to verify the satellite transmission. We painted the white enclosure camouflage brown.

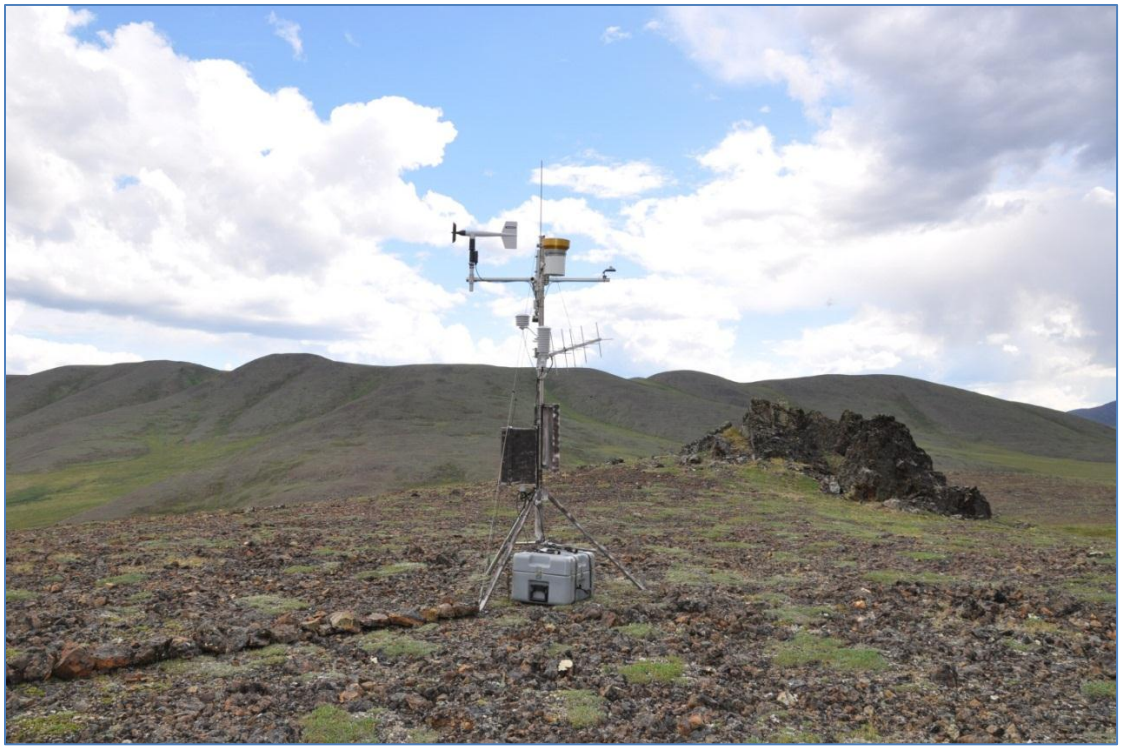

Figure 6. Howard Pass I&M RAWS looking East.

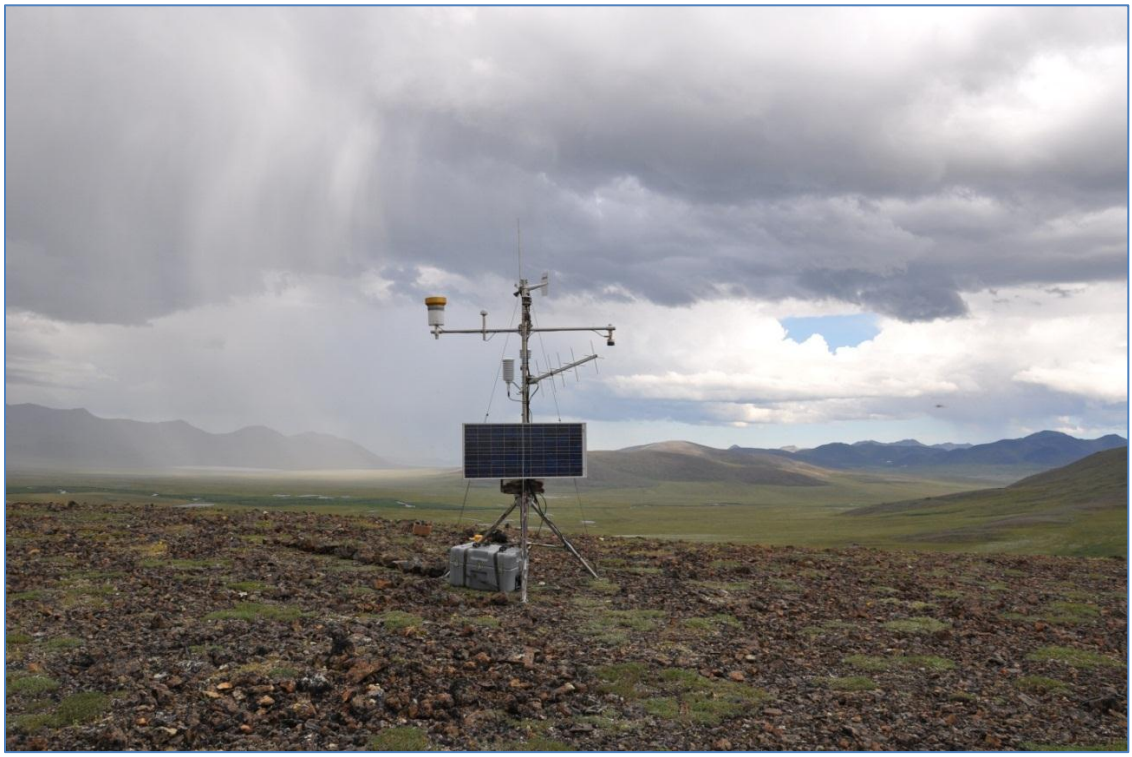

Figure 7. Howard Pass I&M RAWS installed July 7, 2011.

Figure 8. Aerial view of Howard Pass station looking south.

Salmon River
Date: July 8, 2011
Time of visit: 10:00 am – 3:00 pm
Personnel: Pam Sousanes, Davyd Betchkal, Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver
Purpose of trip: Installation
Weather: Partly cloudy, light winds, 62°F.
NESDIS ID: 3960F688
Channel: 152
Transmission Time: 00:38:30

Narrative: The installation of the site went smoothly. We were able to connect to the datalogger with both the field computer and the PDA. We did nothing different from the previous two sites, so it is still a mystery as to why we could not connect. We loaded the ARCN_V1_2011 to the datalogger and input the snow depth sensor height (88.5 inches). All values looked good upon departure. We called the DCS technicians to verify the satellite transmission. We painted the white enclosure camouflage brown.

Figure 9. Preparing to set up Salmon River station.

Figure 10. Setting up Salmon River station

Figure 11. Salmon River station looking north east.

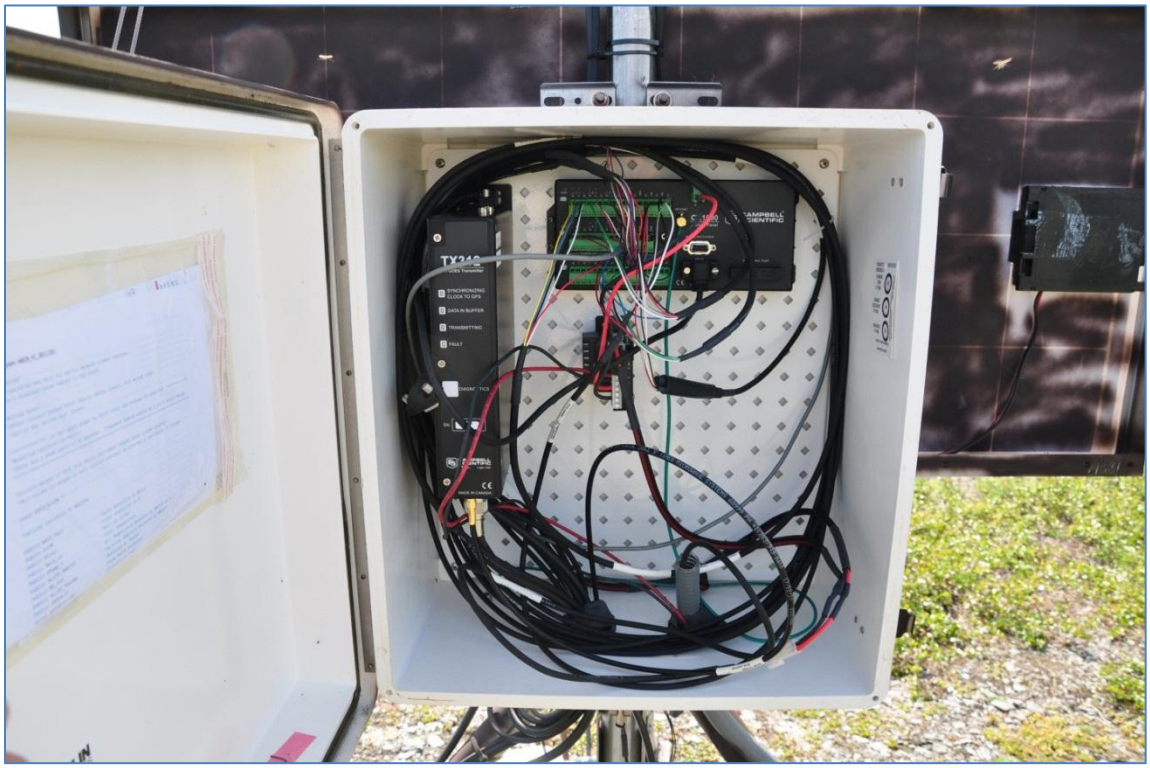

Figure 12. Salmon River datalogger inside enclosure.

Figure 13. Aerial view of Salmon River looking southeast.

Base 2 - Kotzebue

Stations installed from Kotzebue include: Sisiak (NOAT); Tahinichok & Mt. Noak (CAKR). Logistics: The helicopter was used to ferry two passengers and gear to Kobuk village, which is ~ 3 miles south of Dahl Creek, where they purchased two seat fares on Bering Air to Kotzebue. The helicopter flew from Dahl Creek to Kotzebue. Davyd Betchkal, the field assistant for the Dahl Creek sites, returned to his duty station at Denali. Holly Howard the WEAR expeditor joined as the field assistant on July 10. We based out of the NPS bunkhouse at Kotzebue from July 10 – 14. The helicopter was based at the NPS/FWS hangar and we used the NPS/FWS 100 LL Av Gas fuel tank. For each of the installations we ferried 2 staff and gear to the site and the helicopter returned to base for a second load of equipment.

<u>Tahinichok</u>
Date: July 10, 2011
Time of visit: 10:00 am – 3:00 pm
Personnel: Pam Sousanes, Holly Howard, Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver
Purpose of trip: Installation
Weather: Mostly cloudy, wind ~ 10 mph, 56°F.
NESDIS ID: 396147FC
Channel: 152
Transmission Time: 00:39:20

Narrative: The installation of the site went smoothly – we did leave behind the lightning rod and straps to secure the battery box (we returned the next day on our way back from Sisiak). We were able to connect to the datalogger with both the field computer and the PDA. We loaded the ARCN_V1_2011 to the datalogger and input the snow depth sensor height. All values looked good upon departure. We called the DCA technicians to verify the satellite transmission. We painted the white enclosure camouflage brown.

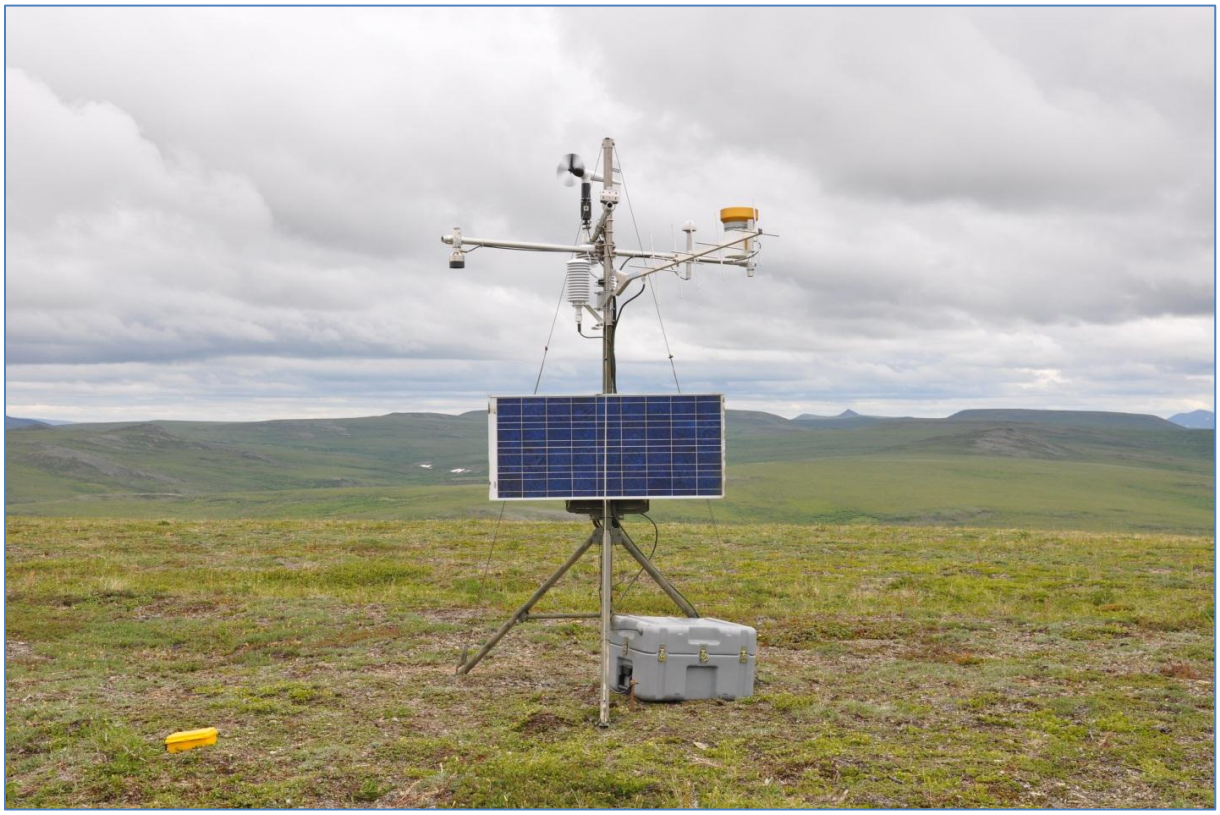

Figure 14. Tahinichok station after installation.

Figure 15. Tahinichok and field assistant Holly Howard.

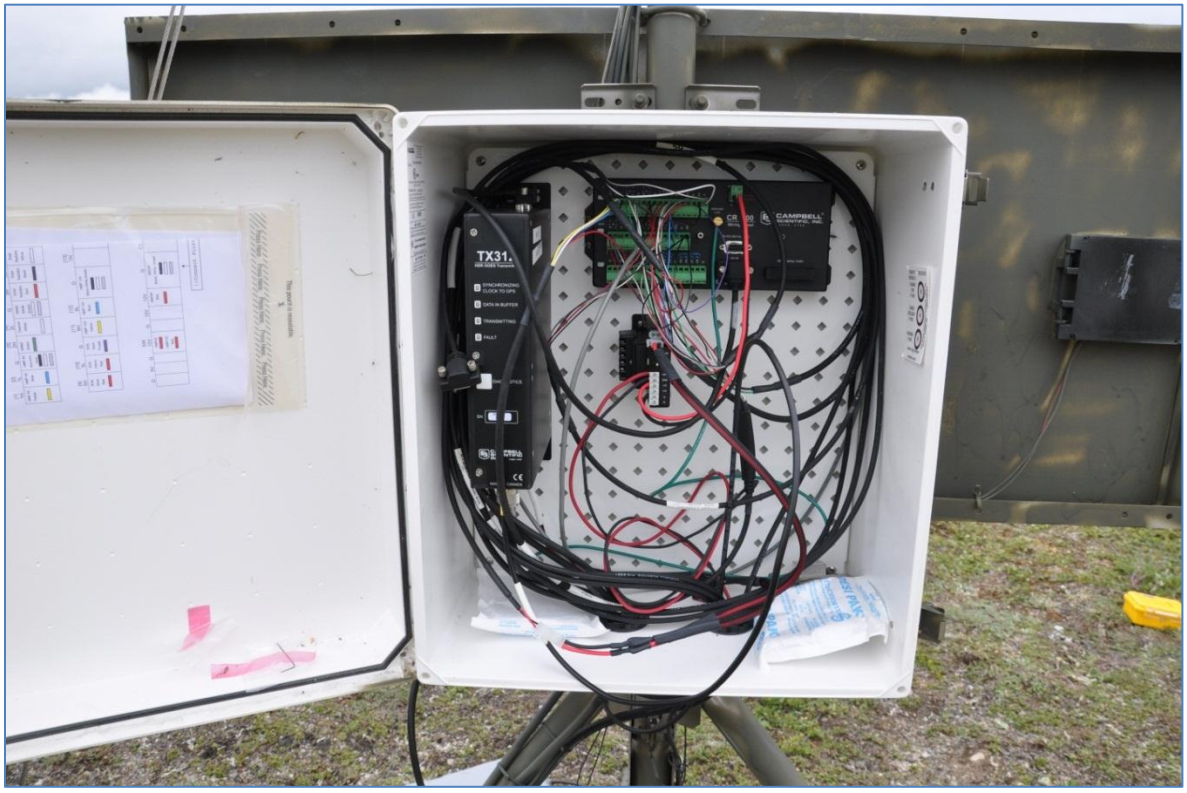

Figure 16. Tahinichok datalogger inside enclosure.

Figure 17. Aerial view of Tahinichok, approaching from the east.

Mt Noak
Date: July 11, 2011
Time of visit: 9:30 am – 2:00 pm
Personnel: Pam Sousanes, Holly Howard, Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver
Purpose of trip: Installation
Weather: Mostly cloudy, 58°F, no rain.
NESDIS ID: 39616110
Channel: 152
Transmission Time: 00:39:40

Narrative: This was the 5th installation over a short period of time, so the installation of the site went smoothly – we increased the leg stance on this site to make it more stable. We were able to connect to the datalogger with both the field computer and the PDA. We loaded the ARCN_V1_2011 to the datalogger and input the snow depth sensor height (79.9 inches). All values looked good upon departure. We called the DCA technicians to verify the satellite transmission. We painted the white enclosure camouflage brown.

Figure 18 . Installation of Mt. Noak station.

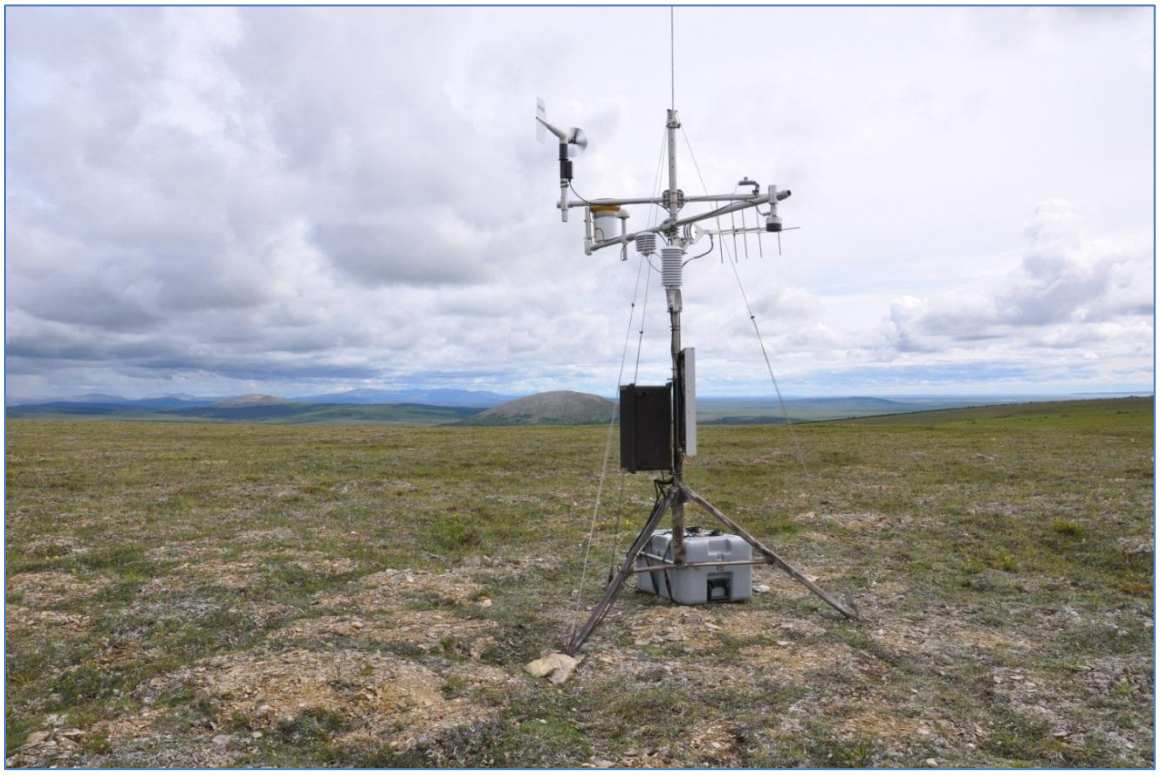

Figure 19. Mt. Noak after installation looking east.

Figure 20. Aerial view of Mt. Noak, approaching form the northeast.

Kelly SNOTEL Site
Date: July 13, 2012
Time: 9:00 am – 5:00 pm
Personnel: Dan Kenney (NRCS), Cody Priest, Dave Swanson, Pam Sousanes, Holly Howard, and Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver; Cessna 206 – Golden Eagle Outfitters
Purpose of trip: Finish installation
Weather: Mostly cloudy, 55°F, light wind

Narrative: The crew was transported to Kelly Ranger Station on July 12. We transported the SNOTEL equipment and a 55 gallon drum of antifreeze solution with a Cessna 206, followed by the passenger flight with 3 people. We used the helicopter to sling the 55 gallon drum up to the site from the river bar ~ 0.5 miles distance. We started the installation on July 12 and continued on July 13. Dan Kenny, Cody Priest and Dave Swanson worked at the SNOTEL site, while Pam and Holly installed the Sisiak climate station. The snow pillow was replaced and filled with the antifreeze solution; an iridium system was installed for data transmissions. An electric fence was installed around the new snow pillow. The 55 gallon drum and all old equipment was backhauled from the site.

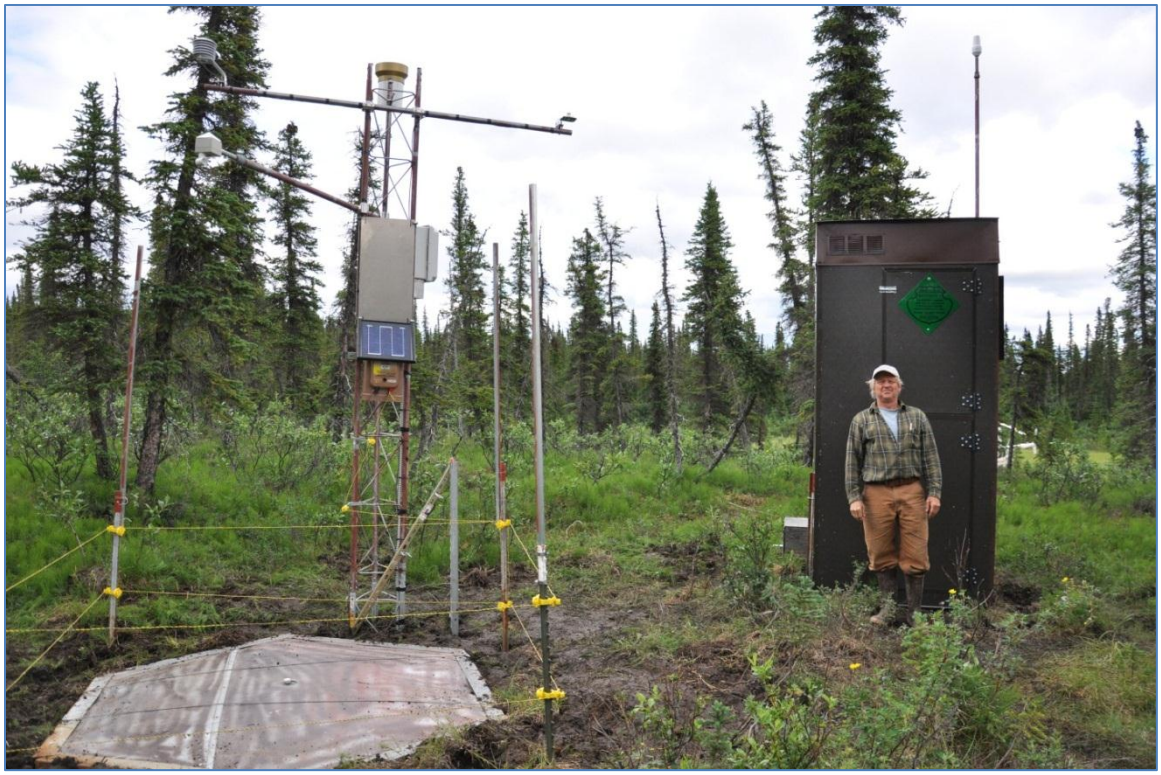

Figure 21. Dan Kenney upgrading the Kelly SNOTEL site.

Figure 22. Precipitation gage and aerial snow marker at Kelly SNOTEL site.

Figure 23. Field assistants Dave Swanson and Cody Priest at Kelly SNOTEL site.

Sisiak
Date: July 13, 2011
Time of visit: 9:30 am – 2:00 pm
Personnel: Pam Sousanes, Holly Howard, Quintin Slade (pilot)
Mode of transport: R44 helicopter – Quicksilver
Purpose of trip: Installation
Weather: Mostly cloudy, cool 45°F, 11 mph wind.
NESDIS ID: 3961548A
Channel: 152
Transmission Time: 00:39:30

Narrative: This was the 6th installation over a short period of time, so again the installation of the site went smoothly. We were able to connect to the datalogger with both the field computer and the PDA. We loaded the ARCN_V1_2011 to the datalogger and input the snow depth sensor height. All values looked good upon departure. We called the DCA technicians to verify the satellite transmission. We painted the white enclosure camouflage brown.

Figure 24. Pam Sousanes and Holly Howard at Sisiak site after the installation.

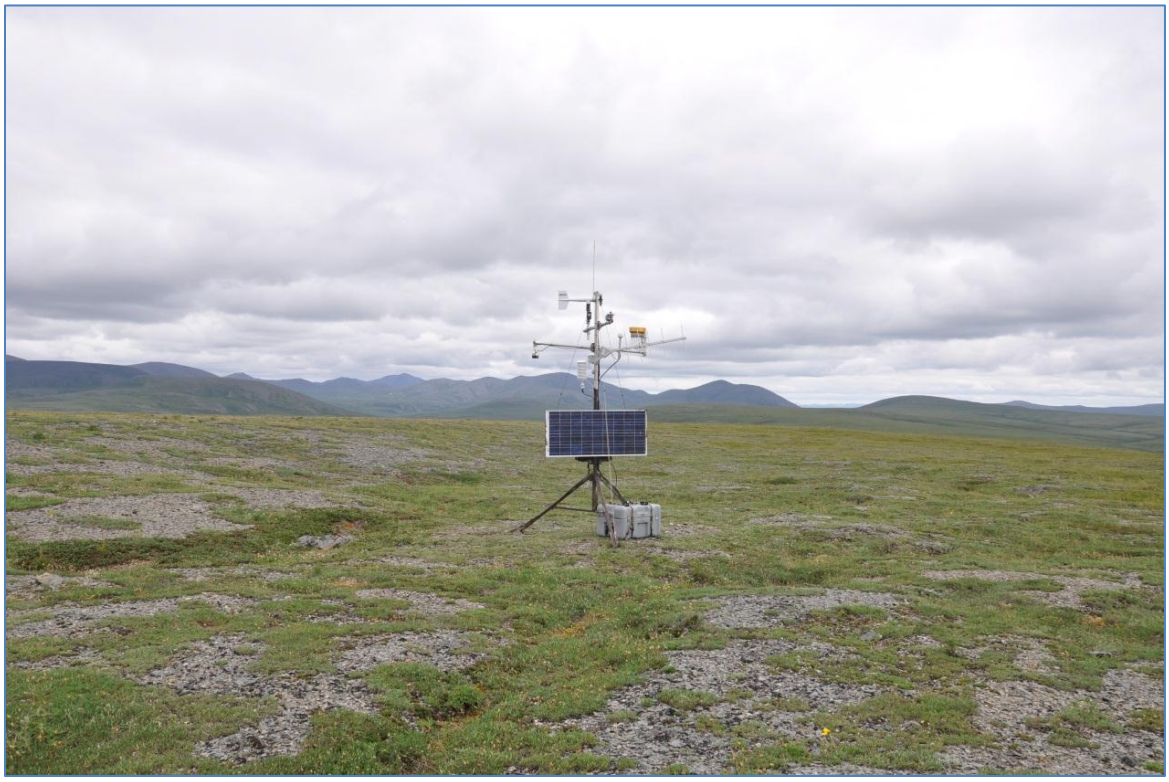

Figure 25 Sisiak Station looking north.

Figure 26. Sisiak station looking west.

Base 3 - Nome/Quartz Creek/Serpentine Hot Springs

Stations installed include: Midnight Mountain, Devil Mountain, and Serpentine Hot Springs (BELA). We arrived in Nome and gathered the equipment that had been shipped via cargo flight from Fairbanks. We stayed at the NPS bunkhouse on the first night. We used a government vehicle from the Nome office to drive three 55-gallon drums of fuel (wet rate – fuel provided by Bering Air) and the field gear to Quartz Creek. The contract helicopter flew from Nome to Quartz Creek. Pam Sousanes and field assistant Tara Whitesell (ARCN) were transported to Serpentine Hot Springs with their personal gear via helicopter. The fuel stayed at Quartz Creek and the equipment was ferried in when the pilot returned for fuel. One of the installations was at the hot springs and another was on a high ridge above it. The 3rd site was at Devil Mountain and required two ferries to get the gear and people to the site. We based out of Serpentine Hot Springs August 16 – 18 and stayed at the public use bunk house, although we were prepared to camp if visitors showed up to use the cabin.

<u>Serpentine</u>
Date: August 16, 2011
Time of visit: 6:00 pm – 8:00 pm
Personnel: Pam Sousanes, Tara Whitesell, Russell Rowe (pilot)
Mode of transport: R44 helicopter – Bering Air
Purpose of trip: Installation
Weather: Clear, calm, ~ 60°F

NESDIS ID: 39611780
Channel: 152
Transmission Time: 00:39:30

Narrative: We started the Serpentine installation in late afternoon on August 16 and got about 30% of the station build done. We then returned on August 17 at ~ 5 pm and worked on it another couple of hours to finish the wiring and load the program. We also returned to the site once more on the morning of August 18 to make final adjustments and to make the call to check the transmissions. All values looked good upon departure. We painted the white enclosure camouflage brown.

Figure 27. Serpentine Hot Springs Looking East

Figure 28. Serpentine Hot Springs station looking west.

Figure 29. Aerial view Serpentine Looking East

Figure 30. Close-up of Serpentine station.

Midnight Mountain
Date: August 17, 2011
Time of visit: 10:00 am – 5:00 pm
Personnel: Pam Sousanes, Tara Whitesell, Russell Rowe (pilot)
Mode of transport: R44 helicopter – Bering Air
Purpose of trip: Installation
Weather: Foggy morning, clear afternoon, ~ 60°F
NESDIS ID: 396104F6
Channel: 152
Transmission Time: 00:38:40

Narrative: We were fogged in at Serpentine until 9:30 am and then headed for Devil Mountain. There was fog to the north so we returned to Midnight Mountain. The site is located southwest of the repeater hut. The build went smoothly; it took us about 6.5 hours to finish the station. There were caribou in the area and they circled us as we worked on the station. The ARCN_VI_2011 program was loaded and the values looked good. We checked with the DCS technicians and they

verified the transmission. All values looked good upon departure. We painted the white enclosure camouflage brown.

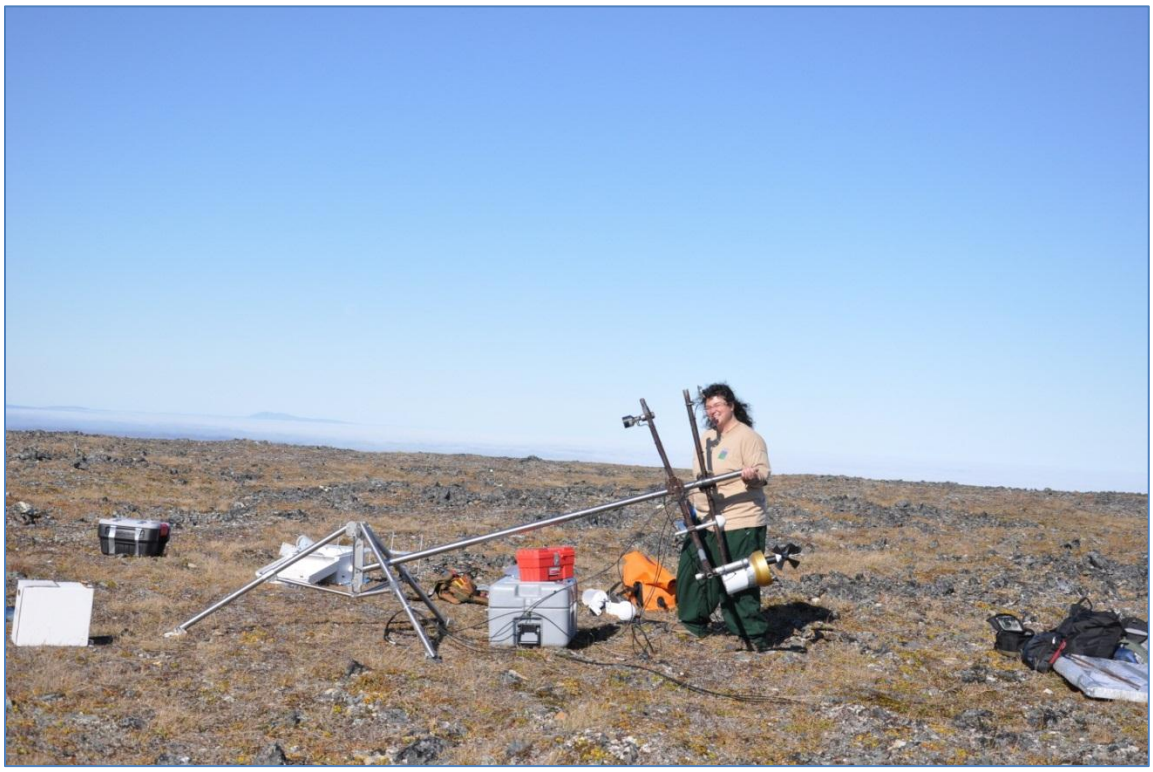

Figure 31. Installation of Midnight Mountain site.

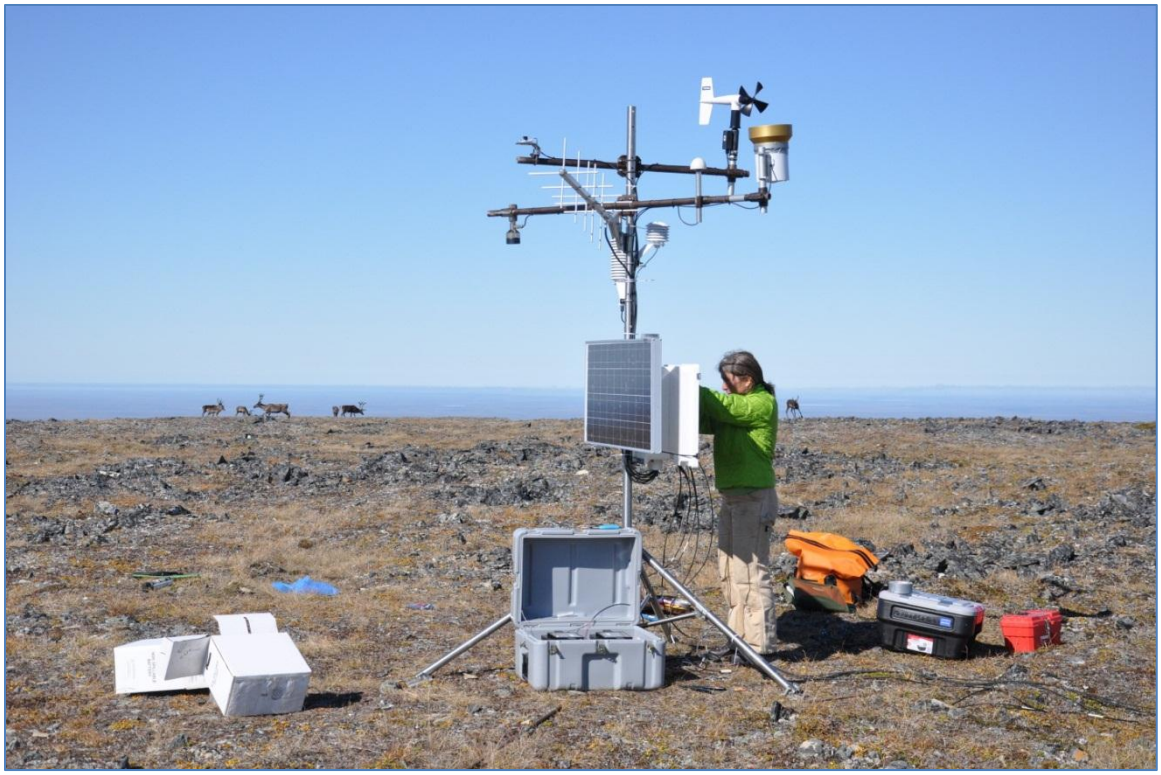

Figure 32. Installation of Midnight Mountain looking northwest.

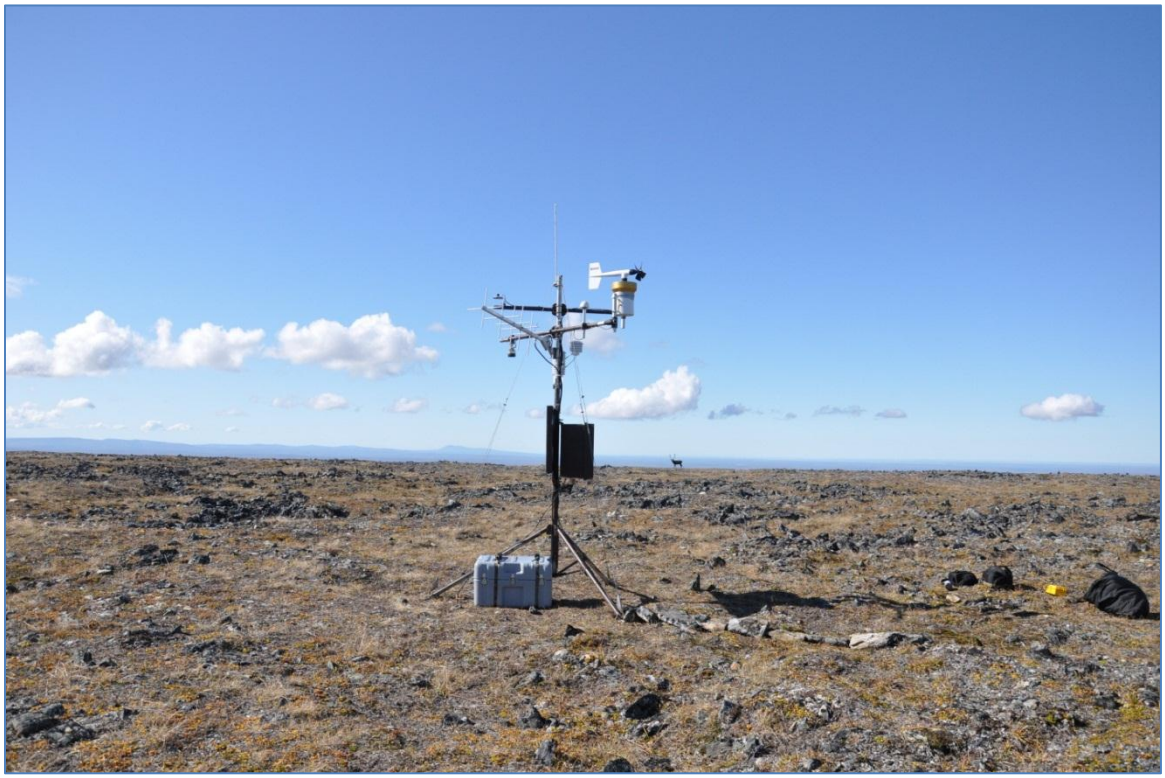

Figure 33 Midnight Mountain station looking west

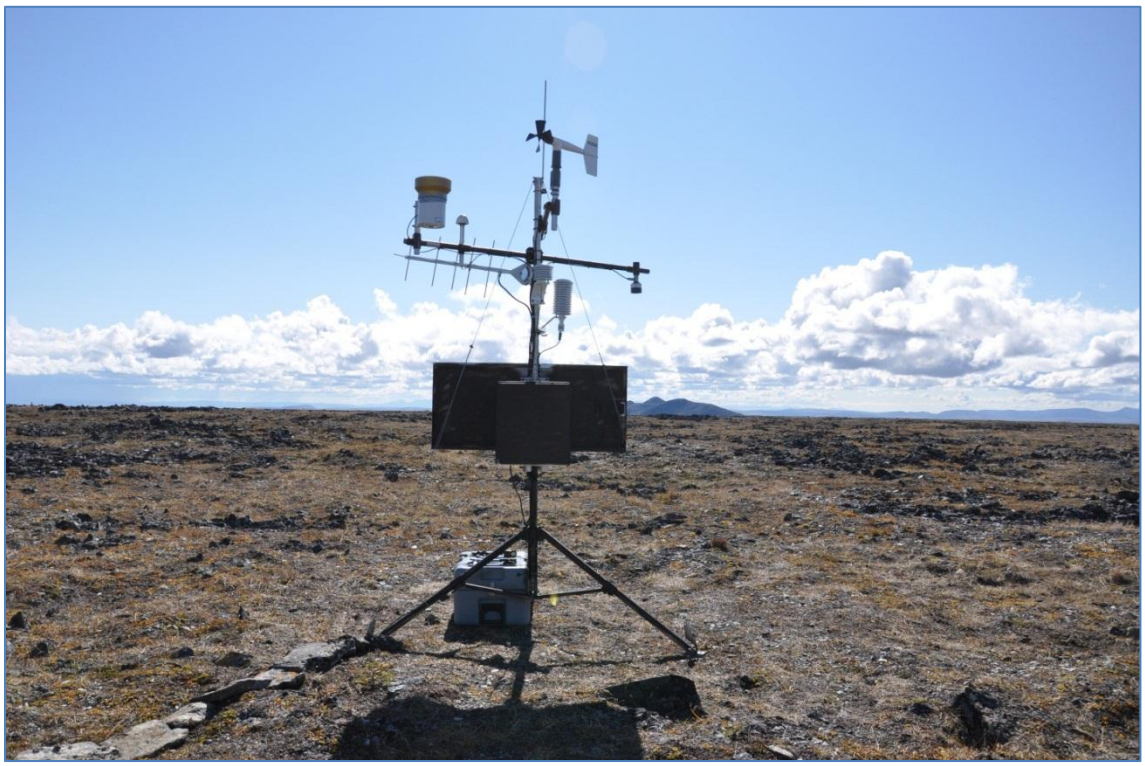

Figure 34. Midnight Mountain station - looking south

Figure 35. Aerial view looking northwest

Devil Mountain
Date: August 18, 2011
Time of visit: 10:30 am – 4:00 pm
Personnel: Pam Sousanes, Tara Whitesell, Russell Rowe (pilot)
Mode of transport: R44 helicopter – Bering Air
Purpose of trip: Installation
Weather: Clear, calm. 61°F
NESDIS ID: 3961221A
Channel: 152
Transmission Time: 00:39:00

Narrative: Absolutely beautiful day! The station installation went smoothly. The ARCN_VI_2011 program was loaded and the values looked good. We checked with the DCS technicians before we departed and they verified the transmission. We painted the white enclosure camouflage brown.

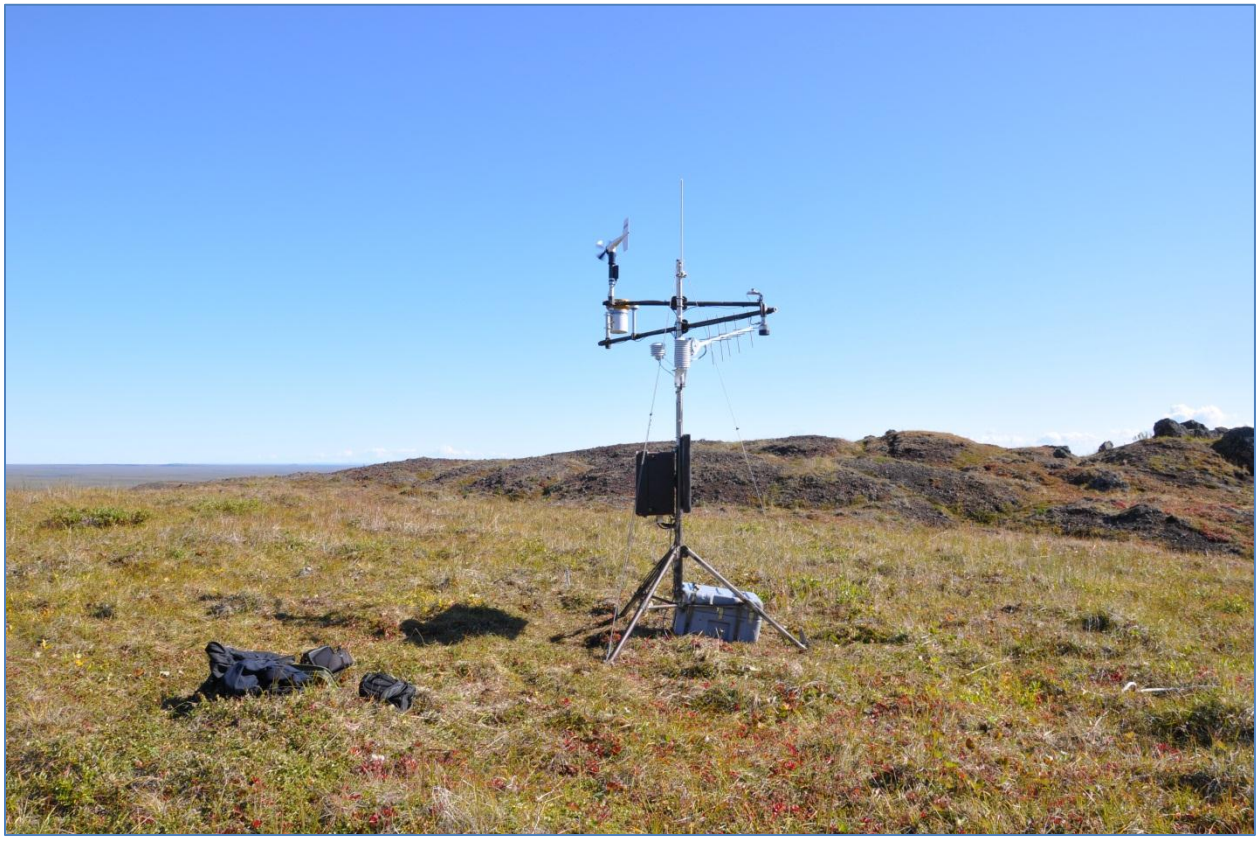

Figure 36. Devil Mountain station east view.

Figure 37. Devil Mountain after installation looking southeast.

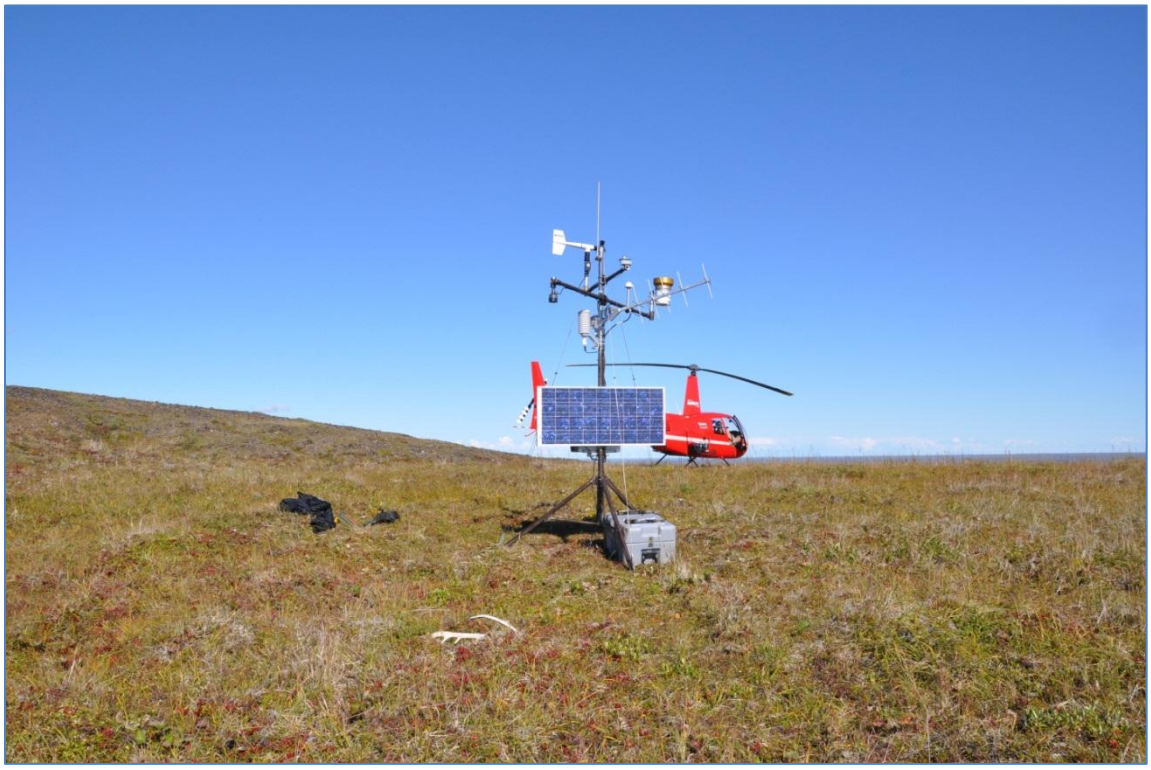

Figure 38. Devil Mountain station west view

Figure 39. Aerial view of Devil Mountain - looking northeast

Future Plans

In 2012 the plan is to install the remaining 8 climate stations in the Arctic parks and to perform annual maintenance on the sites that were installed in 2011.

Literature Cited

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