



Weather Station Maintenance in Southwest Alaska Network Parks

Summary for the 2014 Hydrologic Year

Natural Resource Data Series NPS/SWAN/NRDS—2014/725



ON THE COVER

T. Rovinelli replaces wind sensors on a remote automated weather station near Snipe Lake, Lake Clark National Park and Preserve

Photograph by: C. Lindsay

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Chuck Lindsay

National Park Service
Southwest Alaska Network Inventory and Monitoring Program
240 W 5th Avenue
Anchorage, Alaska 99501

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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 (Lindsay et al. 2012) and were analyzed and interpreted within the guidelines of the protocols.

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This report is available in digital format from the Southwest Alaska Network Inventory and Monitoring Program website (<http://science.nature.nps.gov/im/units/swan/index.cfm>), and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>). To receive this report in a format optimized for screen readers, please email irma@nps.gov.

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Abstract

Field maintenance of climate monitoring stations is necessary to provide for the continuous acquisition of quality meteorological data, retrieval of complete station data, and fulfilling the station standards issued by respective climate monitoring programs (e.g. National Wildfire Coordinating Group 2012). In 2014, the Southwest Alaska Network (SWAN) Inventory and Monitoring Program operated and maintained 11 Remote Automated Weather Stations (RAWS) and six time lapse cameras (phenocams) in three network parks. This report summarizes all work (annual maintenance, unscheduled maintenance, station removal, and new installations) for the 2014 hydrologic year (October 1, 2013 to September 30, 2014) and includes up-to-date sensor metadata.

Acknowledgments

Successfully maintaining weather stations in three park units wouldn't have been possible without the cooperation, field assistance, and air support from Alaska Wildland Adventures, E. Booher, M. Elerick, M. Fell, A. Gilliland, V. Gilliland, R. Gonzales, G. Irvine, R. Jones, M. Kansteiner, M. Knight, D. Kurtz, S. LaHusen, K. Laurie, G. Murdock, J. Nelson, R. Parker, Pathfinder Aviation, D. Peratrovich, L. Phillips, J. Pletz, Port Graham Corporation, W. Rapp, R. Richotte, D. Rose, T. Rovinelli, L. Thomas, S. Venator, and K. Wilkinson.

List of Acronyms

Ah	Amp hour
AKDST	Alaska Daylight Savings Time
AT-RH	Air Temperature – Relative Humidity
B206	Bell 206 helicopter
C	Degrees Celsius
CRN	Climate Reference Network
CS	Campbell Scientific
C185	Cessna 185 airplane
C206	Cessna 206 airplane
DHC-2	de Havilland Canada Beaver airplane
DLP	Data Logger Program
F	Degrees Fahrenheit
Ft	Feet
FTS	Forest Technology Systems
GB	Gigabyte
GOES	Geostationary Operational Environmental Satellite
In	Inch
JPG	Joint Photographics Expert Group image compression
KATM	Katmai National Park and Preserve
KEFJ	Kenai Fjords National Park
LACL	Lake Clark National Park and Preserve

List of Acronyms (continued)

MPH	Miles per hour
M/V	Motor Vessel
NESDIS ID	National Environmental Satellite, Data, and Information Service Identifier
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
RAWS	Remote Automated Weather Station
RG-TB	Rain Gauge – Tipping Bucket
RMA	Return Merchandise Authorization
SD	Snow Depth (weather station sensor) or Secure Data (camera memory storage)
SDI	Serial Digital Interface
SDI-AM	Serial Digital Interface – Analog Module
S/N	Serial Number
SR	Solar Radiation
SWAN	Southwest Alaska Network
W	Watt (unit of energy) or
WD	Wind Direction
WFMI	Wildland Fire Management Information
WRCC	Western Regional Climate Center
WS	Wind Speed

Weather Station Locations

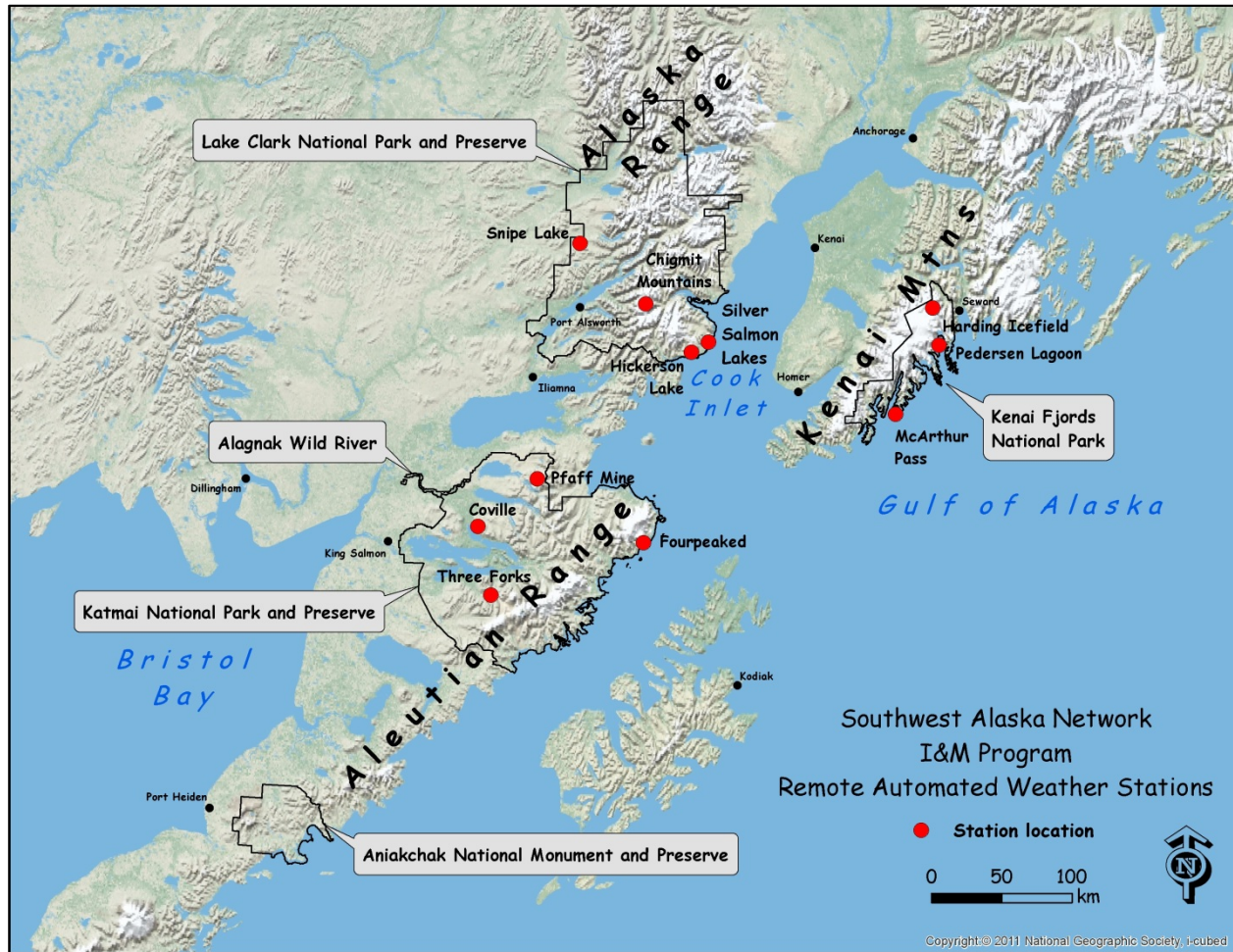


Figure 1. Map showing locations of weather stations operated and maintained by the SWAN.

Table 1. Metadata for weather stations operated and maintained by the SWAN.

Station name	Park	Station type	NESDIS ID no.	Lat. N	Lon. W	Elev ft.	Start date	End date
Chigmit Mountains	LACL	RAWS	FA6544FC	60.2249	153.4675	4658	7/2009	--
Coville	KATM	RAWS	3280B12C	58.8025	155.5629	1567	6/2008	--
Fourpeaked	KATM	RAWS	328135C2	58.7057	153.5179	1074	6/2009	--
Harding Icefield	KEFJ	RAWS	FA656210	60.1325	149.7820	4335	7/2004	--
Hickerson Lake	LACL	RAWS	3280C7BC	59.9148	152.8925	1048	6/2008	6/2014
McArthur Pass	KEFJ	RAWS	3280244E	59.4726	150.3337	1266	6/2008	--
Pedersen Lagoon	KEFJ	RAWS	326AD012	59.8944	149.7308	624	8/2011	--
Pfaff Mine	KATM	RAWS	FA65578A	59.1109	154.8367	2018	6/2008	--
Silver Salmon Lakes	LACL	RAWS	32352246	59.9737	152.6713	23	7/2013	--
Snipe Lake	LACL	RAWS	328041A8	60.6103	154.3199	2315	6/2008	--
Three Forks	KATM	RAWS	32803738	58.3678	155.3839	1358	9/2013	--

Weather Station Maintenance Summaries

Chigmit Mountains Weather Station – Annual Maintenance – May 20, 2014

Time of visit: 1400-1700

Personnel: C. Lindsay, D. Rose

Mode of transport: B206 helicopter from Homer

Purpose of trip: Annual maintenance

Weather: Mostly sunny, 40 F, winds north 10 mph gusting 15 mph, 0 in snow on the ground

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Snow depth (SR50)

GOES antenna tines

Narrative:

Maintenance of Chigmit Mountains weather station was done on the same day as maintenance on Fourpeaked weather station. A round-trip helicopter flight was made from Homer with a refueling stop at the Iliamna airport. The station was only moderately damaged by rime ice during the winter of 2013-14. One of the spreader bars on the wind mast had broken (Figure 2), the vane had fallen off the wind direction sensor (Figure 3), the air temperature – relative humidity sensor mount was loose (Figure 4), and the GOES antenna was missing several tines (Figure 5). The reinforced mast that was installed in 2013 held up. The AT-RH sensor, WS sensor, and WD sensor were replaced. A WD sensor direction test was done. The rain count for the tipping bucket was zeroed, and a tipping bucket test was done. All data in the data logger were downloaded to send to the WRCC in order to update the archive. The SD sensor was replaced with a Campbell Scientific SR50 SD sensor, which was rehabbed with new transducer plates and desiccant. Data logger program CHMO_DLP_SR50.prg was edited to zero the SD sensor. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. In response to the warm winter and spring, there was almost no snow present directly at the station at the time of maintenance. All bolts on the station were checked and tightened if loose and all cables were zip-tied. The north guy-wire on the wind sensor mast could not be replaced because of the broken weld (Figure 2). This mast may need to be replaced in the future in order to accommodate a guy-wire again. However, the existing mast can probably be repaired by a welder. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 6) and the inside of the instrument enclosure (Figure 7) was also photographed.



Figure 2. Chigmit Mountain RAWS – Broken weld on spreader bar that supports guy-wires for the wind sensor mast.



Figure 3. Chigmit Mountain RAWS – Wind vane missing from wind direction sensor.



Figure 4. Chigmit Mountain RAWS – Loose mount on AT-RH sensor.



Figure 5. Chigmit Mountain RAWS – Missing tines on GOES antenna.

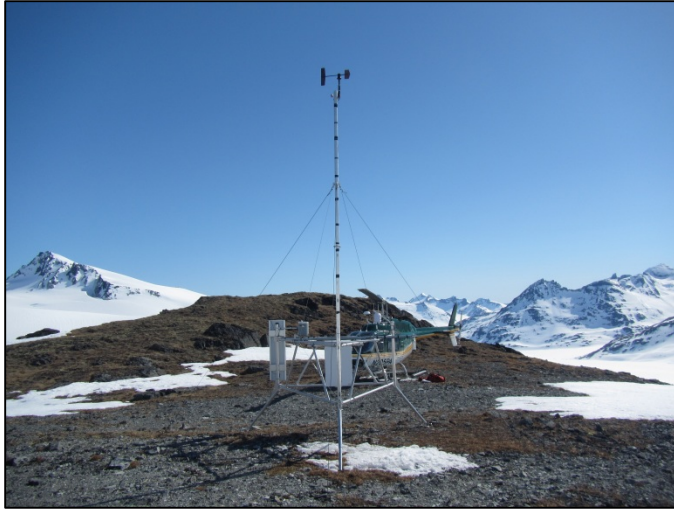


Figure 6. Chigmit Mountain RAWS – Station after maintenance, viewed from the north.



Figure 7. Chigmit Mountain RAWS – Instrument enclosure after maintenance.

Contact Creek Phenocam – Annual Maintenance – June 3, 2014

Time of visit: 15:30-16:30

Personnel: C. Lindsay, A. Gilliland, R. Gonzales

Mode of transport: C185 (on wheels) from King Salmon (NPS aircraft)

Purpose of trip: Download camera and replace desiccant

Weather: Mostly cloudy, 60 F, winds light and variable

Maintenance:

Harbortronics time lapse camera:

New desiccant

New SD card

Narrative:

The electric fence set up around the climate reference network station was not operating. The line was broken in several places (prior to March based on time lapse photographs). It was field repaired and was functioning again upon departure. In the future some additional hardware will be needed to make it fully functional again. This hardware includes: corner standoffs (6), T-post insulators (6), 12 feet of copper grounding wire, and approximately 200 feet of electric fence wire (polywire).

The Harbortronics time lapse camera collected four RAW-format photos/day between September 3, 2013 (date of last visit) and December 30, 2013. No photos were obtained between December 30, 2013 and February 15, 2014. The photos that were obtained beginning in February 15, 2014 were no longer taken at the correct time (camera clock indicated acquisition at 00:40, 01:40, 02:40, and 03:40 – daily). Four photos per day at these early morning hours were collected until maintenance on June 3, 2014. It is unclear if the 10 W solar panel wasn't able to adequately charge the batteries and if this is why the intervalometer reset. Battery voltage was good during this visit so the 100 Ah battery wasn't replaced.

The intervalometer was reprogrammed because the timing was off. The original specifications were used (four photos per day, hourly from 11 AM to 2 PM (AKDST). The 32 GB SD card was exchanged for an empty one and the desiccant packs were replaced. Before departure a thin film of silicone grease was applied to the gasket on the housing door with an irrigation syringe to help maintain a weather-tight seal.

The photographs taken with the current setup are not ideal (Figure 8). The view is obscured by the weather station and the solar panel array on which the camera is mounted moves. A better place to mount a time lapse camera would be on the NOAA CRN instrument tower (visible in Figure 12). One of the newer Campbell Scientific cameras could be mounted to this station but some modifications would be necessary in order to mount a solar panel, battery and charge regulator at this location in a way that doesn't interfere with the weather station operation.



Figure 8. Contact Creek phenocam – Photo taken on 3/17/2014. The Climate Reference Network station instrument tower is visible in the foreground and the electric fence is visible in the center of the photograph.

Coville Weather Station – Annual Maintenance – June 2, 2014

Time of visit: 1300-1700

Personnel: C. Lindsay, K. Wilkinson, K. Laurie

Mode of transport: DHC-2 Beaver (on floats) from King Salmon (NPS aircraft)

Purpose of trip: Annual maintenance

Weather: Mostly cloudy, 42 F, winds southwest 10 mph gusting 15 mph

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Solar radiation

Rain gauge tipping bucket

Snow depth (SR50)

Batteries

Narrative:

Access to the Coville weather station was by NPS float plane from King Salmon. NPS rangers helped carry two 70-pound batteries to the weather stations (Figure 9). The station was in good condition. The two 100 Ah batteries that power the station were replaced after six years of service. The AT-RH sensor, WS sensor, WD sensor, SR sensor, and rain gauge tipping bucket were replaced. A WD sensor direction test was done. The rain count for the tipping bucket was zeroed, and a tipping bucket test was done. All data in the data logger were downloaded to send to the WRCC in order to update the archive. The SD sensor was replaced with a Campbell Scientific SR50A SD sensor, which was rehabbed with new transducer plates and desiccant. Data logger program COVI_DLP_SR50A.prg was edited to zero the SD sensor. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. All bolts on the station were checked and tightened if loose and all cables were zip-tied. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 10) and the inside of the instrument enclosure (Figure 11) was also photographed. An unused 10 W solar panel remains mounted to the station (Figure 12). This solar panel originally charged a separate battery used for the Campbell Scientific camera described below.



Figure 9. Coville RAWS – NPS rangers each carrying 70-pound batteries.

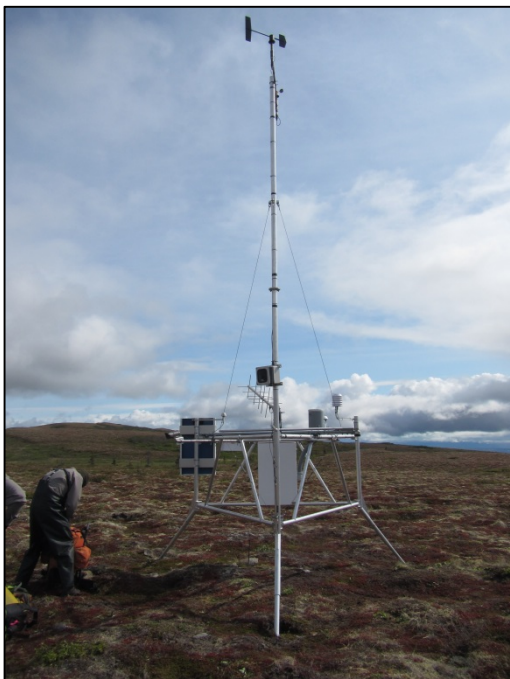


Figure 10. Coville RAWS – Station after maintenance, viewed from the north.



Figure 11. Coville RAWS – Instrument enclosure after maintenance.

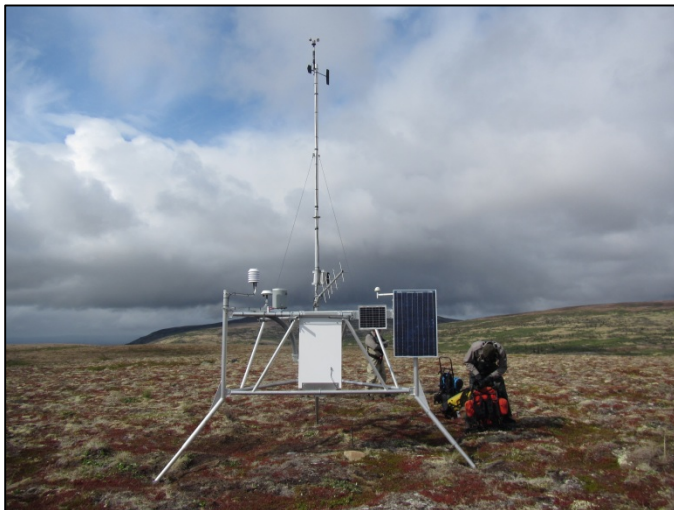


Figure 12. Coville RAWS – The small solar panel left of the larger one is not currently in use.

Coville Phenocam – Annual Maintenance – June 2, 2014

Time of visit: 1300-1700

Personnel: C. Lindsay, K. Wilkinson, K. Laurie

Mode of transport: DHC-2 Beaver (on floats) from King Salmon (NPS aircraft)

Purpose of trip: Download camera and replace desiccant

Weather: Mostly cloudy, 42 F, winds southwest 10 mph gusting 15 mph

Maintenance:

Campbell Scientific time lapse camera:

Removed camera S/N 01123

Installed camera S/N 01828 with firmware 1.22

New desiccant

New SD card

Harbortronics time lapse camera:

New desiccant

New SD card

Narrative:

The existing Campbell Scientific time lapse camera (S/N 01123) was removed for return to Campbell Scientific (RMA# 19871) for a necessary hardware modification to fix the power consumption problem experienced in 2012-13. The camera did operate correctly during 2013-14 after it was powered directly off the weather station batteries (two 100 Ah batteries). The camera collected 13 JPG-format photos/day between June 25, 2013 and June 2, 2014. A new Campbell Scientific time lapse camera (S/N 01828) was installed with updated firmware (version 1.22; Figure 13). New desiccant and an empty 16 GB SD card were installed.

The Harbortronics time lapse camera was maintained (Figure 14). The 32 GB SD card was exchanged for an empty one and the desiccant packs were replaced. The camera collected four RAW-format photos/day between June 25, 2013 and June 2, 2014. The intervalometer was reprogrammed because the weather station batteries were replaced. The same specifications as before were used. Before departure a thin film of silicone grease was applied to the gasket on the housing door with an irrigation syringe to help maintain a weather-tight seal.



Figure 13. Coville RAWS phenocam – The Campbell Scientific time lapse camera was replaced with this updated version of the same equipment.

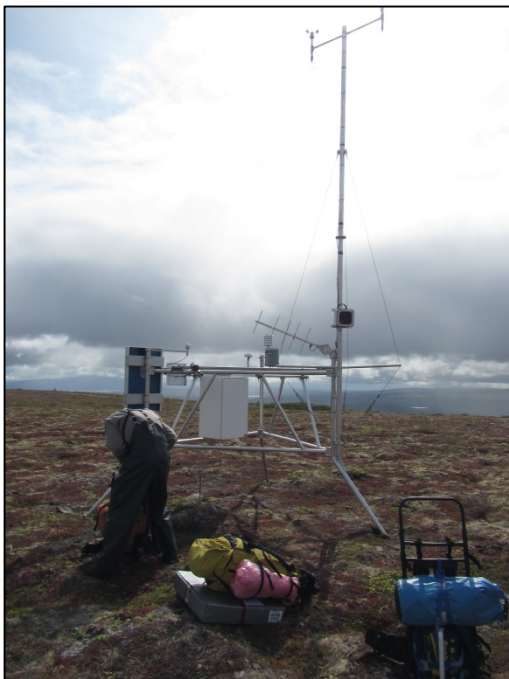


Figure 14. Coville RAWS phenocam – The Harbortronics time lapse camera is mounted to the mast.

Exit Glacier Phenocam – Download – April 22, 2014

Time of visit: 1100-1200

Personnel: C. Lindsay, D. Kurtz, S. Venator

Mode of transport: Ski

Purpose of trip: Download camera and replace desiccant

Weather: Mostly sunny, 42 F, winds light and variable

Maintenance:

New desiccant

New SD card

Narrative:

The Campbell Scientific time lapse camera at Exit Glacier (Figure 15) operated without flaw during 2013-14 after it was powered directly off a 100 Ah batteries and 10 W solar panel. The camera collected 13 JPG-format photos/day between October 23, 2013 and April 22, 2014. New desiccant and an empty 16 GB SD card were installed.



Figure 15. Exit Glacier phenocam – CC5MPX phenocam image acquired on April 1, 2014.

Exit Glacier Phenocam –Annual Maintenance – September 23, 2014

Time of visit: 1600-700

Personnel: C. Lindsay, D. Kurtz

Mode of transport: Vehicle from Seward

Purpose of trip: Download camera and replace desiccant

Weather: Mostly sunny, 60 F, winds light and variable

Maintenance:

- New desiccant

- New SD card

Narrative:

The Campbell Scientific time lapse camera at Exit Glacier operated without flaw during the summer

The camera collected 13 JPG-format photos/day between April 22, 2014 and September 24, 2014.

New desiccant and an empty 16 GB SD card were installed.

Fourpeaked Weather Station – Annual Maintenance – May 20, 2014

Time of visit: 0900-1300

Personnel: C. Lindsay, D. Rose

Mode of transport: B206 helicopter from Homer

Purpose of trip: Annual maintenance

Weather: Mostly sunny, 50 F, winds southwest 10 mph gusting 15 mph

Sensors replaced:

Air temperature – relative humidity

Wind speed and cable

Wind direction and cable

Rain gauge tipping bucket

Data logger

GOES antenna and cable

Narrative:

Maintenance of Fourpeaked Mountains weather station was done on the same day as maintenance on Chigmit weather station. A round-trip helicopter flight was made from Homer with a refueling stop at the Iliamna airport. The station was moderately damaged by rime ice and wind during the winter of 2013-14. The GOES antenna was broken and pointing at the ground (Figure 16). It was remarkable that the station was still transmitting effectively. The air temperature – relative humidity sensor mount was loose (Figure 17). There was no visible damage to either the WD sensor or the WD cable, although wind direction observations have been erroneous since February 2014. There was also no visible damage to the rain gauge tipping bucket although precipitation measurements were greatly exaggerated during the 2013-14 winter. The data logger was replaced, telemetry was configured and data logger program FOUR_DLP_SR50A.prg was loaded. The AT-RH sensor, WS sensor and cable, and WD sensor and cable were replaced. A WD sensor direction test was done. The rain gauge tipping bucket was replaced. The rain count was zeroed, and a tipping bucket test was done. The GOES antenna and cable were replaced (the replacement antenna uses narrow diameter tines). All data in the data logger were downloaded to send to the WRCC in order to update the archive. All bolts on the station were checked and tightened if loose and all cables were zip-tied. The mast may need to be replaced in the future because the clamp that attaches to the tower has a groove eroded into it and this allows for play that will eventually affect the accuracy of wind direction observations. One additional tower frame panel remains cached on site. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 18) and the inside of the instrument enclosure (Figure 19) was also photographed.

The Fourpeaked remote automated weather station was set up on June 11, 2009 in support of the weather and climate ‘vital signs’ monitoring efforts of the SWAN. During the five years (2009-2014) that the Fourpeaked RAWS has operated access to the station has proven more challenging than anticipated and the station has not performed as well as originally desired because of the harsh climatic conditions encountered at higher elevations along the Katmai coast. In 2014, an unpublished administrative report (Lindsay 2014) was completed. This report identifies priority-ranked sites for relocation and serves as a proposal to KATM and SWAN for further consideration. An evaluation of the possible sites based on expert opinion identified a preferred location adjacent to the National Park Service cabin at Swikshak Bay. This site is located in designated wilderness however it is adjacent to an existing installation (NPS cabin). This site is relatively accessible (by wheel plane) and has good climatological exposure appropriate for a weather station. It is recommended that compliance work be completed at this time in anticipation of station relocation in the future.



Figure 16. Fourpeaked RAWS – The GOES antenna mount broke.



Figure 17. Fourpeaked RAWS – Loose mount on AT-RH sensor.



Figure 18. Fourpeaked RAWS – Station viewed from north after maintenance.



Figure 19. Fourpeaked RAWS – Inside of instrument enclosure after maintenance.

Harding Icefield Weather Station – Unscheduled Maintenance – October 26, 2013

Time of visit: 1300-1330

Personnel: C. Lindsay

Mode of transport: B206 helicopter from Seward

Purpose of trip: Unscheduled maintenance

Weather: Mostly sunny, 32 F, winds southeast 7 mph gusting 13 mph, snow present on the ground

Sensors replaced:

Solar radiation

Narrative:

The solar radiation sensor was replaced. It failed on September 1, 2013. This was unscheduled maintenance supported by helicopter availability for glacier monitoring field work. The station was heavily iced (Figures 20 and 21) and the tip had fallen off of the wind direction sensor (Figure 22). Wind direction seemed to be accurate.



Figure 20. Harding Icefield RAWS – Rime ice covers the weather station.

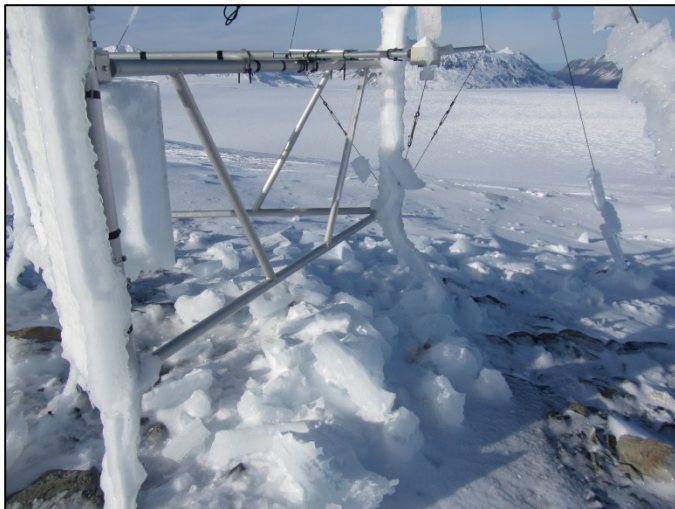


Figure 21. Harding Icefield RAWS – Ice chunks that had fallen off the station.



Figure 22. Harding Icefield RAWS – Wind direction sensor without tip.

Harding Icefield Weather Station – Annual Maintenance – May 15, 2014

Time of visit: 1000-1500

Personnel: C. Lindsay, S. LaHusen

Mode of transport: B206 helicopter from Seward

Purpose of trip: Annual maintenance

Weather: Mostly sunny, 46 F, winds northwest 5 mph gusting 10 mph, 4 in snow on the ground

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction and cable

Snow depth sensor

Serviced precipitation gauge

Mast spreader bar and guy-wire

Narrative:

The weather station was not maintained during late April (the usual timeframe) because weather conditions only allowed for a half-day helicopter flight in support of springtime glacier monitoring field work. However, replacement solution for the precipitation gauge was cached on-site at this time. In mid-May, a round-trip helicopter flight was made from Homer to the weather station, stopping in Seward to pick up S. LaHusen and refuel. The station was only moderately damaged by rime ice during the winter of 2013-14. One of the spreader bars and a guy-wire on the wind mast had broken (Figure 23), the tip had fallen off the wind direction sensor (Figure 24), and the GOES antenna was missing one tine (Figure 25). In contrast to previous years, in April and May (of 2014) the precipitation gauge was not capped by ice (Figure 26) like it was in the spring of both 2012 and 2013. The AT-RH sensor, WS sensor and cable, and WD sensor were replaced. A WD sensor direction test was done. The all-weather precipitation gauge was serviced by draining the antifreeze/alcohol/water solution and replacing it with a fresh solution. Lightweight (10W) hydraulic oil was poured on top of the antifreeze solution instead of regular motor oil (as in the past) in order to limit evaporation. The rain count for the tipping bucket was zeroed, and a tipping bucket test was done. All data in the data logger were downloaded to send to the WRCC in order to update the archive. The SD sensor was replaced with a Judd Communications SD sensor, which was rehabbed with new transducer plates and desiccant. Data logger program HAIC_DLP_Judd.prg was edited to zero the SD sensor. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. There was four inches of snow on the ground during maintenance. It was removed prior to zeroing the snow depth sensor and then replaced. All bolts on the station were checked and tightened if loose and all cables were zip-tied. The north spreader bar and guy-wire on the wind sensor mast were replaced. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 27) and the inside of the instrument enclosure (Figure 28) was also photographed.

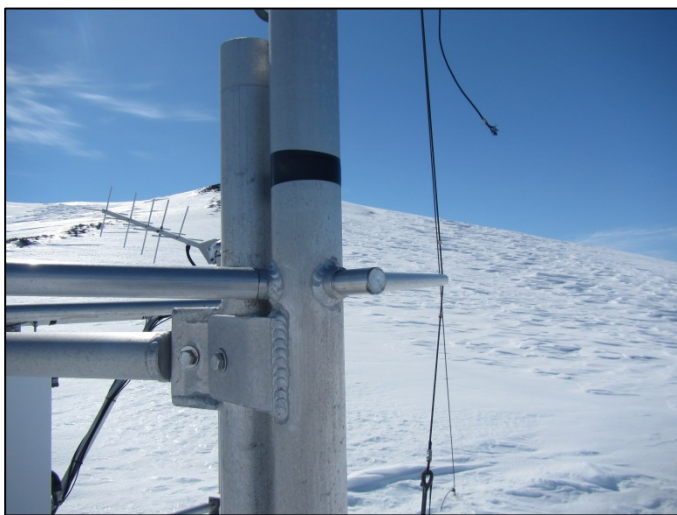


Figure 23. Harding Icefield RAWS – Broken spreader bar and guy-wire on the wind sensor mast.



Figure 24. Harding Icefield RAWS – Wind direction sensor without tip and broken guy-wire.



Figure 25. Harding Icefield RAWS – GOES antenna tine broken off inside antenna.



Figure 26. Harding Icefield RAWS – View down precipitation gauge. No ice was present.

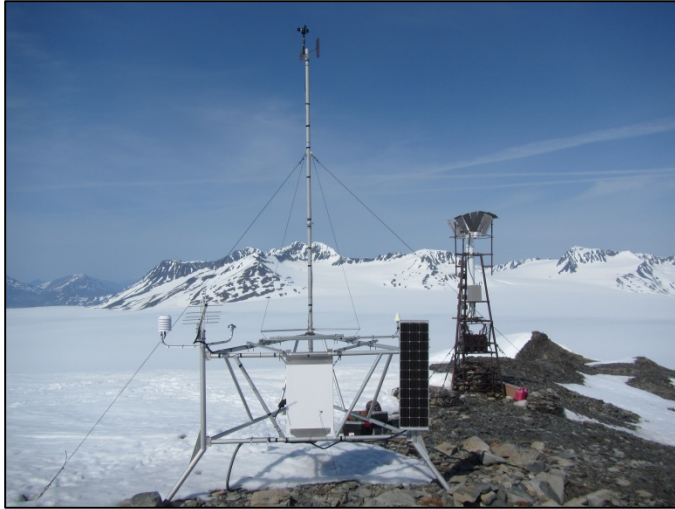


Figure 27. Harding Icefield RAWS – Station viewed from south after maintenance.



Figure 28. Harding Icefield RAWS – Inside of instrument enclosure after maintenance.

Harding Icefield Weather Station – Unscheduled Maintenance – September 23, 2014

Time of visit: 1100-1200

Personnel: C. Lindsay

Mode of transport: B206 helicopter from Seward

Purpose of trip: Unscheduled maintenance

Weather: Mostly sunny, 35 F, winds light and variable, 1 in snow present on the ground

Sensors replaced:

Wind direction

Narrative:

The tail fell off the wind direction sensor on June 7, 2013, shortly after it was replaced during annual maintenance. During the intervening time frame, reported wind directions were off by 180 degrees. This unscheduled maintenance was supported by helicopter availability for glacier monitoring field work. The wind direction sensor was replaced (Figures 29 and 30). The precipitation gauge was also inspected. It was full of antifreeze solution to the outlet and there was no ice inside the gauge orifice – normal conditions.



Figure 29. Harding Icefield RAWs – Wind direction sensor (right) without tail piece.



Figure 30. Harding Icefield RAWS – Wind direction sensors after unscheduled repairs.

Hickerson Lake Weather Station – Station Removal – June 11, 2014

Time of visit: 0900-1300

Personnel: C. Lindsay, D. Rose

Mode of transport: B206 helicopter from Homer

Purpose of trip: Station removal

Weather: Partly cloudy, 52 F, winds southwest 5 mph gusting 10 mph

Narrative:

The Hickerson Lake weather station in Lake Clark National Park and Preserve has been decommissioned after 6 years of service. It was installed in June 2008. It was decommissioned because access for maintenance was really difficult and also unsafe. The Hickerson Lake weather station likely represented the first continuously operating automated weather station on the Cook Inlet coast located within Lake Clark National Park and Preserve. During the time that this weather station operated it documented the following climate conditions:

Average annual air temperature: 36.6 F

Average annual rainfall: 46.8 in

Average April snow depth: 23 in

Maximum temperature: 81.7 F (June 2013)

Minimum temperature: -8.1 F (January 2012)

Maximum monthly rainfall: 17.6 in (September 2012)

Maximum snow depth: 30.4 in (March 2012)

Maximum wind gust: 139.6 mph (Feb 2010)

The Hickerson Lake weather station has been replaced by a new station located near Silver Salmon Lakes on the Lake Clark coastline of Cook Inlet. These stations overlapped in operation from July 9, 2013 to June 11, 2014.

The weather station was disassembled and transported by helicopter sling load to the NPS cabin at Chinitna Bay. All sensors were removed from the station, tow straps were attached to the frame and a 100 ft long line with a remote hook was used to sling the station (Figure 31). No trace of the weather station remains on-site (Figure 32). The weather station components will be stored for future use at the NPS warehouse in Anchorage. Some sensors will need to be replaced before use because they will be out of calibration.



Figure 31. Hickerson Lake RAWs – Helicopter sling load of Hickerson Lake weather station frame.



Figure 32. Hickerson Lake RAWs – Weather station site after removal.

McArthur Pass Weather Station – Annual Maintenance – May 15, 2014

Time of visit: 1000-1500

Personnel: C. Lindsay, R. Jones, D. Rose

Mode of transport: B206 helicopter from Homer

Purpose of trip: Annual maintenance

Weather: Sunny, 60 F, winds light and variable

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Narrative:

A round-trip helicopter flight was made from Homer. The station showed little signs of damage from rime ice and wind during the winter of 2013-14. However, the solar panel had shifted in orientation and was facing south east (the prevailing wind direction) and three of the four hose clamps that support the solar panel were broken (Figure 33). The AT-RH sensor had malfunctioned on September 25, 2013, but there was no visible damage to sensor or cable. Two tines were missing from the GOES antenna. The AT-RH sensor, WS sensor, and WD sensor were replaced. The missing GOES antenna tines were also replaced. A WD sensor direction test was done. The rain count was zeroed, and a tipping bucket test was done. All data in the data logger were downloaded to send to the WRCC in order to update the archive. All bolts on the station were checked and tightened if loose and all cables were zip-tied. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 34) and the inside of the instrument enclosure (Figure 35) was also photographed. It is recommended that a new solar panel be mounted on to the weather station in the future because the existing hose clamp mounting system does not work well at this location. The solar panel could be set up with U-bolts that would mount onto the frame. For reference, the outside diameter of the aluminum pipe to which the solar panel is mounted is 2-3/8 in.



Figure 33. McArthur Pass RAWs – Three out of four hose clamps used to mount the solar panel had broken.

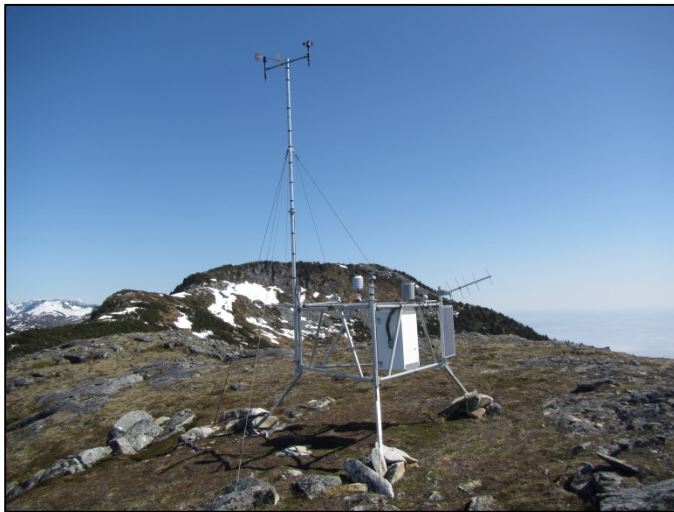


Figure 34. McArthur Pass RAWs – Station viewed from southwest after maintenance.



Figure 35. McArthur Pass RAWs – Inside of instrument enclosure after maintenance.

McArthur Pass Weather Station – Unscheduled Maintenance – September 8, 2014

Time of visit: 1000-1100

Personnel: C. Lindsay

Mode of transport: B206 helicopter from Homer

Purpose of trip: Unscheduled maintenance

Weather: Mostly cloudy, 50 F, winds southeast 15 mph gusting 25 mph.

Sensors replaced:

Wind direction

Narrative:

A round-trip helicopter flight was made from Homer to replace the wind direction sensor, which had failed on June 17 during a storm that had peak wind speeds of 93 mph. The fletching (tail) had fallen off the wind speed sensor, so wind directions for this period are off by 180 degrees.

Low clouds prevented landing the helicopter at the weather station so a landing zone (Figure 36) located about 300 ft below the weather station on the lee (north) side of the ridge was used. Hiking time to the weather station from this helistop was about 20 minutes. During the hike up, an old AT-RH sensor and a different WD sensor fletching were found and recovered. The wind direction sensor was replaced (Figure 37). Deteriorating weather conditions prevented any further maintenance tasks from being completed, but the station looked like it was in good condition (Figure 38).



Figure 36. McArthur Pass RAWS – Helicopter landing zone located about 300 ft below and to the northwest of the weather station.



Figure 37. McArthur Pass RAWS – The fletching (tail) had fallen off the wind direction sensor.



Figure 38. McArthur Pass RAWS – Station viewed from north after maintenance.

Pedersen Lagoon Weather Station – Unscheduled Maintenance – November 1, 2014

Time of visit: 1000-1200

Personnel: D. Kurtz, L. Phillips

Mode of transport: Boat (water taxi) from Seward

Purpose of trip: Unscheduled maintenance

Weather: 45 F, winds light and variable.

Sensors replaced:

Air temperature – relative humidity

Narrative:

The AT-RH sensor started reporting cooler than expected temperatures (relative to adjacent weather stations) on September 27, 2013 and then much warmer than expected temperatures on October 25, 2013. Kenai Fjords staff volunteered to perform the maintenance and a water taxi from Seward was used to access the weather station. The AT-RH sensor was replaced. No other maintenance was completed, but the station appeared to be in good condition. Replacing the AT-RH sensor worked, however data that was subsequently available on the web was incorrectly reported. After maintenance, an email was sent to WFMI requesting that all temperature elements be enabled so that temperature data could be passed on to client websites (it was purposely blocked). For some reason, output units were inadvertently changed to degrees F for maximum and minimum temperatures. However, client websites still expected the input to be in degrees C. This meant that maximum and minimum temperatures were doubly converted from C to F. Mean temperatures were not affected. This problem persisted from November 1, 2013 to August 8, 2014 (Figure 39). Fortunately, reported temperatures should resolve after station data is sent to the WRCC and the archive is updated.

Hour of Day	Total Solar	Wind		Air Temperature				Relative Humidity
Ending at L.S.T.	Rad. ° ly.	Ave. mph	V. Dir. Deg	Max. mph	Mean	Max Deg. F	Min	Mean Percent
1 am	0.1	15.7	88	39.6	52.3	126.5	126.0	92
2 am	0.1	17.4	88	41.4	52.3	126.1	125.6	92
3 am	0.1	20.1	103	42.5	52.3	126.9	126.0	92
4 am	0.1	19.0	108	43.0	52.5	127.8	125.6	92
5 am	0.1	16.1	100	42.1	52.7	127.8	126.1	92
6 am	0.8	11.6	85	42.3	52.7	127.6	126.0	93
7 am	1.8	11.0	75	26.4	52.7	128.1	126.0	93
8 am	3.8	13.9	92	48.8	53.4	129.2	127.2	92
9 am	6.1	15.7	109	36.2	53.6	54.0	53.4	93
10 am	6.3	16.3	108	43.2	54.0	54.1	53.8	94
11 am	6.2	18.1	94	40.5	54.1	54.3	54.0	97

Figure 39. Pedersen Lagoon RAWs – Maximum and minimum temperatures were inadvertently converted from degrees C to degrees F but were still reported as degrees C. This meant that some websites doubly converted the values to degrees F, which resulted in completely inaccurate temperatures.

Pedersen Lagoon Weather Station – Annual Maintenance – August 14, 2014

Time of visit: 1000-1300

Personnel: C. Lindsay, M. Kansteiner, S. LaHusen

Mode of transport: M/V Serac

Purpose of trip: Annual maintenance

Weather: Rain, 55 F, winds northwest 5 mph gusting 10 mph

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Solar radiation

Rain gauge tipping bucket

Snow depth

Narrative:

Access to the Pedersen Lagoon weather station was by M/V Serac (NPS boat from Seward) and foot (from Alaska Wildland Adventure's Kenai Fjords Glacier Lodge). It rained, with almost two inches of precipitation falling on the same day that maintenance was completed. Vegetation beneath and around station had grown significantly (Figure 40) but not as much as in previous years. This vegetation was trimmed using garden shears. The weather station was in good condition. To date, there has been no damage caused by wildlife. This is surprising given the abundance of bear (black bear) sign around the weather station. The AT-RH sensor, WS sensor, WD sensor, SR sensor, and rain gauge tipping bucket were all replaced. A WD sensor direction test was done. The rain count for the tipping bucket was zeroed and a tipping bucket test was done. All data from the data logger were downloaded to send to the WRCC in order to update the data archive. The SD sensor was replaced with a Judd Communications SD sensor that had been rehabbed with a new transducer plate and desiccant. The data logger configuration file PELA_F6config_Judd.xml was modified to zero snow depth to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. All bolts on the station were checked and tightened if loose and cables were zip-tied. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure, the station was photographed from eight directions (every 45°; Figure 40) and the inside of the instrument enclosure (Figure 42) was also photographed.



Figure 40. Pedersen Lagoon RAWS – Abundant vegetation grows around the weather station each summer. Plant growth is incidentally documented by the snow depth sensor which recorded a growth spurt beginning around June 9.

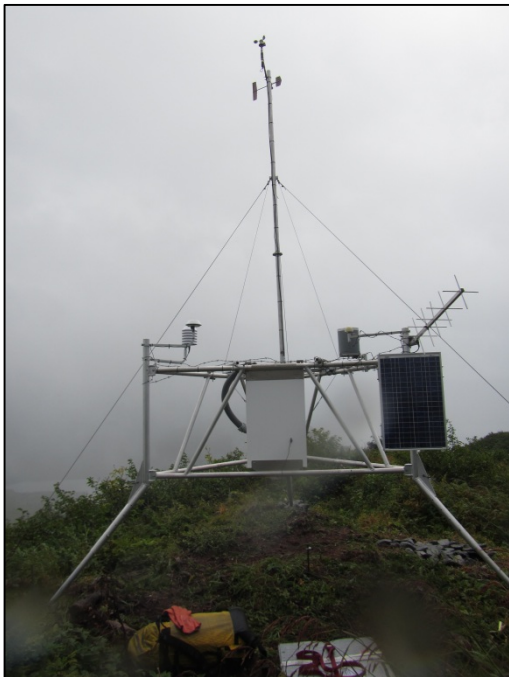


Figure 41. Pedersen Lagoon RAWS – Station viewed from south after maintenance.



Figure 42. Pedersen Lagoon RAWS – Inside of instrument enclosure after maintenance.

Pfaff Mine Weather Station – Annual Maintenance – June 3, 2014

Time of visit: 1000-1300

Personnel: C. Lindsay, A. Gilliland, R. Gonzales

Mode of transport: C185 (on wheels) from King Salmon (NPS aircraft)

Purpose of trip: Annual maintenance

Weather: Sunny, 50 F, winds east 5 mph gusting 10 mph

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Solar radiation

Snow depth

Soil temperature probes

SDI analog module

Batteries

Narrative:

Access to the Pfaff Mine weather station was by NPS wheel plane. The station was in good condition but the soil temperature sensors were acting up. This has been a persistent problem at this station. The first (10 cm) soil temperature sensor stopped working in early March 2014. The AT-RH sensor, WS sensor, WD sensor, and SR sensor were replaced. A wind direction test was done. The rain count was zeroed, and a tipping bucket test was done. The SD sensor was replaced with a Campbell Scientific SR50A SD sensor, which had been rehabbed with new transducer plates and desiccant. Note that this station can only accommodate the SR50A sensor when soil temperature probes are also in use. The dual soil temperature probes were replaced at the same location and depth of 10 and 50 cm (Figure 43). The SDI-AM module was also replaced (Figure 44) in case it was the cause of the failed soil temperature sensor. Both 100 Ah batteries were replaced. Data logger program PFMI_DLP_SR50A_SoilTemp.prg was edited to zero snow depth and operate the soil temperature sensors (transmitted element No. 17 corresponds to Temp1 in the data logger program and this is the soil temperature at 10 cm depth. Transmitted element No. 18 corresponds to Temp2 in the data logger program and this is the soil temperature at 50 cm depth). SD was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. All data were downloaded to send to the WRCC in order to update the archive. A large rock was placed in the rain gauge tipping bucket in order to mitigate excessive tipping that occurs during strong wind events (Figure 45). This has now been done for the last three years. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. All bolts on the station were checked and tightened if loose and cables were zip-tied. Before departure the station was photographed from eight directions (every 45°, Figure 46) and the inside of the instrument enclosure (Figure 47) was also photographed.



Figure 43. Pfaff Mine RAWs – Soil temperature probes are located 1 m from the base of the SW corner of the weather station at 10 and 50 cm depth.



Figure 44. Pfaff Mine RAWs – Wiring configuration used on the replacement analog/digital convertor that accommodates dual soil temperature sensors through SDI.



Figure 45. Pfaff Mine RAWS – A large rock was placed inside the tipping bucket in order to mitigate excessive tipping that occurs during strong wind events.

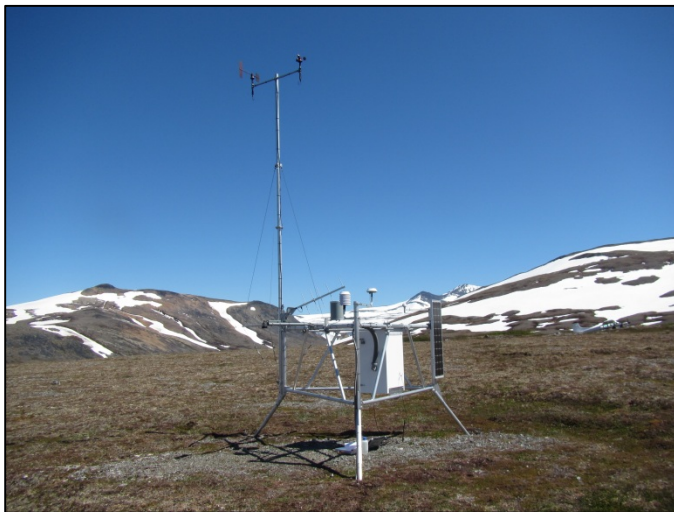


Figure 46. Pfaff Mine RAWS – Station viewed from southwest after maintenance.



Figure 47. Pfaff Mine RAWS – Inside of instrument enclosure after maintenance.

Pfaff Mine Weather Station – Unscheduled Maintenance – August 29, 2014

Time of visit: 1000-1100

Personnel: J. Nelson

Mode of transport: C185 (on wheels) from King Salmon (NPS aircraft)

Purpose of trip: Unscheduled maintenance

Weather: Sunny, 45 F, winds north 10 mph gusting 15 mph

Sensors replaced:

None

Narrative:

All the sensors that share SDI (snow depth, solar radiation, and soil temperature) stopped working on June 19, 2014. It was assumed that the soil temperature sensors were the cause of this problem because they have been problematic before. Unscheduled maintenance included unplugging the soil temperature SDI-AM from the SDI port (Figure 48). This did not work (snow depth and solar radiation still didn't work). The solar radiation sensor was then directly plugged into the SDI port on the data logger. This also didn't work. The BLM RAWS Depot thinks that the SDI bus in the data logger failed and suggests replacing the data logger.

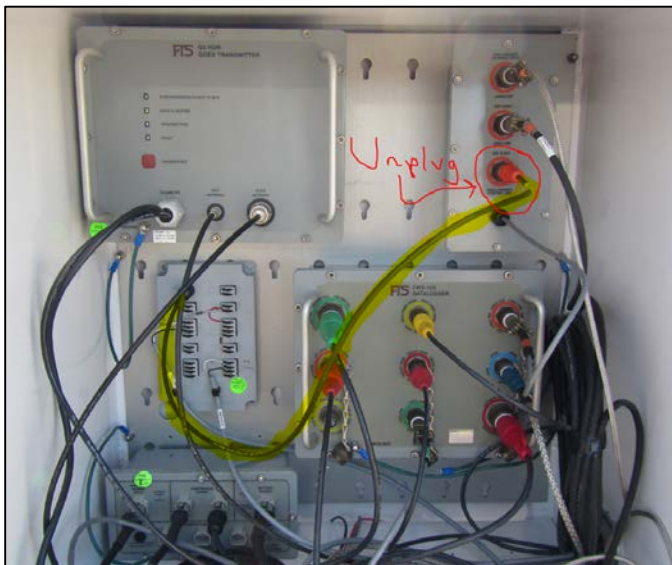


Figure 48. Pfaff Mine RAWS – Inside of instrument enclosure before maintenance. First, the soil temperature sensors were unplugged from the SDI splitter box and then the solar radiation sensor was plugged directly into the data logger SDI port. Neither solution worked.

Pfaff Mine Weather Station – Unscheduled Maintenance – September 25, 2014

Time of visit: 0900-1100

Personnel: E. Booher, J. Nelson

Mode of transport: C185 (on wheels) from King Salmon (NPS aircraft)

Purpose of trip: Unscheduled maintenance

Weather: Sunny, 39 F, winds light and variable, no snow on the ground

Sensors replaced:

Data logger

Solar radiation

Narrative:

All the sensors that share SDI (snow depth, solar radiation, and soil temperature) stopped working on June 19, 2014. It was assumed that the soil temperature sensors were the cause of this problem because they have been problematic before. Unscheduled maintenance included replacing the data logger. Data logger program PFMI_DLP_SR50A.prg was edited to zero the SD sensor. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. The soil temperature-enabled data logger program was not used and the problem with the soil temperature sensors will not be resolved until summer of 2015. The existing solar radiation sensor wasn't working after replacing the data logger, so it was also replaced. The data logger and solar radiation sensor will be returned to the RAWS Depot for inspection and hopefully the problem's cause can be identified. The inside of the instrument enclosure (Figure 49) was photographed before departure.



Figure 49. Pfaff Mine RAWS – Inside of instrument enclosure after maintenance. The soil temperature sensor and SDI-AM are not plugged into the data logger.

Port Alsworth Phenocam – Camera removal – June 6, 2014

Time of visit: 1300-1900

Personnel: Chuck Lindsay

Mode of transport: Foot from Port Alsworth

Purpose of trip: RAWS Annual maintenance for NPS Radio Shop and phenocam removal

Weather: Sunny, 65 F, winds light and variable

Sensors replaced:

The Campbell Scientific time lapse camera that was mounted to the Port Alsworth RAWS was removed. The camera collected 13 JPG-format photos/day, but only from June 23, 2013 to September 14, 2013. During the last visit to this phenocam, on June 21 of 2013, the 35 Ah battery and charge controller were removed and the camera was directly connected to a standard car battery with no solar panel input. Without a charging input, it was not expected to successfully operate for long. When Campbell Scientific was contacted later in 2013, they indicated that there was a recall on early model CC5MPX cameras and that the cameras would need to be sent in for a hardware upgrade. The camera (S/N 1181) was removed and returned to Campbell Scientific on September 9, 2014 (RMA no. 19878).

An additional CC5MPX camera was purchased from Campbell Scientific in September 2014. It is recommended that this camera be installed on the headquarters building in Port Alsworth and powered using AC. It could be connected to the network and used as a webcam, in addition to its use as a phenocam.

Silver Salmon Lakes Weather Station – Annual Maintenance – June 10, 2014

Time of visit: 1100-1400

Personnel: C. Lindsay

Mode of transport: C206 (on wheels) from Pt. Alsworth (NPS aircraft)

Purpose of trip: Annual maintenance

Weather: Sunny, 55 F, winds south 15 mph gusting 25 mph

Sensors replaced:

Air temperature – relative humidity

Snow depth

Narrative:

The station was in great condition. Vegetation beneath and around the station had grown significantly (Figure 50). This vegetation was trimmed using a hand-held weed whip and by hand pulling. The electric fence was operational and in good condition. The AT-RH sensor was replaced. The rain count was zeroed, and a tipping bucket test was done. The SD sensor was replaced with a Judd Communications SD sensor (Figure 51), which was rehabbed with new transducer plates and desiccant. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. All data in the data logger were downloaded to send to the WRCC in order to update the archive. All bolts on the station were checked and tightened if loose and all cables were zip-tied. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 52) and the inside of the instrument enclosure (Figure 53) was also photographed.



Figure 50. Silver Salmon Lakes RAWS – Vegetation growth around the weather station.



Figure 51. Silver Salmon Lakes RAWS – Judd snow depth sensor and snow depth target cleared of vegetation.



Figure 52. Silver Salmon Lakes RAWS – Station viewed from south after maintenance.



Figure 53. Silver Salmon Lakes RAWs – Station viewed from south after maintenance.

Silver Salmon Lakes Phenocam – Annual Maintenance – June 10, 2014

Time of visit: 1100-1400

Personnel: C. Lindsay

Mode of transport: C206 (on wheels) from Pt. Alsworth (NPS aircraft)

Purpose of trip: Annual maintenance

Weather: Sunny, 55 F, winds south 15 mph gusting 25 mph

Maintenance:

New desiccant

New SD card

Reprogram intervalometer

Narrative:

The Harbortronics time lapse camera was maintained (Figure 54). The 32 GB SD card was exchanged for an empty one and the desiccant packs were replaced. The camera was set up to collect five RAW-format photos/day between July 10, 2013 and March 7, 2014. For some unknown reason, the camera actually collected two photos for each scheduled acquisition, so a total of 10 photos/day were collected. On March 7 the camera started acquiring photographs every two seconds. This rate of acquisition continued until the memory card filled on March 8. When the camera was maintained the enclosure was very wet inside (Figure 55). It was dried out and the camera was still functional. The intervalometer was reprogrammed. The same specifications as before were used. A thin film of silicone grease was applied to the inside gasket on the housing door with an irrigation syringe and a layer of silicone sealant was applied on the outside of the gasket to help maintain a weather-tight seal.



Figure 54. Silver Salmon Lakes phenocam – Phenocam image acquired on January 18, 2014.



Figure 55. Silver Salmon Lakes phenocam – Moisture inside the phenocam housing.

Snipe Lake Weather Station – Annual Maintenance – June 8, 2014

Time of visit: 1100-1600

Personnel: C. Lindsay, T. Rovinelli

Mode of transport: C185 (on floats) from Pt. Alsworth (NPS aircraft)

Purpose of trip: Annual maintenance

Weather: Mostly cloudy, 48 F, winds west 10 mph gusting 20 mph

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Solar radiation

Rain gauge tipping bucket

Snow depth (SR50A)

Narrative:

The Snipe Lake weather station was in great condition. The AT-RH sensor, WS sensor, WD sensor, SR sensor, and rain gauge tipping bucket were replaced. A WD sensor direction test was done. The rain count for the tipping bucket was zeroed, and a tipping bucket test was done. All data in the data logger were downloaded to send to the WRCC in order to update the archive. The SD sensor was replaced with a Campbell Scientific SR50A SD sensor, which was rehabbed with new transducer plates and desiccant. Data logger program SNLA_DLP_SR50A_2SOILTEMP.prg was edited to zero the SD sensor. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. The dual soil temperature sensors continued to operate without any issues. All bolts on the station were checked and tightened if loose and all cables were zip-tied. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 56) and the inside of the instrument enclosure (Figure 57) was also photographed. An unused 10 W solar panel remains mounted to the station. This solar panel originally charged a separate battery used for the Campbell Scientific camera described below.

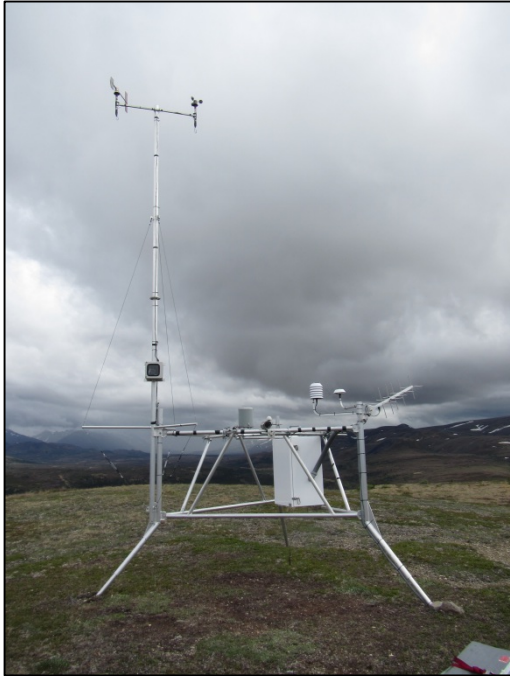


Figure 56. Snipe Lake weather station – Station viewed from northwest after maintenance.



Figure 57. Snipe Lake weather station – Inside of instrument enclosure after maintenance.

Snipe Lake Phenocam – Annual Maintenance – June 8, 2014

Time of visit: 1100-1600

Personnel: C. Lindsay, T. Rovinelli

Mode of transport: C185 (on floats) from Pt. Alsworth (NPS aircraft)

Purpose of trip: Annual maintenance

Weather: Mostly cloudy, 48 F, winds west 10 mph gusting 20 mph

Maintenance:

Campbell Scientific time lapse camera:

Removed camera S/N 01115

Installed camera S/N 01063 with firmware 1.22

New desiccant

New SD card

Harbortronics time lapse camera:

New desiccant

New SD card

Narrative:

The existing Campbell Scientific time lapse camera (S/N 01115) was removed for return to Campbell Scientific (RMA no. 19878) for a necessary hardware modification to fix the power consumption problem experienced in 2012-13. The camera did operate correctly for most (but not all) of 2013-14 after it was powered directly off the weather station batteries (two 100 Ah batteries: Figure 58). The camera collected 13 JPG-format photos/day between June 20, 2013 and April 8, 2014. All photos collected after April 8 were solid green images along with some earlier photographs (Figure 59). A different Campbell Scientific time lapse camera (S/N 01063; previously repaired by Campbell Scientific) was installed with updated firmware (version 1.22). New desiccant and an empty 16 GB SD card were installed.

The Harbortronics time lapse camera was maintained. The 32 GB SD card was exchanged for an empty one and the desiccant packs were replaced. The camera collected four RAW-format photos/day between June 20, 2013 and June 8, 2014. The same specifications as before were used. Before departure a thin film of silicone grease was applied to the gasket on the housing door with an irrigation syringe to help maintain a weather-tight seal.



Figure 58. Snipe Lake phenocam – CC5MPX phenocam image acquired on December 5, 2013.

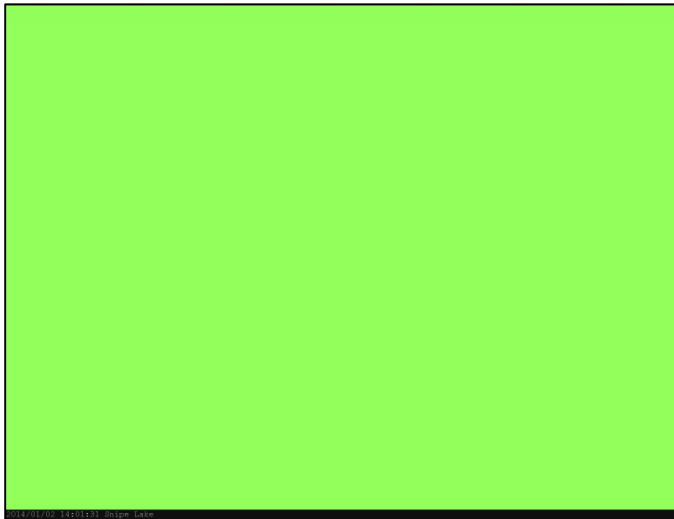


Figure 59. Snipe Lake phenocam – CC5MPX phenocam faulty image acquired on January 2, 2014.

Three Forks Weather Station – Annual Maintenance – June 4, 2014

Time of visit: 1100-1500

Personnel: C. Lindsay, L. Thomas

Mode of transport: Vehicle from Brooks Camp

Purpose of trip: Annual maintenance

Weather: Mostly sunny, 65 F, winds east 10 mph gusting 20 mph

Sensors replaced:

Air temperature – relative humidity

Wind speed

Wind direction

Solar radiation

Rain gauge tipping bucket

Snow depth (SR50)

Batteries

Narrative:

The Three Forks weather station was in great condition. The AT-RH sensor, WS sensor, WD sensor, SR sensor, and rain gauge tipping bucket were replaced. Both 100 Ah batteries were replaced. A WD sensor direction test was done. The rain count for the tipping bucket was zeroed, and a tipping bucket test was done. All data in the data logger were downloaded to send to the WRCC in order to update the archive. The SD sensor was replaced with a Campbell Scientific SR50 SD sensor, which was rehabbed with new transducer plates and desiccant. Data logger program THFO_DLP_SR50.prg (copied from COCR_DLP_SR50.prg) was edited to zero the SD sensor. Snow depth was zeroed to an average reading of -0.5 inches to account for fluctuation without reporting misleading snow depth readings. All bolts on the station were checked and tightened if loose and all cables were zip-tied. An additional three foot long steel stake was driven through each foot on the weather station to better anchor it. Station observations and GOES transmission quality were checked before departure. Observations and transmissions were verified from the WFMI website and relayed by satellite phone. Before departure the station was photographed from eight directions (every 45°, Figure 60) and the inside of the instrument enclosure (Figure 61) was also photographed.

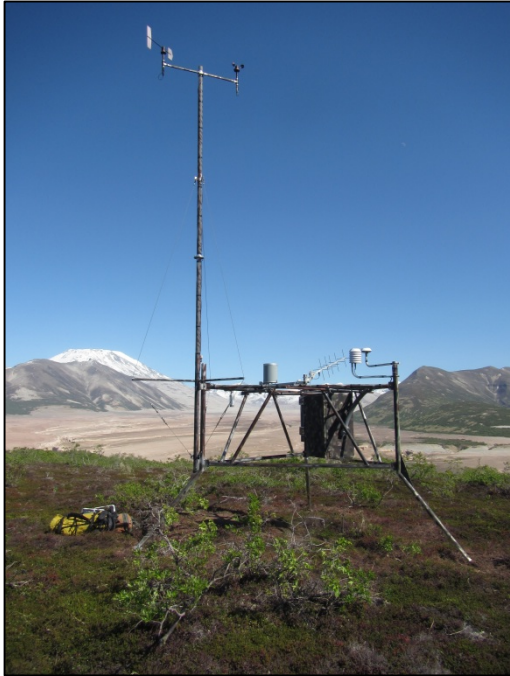


Figure 60. Three Forks weather station – Station viewed from NW after maintenance.



Figure 61. Three Forks weather station – Inside of instrument enclosure after maintenance.

Weather Station Sensor Metadata

Table 2. Sensor metadata for weather stations operated and maintained by the SWAN.

Station name	Sensor	Model	Height m	Serial no	Asset no	Start date	Stop date
Chigmit Mountains	AT-RH	FTS THS-3	2.34	31672	22269	6/12/13	5/20/14
	AT-RH	FTS THS-3	2.34	42184	37561	5/20/14	active
	WD	FTS 023-30	6.10	415511	40441	6/12/13	5/20/14
	WD	FTS 023-30	6.10	27979	125044	5/20/14	active
	WS	FTS 013-30	6.10	47792	41774	6/12/13	5/20/14
	WS	FTS 013-30	6.10	42184	37561	5/20/14	active
	RG-TB	FTS RG-T	2.18	2754	121530	6/11/12	active
	SR	FTS SDI-SR-PYR	2.29	14519	7029	6/30/11	5/20/14
	SR	FTS SDI-SR-PYR	2.29	3988	122055	5/20/14	active
	SD	CS SR50	1.87	8118	n/a	6/12/13	5/20/14
	SD	CS SR50	1.87	18259	n/a	5/20/14	active
Coville	AT-RH	FTS THS-3	2.06	26745	106015	6/25/13	6/2/14
	AT-RH	FTS THS-3	2.06	41014	36364	6/2/14	active
	WD	FTS 023-30	6.10	37246	39665	6/20/12	6/2/14
	WD	FTS 023-30	6.10	K4004	110846	6/2/14	active
	WS	FTS 013-30	6.10	37241	107508	6/20/12	6/2/14
	WS	FTS 013-30	6.10	40640	36193	6/2/14	active
	RG-TB	FTS RG-T	2.21	1596	6808	6/14/11	6/2/14
	RG-TB	FTS RG-T	2.21	2817	122972	6/2/14	active
	SR	FTS SDI-SR-PYR	2.21	PYR112	4049	6/25/13	6/2/14
	SR	FTS SDI-SR-PYR	2.21	2697	6582	6/2/14	active
	SD	CS SR50A	1.52	3341	n/a	6/25/13	6/2/14
	SD	CS SR50A	1.52	41909	n/a	6/2/14	active

Table 2 continued. Sensor metadata for weather stations operated and maintained by the SWAN.

Station name	Sensor	Model	Height m	Serial no	Asset no	Start date	Stop date
Fourpeaked	AT-RH	FTS THS-3	2.34	30638	16584	6/12/13	5/20/14
	AT-RH	FTS THS-3	2.34	53110	42646	5/20/14	active
	WD	FTS THS-3	6.10	40928	41252	6/12/13	5/20/14
	WD	FTS THS-3	6.10	47160	38754	5/20/14	active
	WS	FTS 023-30	6.10	18177	124921	6/12/13	5/20/14
	WS	FTS 013-30	6.10	42199	40835	5/20/14	active
	RG-TB	FTS RG-T	2.18	97206	121220	6/30/11	5/20/14
	RG-TB	FTS RG-T	2.18	4086	126948	5/20/14	active
	SR	FTS SDI-SR-PYR	2.29	3993	110789	10/22/12	5/20/14
	SD	removed	n/a	n/a	n/a	6/7/12	n/a
Harding Icefield	AT-RH	FTS THS-3		31560	30469	4/19/13	5/15/14
	AT-RH	FTS THS-3		28833	6846	5/15/14	active
	WD	FTS 013-30	6.10	17534	125725	4/19/13	5/15/14
	WD	FTS 013-30	6.10	47609	43856	5/15/14	9/23/14
	WD	FTS 013-30	6.10	J7034	30307	9/23/14	active
	WS	FTS 023-30	6.10	6236	40209	4/19/13	5/15/14
	WS	FTS 023-30	6.10	22737	39093	5/15/14	active
	RG-TB	FTS RG-T	6.10	5075	118331	4/19/13	active
	SR	FTS SDI-SR-PYR		36485	30140	4/24/10	10/26/13
	SR	FTS SDI-SR-PYR		1253	119897	10/26/13	active
	SD	Judd	1.74	4070	n/a	4/19/13	active
	SD	Judd	1.74	4610	n/a	5/15/14	active
Hickerson Lake	AT-RH	FTS THS-3	2.49	28820	6848	8/27/13	6/11/14
	WD	FTS 013-30	6.10	7145	125325	6/16/12	6/11/14
	WS	FTS 023-30	6.10	N1501	105962	6/16/12	6/11/14
	RG-TB	FTS RG-T	2.46	1686	117213	7/7/11	6/11/14
	SR	FTS SDI-SR-PYR	2.54	22383	126817	7/7/11	6/11/14
	SD	CS SR50A	1.65	41908	n/a	8/27/13	6/11/14

Table 2 continued. Sensor metadata for weather stations operated and maintained by the SWAN.

Station name	Sensor	Model	Height m	Serial no	Asset no	Start date	Stop date
McArthur Pass	AT-RH	FTS THS-3	2.24	28502	6637	6/10/13	5/16/14
	AT-RH	FTS THS-3	2.24	30823	22221	5/16/14	active
	WD	FTS THS-3	6.10	42051	41296	6/10/13	5/16/14
	WD	FTS THS-3	6.10	27985	127625	5/16/14	9/8/14
	WD	FTS THS-3	6.10	47617	39646	9/8/14	active
	WS	FTS 023-30	6.10	41222	40431	6/10/13	5/16/14
	WS	FTS 013-30	6.10	41221	36513	5/16/14	active
	RG-TB	FTS RG-T	2.39	26116	42059	6/10/13	active
	SR	FTS SDI-SR-PYR	2.39	50530	39525	6/5/12	active
	SD	removed	n/a	n/a	n/a	6/5/12	n/a
Pedersen Lagoon	AT-RH	FTS THS-3	2.14	31565	30474	8/7/13	11/1/13
	AT-RH	FTS THS-3	2.14	48183	n/a	11/1/13	8/14/14
	AT-RH	FTS THS-3	2.14	22681	40150	8/14/14	active
	WD	FTS 013-30	6.03	42052	41298	8/7/13	8/14/14
	WD	FTS 013-30	6.03	25241	39450	8/14/14	active
	WS	FTS 023-30	6.03	B3090	1354	8/7/13	8/14/14
	WS	FTS 023-30	6.03	J7297	30364	8/14/14	active
	RG-TB	FTS RG-T	1.91	40718	n/a	8/10/11	8/14/14
	RG-TB	FTS RG-T	1.91	BLM-084	119497	8/14/14	active
	SR	FTS SDI-SR-PYR	2.21	39327	n/a	8/10/11	8/14/14
	SR	FTS SDI-SR-PYR	2.21	2687	109943	8/14/14	active
	SD	Judd	1.71	3690	n/a	8/7/13	8/14/14
	SD	Judd	1.71	4070	n/a	8/14/14	active
Pfaff Mine	AT-RH	FTS THS-3	2.03	28824	7148	7/22/13	6/3/14
	AT-RH	FTS THS-3	2.03	43142	41083	6/3/14	active
	WD	FTS 013-30	6.10	39942	39532	6/21/12	6/3/14
	WD	FTS 013-30	6.10	48934	44908	6/3/14	active
	WS	FTS 023-30	6.10	34209	39551	6/21/12	6/3/14
	WS	FTS 023-30	6.10	39938	35955	6/3/14	active
	RG-TB	FTS RG-T	2.21	unknown	37579	6/21/12	active
	SR	FTS SDI-SR-PYR	2.21	19009	102143	6/15/11	6/3/14
	SR	FTS SDI-SR-PYR	2.21	PYR00105	127387	6/3/14	9/25/14
	SR	FTS SDI-SR-PYR	2.21	12363	114795	9/25/14	active
	SD	CS SR50A	1.51	41916	n/a	6/26/13	6/3/14
	SD	CS SR50A	1.51	28267	n/a	6/3/14	active

Table 2 continued. Sensor metadata for weather stations operated and maintained by the SWAN.

Station name	Sensor	Model	Height m	Serial no	Asset no	Start date	Stop date
Silver Salmon Lakes	AT-RH	FTS THS-3	2.27	54810	n/a	7/9/13	6/10/14
	AT-RH	FTS THS-3	2.27	40434	119484	6/10/14	active
	WD	FTS 013-30	6.36	32054	n/a	7/9/13	active
	WS	FTS 023-30	6.36	55017	n/a	7/9/13	active
	RG-TB	FTS RG-T	2.36	40720	n/a	7/9/13	active
	SR	FTS SDI-SR-PYR	2.36	39705	n/a	7/9/13	active
	SD	Judd	2.03	4417	n/a	7/9/13	6/10/14
	SD	Judd	2.03	4015	n/a	6/10/14	active
Snipe Lake	AT-RH	FTS THS-3	2.16	32419	22096	6/20/13	6/8/14
	AT-RH	FTS THS-3	2.16	49783	39329	6/8/14	active
	WD	FTS 013-30	6.10	7147	125837	6/14/12	6/8/14
	WD	FTS 013-30	6.10	J7090	30319	6/8/14	active
	WS	FTS 023-30	6.10	36480	124605	6/14/12	6/8/14
	WS	FTS 023-30	6.10	48802	44909	6/8/14	active
	RG-TB	FTS RG-T	2.26	26640	127456	6/17/11	6/8/14
	RG-TB	FTS RG-T	2.26	13570	8824	6/8/14	active
	SR	FTS SDI-SR-PYR	2.21	15340	122043	6/17/11	6/8/14
	SR	FTS SDI-SR-PYR	2.21	3419	118341	6/8/14	active
	SD	CS SR50A	2.11	41914	n/a	6/20/13	6/8/14
	SD	CS SR50A	2.11	42006	n/a	6/8/14	active
Three Forks	AT-RH	FTS THS-3	2.24	42108	39215	9/5/13	6/4/14
	AT-RH	FTS THS-3	2.24	43144	40563	6/4/14	active
	WD	FTS 013-30	6.28	J7032	30305	9/5/13	6/4/14
	WD	FTS 013-30	6.28	29508	39259	6/4/14	active
	WS	FTS 023-30	6.28	K1530	125507	9/5/13	6/4/14
	WS	FTS 023-30	6.28	47150	38749	6/4/14	active
	RG-TB	FTS RG-T	2.01	93-217	19574	9/5/13	6/4/14
	RG-TB	FTS RG-T	2.01	99-405	17221	6/4/14	active
	SR	FTS SDI-SR-PYR	2.30	18427	7734	9/5/13	6/4/14
	SR	FTS SDI-SR-PYR	2.30	01220	116032	6/4/14	active
	SD	CS SR50A	1.91	41910	n/a	9/5/13	6/4/14
	SD	CS SR50	1.91	15070	n/a	6/4/14	active

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National Park Service
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Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov