Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 1

Evaluating New Climate Station Locations

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/06	P. Sousanes	Took out redundant maps; streamlined	Incorporated peer review comments	1.01

This SOP describes the process for siting climate stations for the Central Alaska Network (CAKN) at Wrangell - St. Elias National Park and Preserve (WRST), Denali National Park and Preserve (DENA), and Yukon-Charley Rivers National Preserve (YUCH). The first section lists the sites that were prioritized from this process including the stations that were installed for the design phase deployment which was necessary prior to writing accurate protocols. Other sites were evaluated and could be used for siting stations in the future. A report was completed in 2003 documenting this entire process and is included as Appendix A of these protocols. This process has been evaluated by climate experts and is thought to be the preferred method for an evaluation of this nature, with recommendations for other networks to follow suit. The site criteria checklist used in the site evaluation process is also included in this SOP.

Climate monitoring sites evaluated, reviewed and prioritized for CAKN Climate Monitoring for design phase deployment:

Park	Station Name	Location	Elevation	Latitude	Longitude	Instal-lation Date
WRST	Chititu	Chugach-St. Elias Mtns. South of May Creek	4600’	61° 16' 26.44"	142° 37' 08.71"	8/2004
	Chicken Creek	Kluane Range. S. Nutzotin Mtns. NE of Chisana	5260’	62° 07' 27.64"	141° 50' 42.76"	8/2004
DENA	Stampede	North of Outer Range. W. of Toklat Basin in Kantishna Hills	1900’	63° 44’ 52”	150° 19’ 41”	4/2003
	Dunkle	S. of Alaska Range. In Dunkle Hills NE of West Fork Chulitna drainage.	2855’	63° 16’ 03”	149° 32’ 21”	8/2003
	Wigand	Toklat Basin, N. of Outer Range	1750’	63° 48’ 43”	150° 02’ 59”	9/2003
YUCH	Coal Creek	Yukon Tanana Uplands. S. of Yukon River	870’	65° 18' 50.05"	143° 07' 56.38"	9/2004

In an effort to fill some of the gaps in the existing climate monitoring network and increase the knowledge of climate variability across the three CAKN parks, we identified and evaluated approximately 40 potential new sites during the summer of 2003. Our main criteria in locating sites were 1) to get the best possible coverage across each park, 2) to sample different ecoregions within each park, and 3) to get a good elevational gradient between sites. Additionally, we considered the issue of access: a site must not be too difficult and/or costly to access for routine maintenance over the next many decades. Criteria used in locating sites varied by park. Each park had to be evaluated differently due to both the extent of natural variations within each park and park management concerns and policies, including, for example, wilderness and historic district designations, helicopter compliance regulations, and variations in landscapes and ecoregions.

The NPS Geographic Information System (GIS) available for all Alaska parks was used to map ecoregions, precipitation patterns, and land designations. Existing weather sites were plotted on these maps, from that point potential new sites were identified in areas not covered by the existing network, but critical to understanding regional climate patterns. On-site evaluation of each of the 40 sites took place during the summer of 2003. A comprehensive report with site descriptions and photo documentation was compiled along with a Microsoft PowerPoint presentation of the evaluation process. During the winter of 2003 and 2004 CAKN staff presented this information to climatologists in and around the state. This panel included Gary Hufford, Jim Jones, Jim Hunter, and Larry Rundquist – NWS/NOAA, Anchorage, Alaska; Rick Thoman and Eric Stevens – NWS/NOAA, Fairbanks, AK; Rick McClure – Natural Resources Conservation Service, Anchorage, AK; Kelly Redmond and Dave Simeral – Western Regional Climate Center, Reno, Nevada, and Sharon Alden – NPS meteorologist/Fire Weather Program Manager Alaska Interagency Coordination Center Fairbanks, Alaska. From this process we selected thirteen prioritized sites to install in the three parks. During the protocol development phase we deployed six stations.

While new sites will enhance our knowledge, we must realize that any site that is chosen will not be free form localized effects such as topography, latitude, elevation, and continentality. The severity of conditions that must be endured can vary greatly in short distances, and thus need to be evaluated individually for each site. Especially in regions of high topographic relief, but even in seemingly simpler situations, it is often better to think of stations as providing “index” values, rather than values of the “true” climate, which vary continuously and on fine scales, even to a few meters. The question of what a “representative” site actually represents seldom has a simple and straightforward answer. Climate measurements must meet a higher standard than “weather” measurements. The most demanding of these is consistency through long periods of time. A time frame of 50-100 years should be envisioned (Redmond and Simeral, 2004).

Wrangell-St. Elias National Park and Preserve

Wrangell-St. Elias National Park and Preserve (WRST) contains both coastal and interior climatic regimes as well a transition zone. Two high elevation mountain ranges disrupt movement of weather systems resulting in numerous localized climatic conditions. Because of the immensity of Wrangell-St. Elias National Park and Preserve, the extensive amount of high elevation terrain and large number of climatic regimes, a model to characterize the area was based upon a transect of sites perpendicular to the coast. This transect includes south and north facing mountain range aspects, sites at high and low elevation, sites in both the coastal and interior regimes, as well as sites within the transition zone Figure 1 shows the north-south transect and the areas we focused on for siting climate stations.

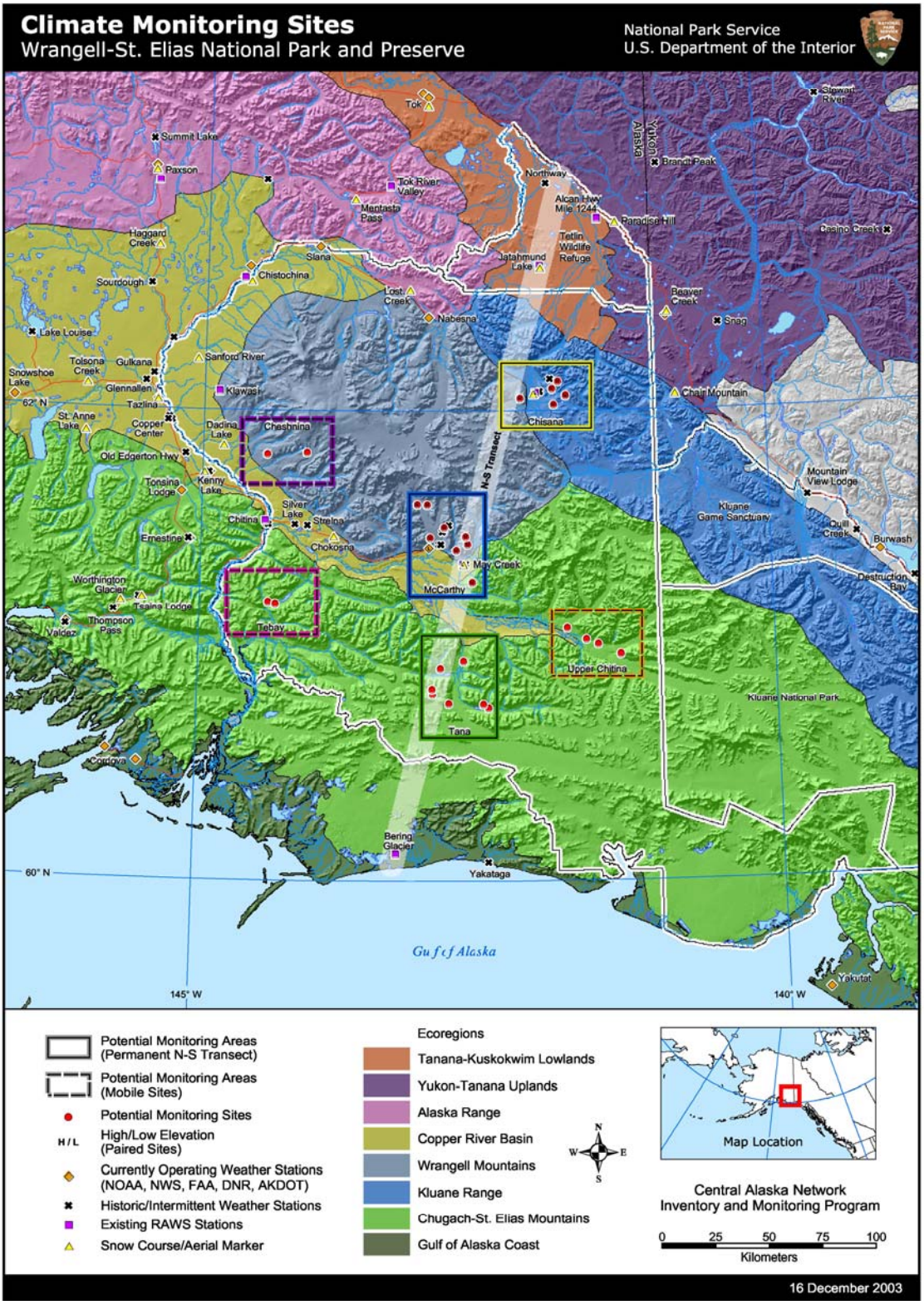

Figure 1. Location of existing and potential climate monitoring sites in relation to Alaska Ecoregions, Wrangell-St. Elias National Park and Preserve

Yukon-Charley Rivers National Preserve

Yukon Charley Rivers encompasses three ecoregions including the Yukon – Old Crow Basin, the North Ogilvie Mountains, and the Yukon-Tanana Uplands. The Yukon-Tanana uplands have no existing representative climate station so potential siting in that area was a priority. Several factors influenced potential site locations including the ecoregions map and the annual precipitation pattern map, and the general climate pattern described by Rick Thoman. Thoman pointed out that a marked change in climate patterns seems to occur at the 144° West parallel with colder temperatures in the hills and valleys east of the parallel which is just west of the Yukon Charley Rivers boundary. Figure 2 shows the ecoregions of the park and the areas we evaluated for additional climate stations.

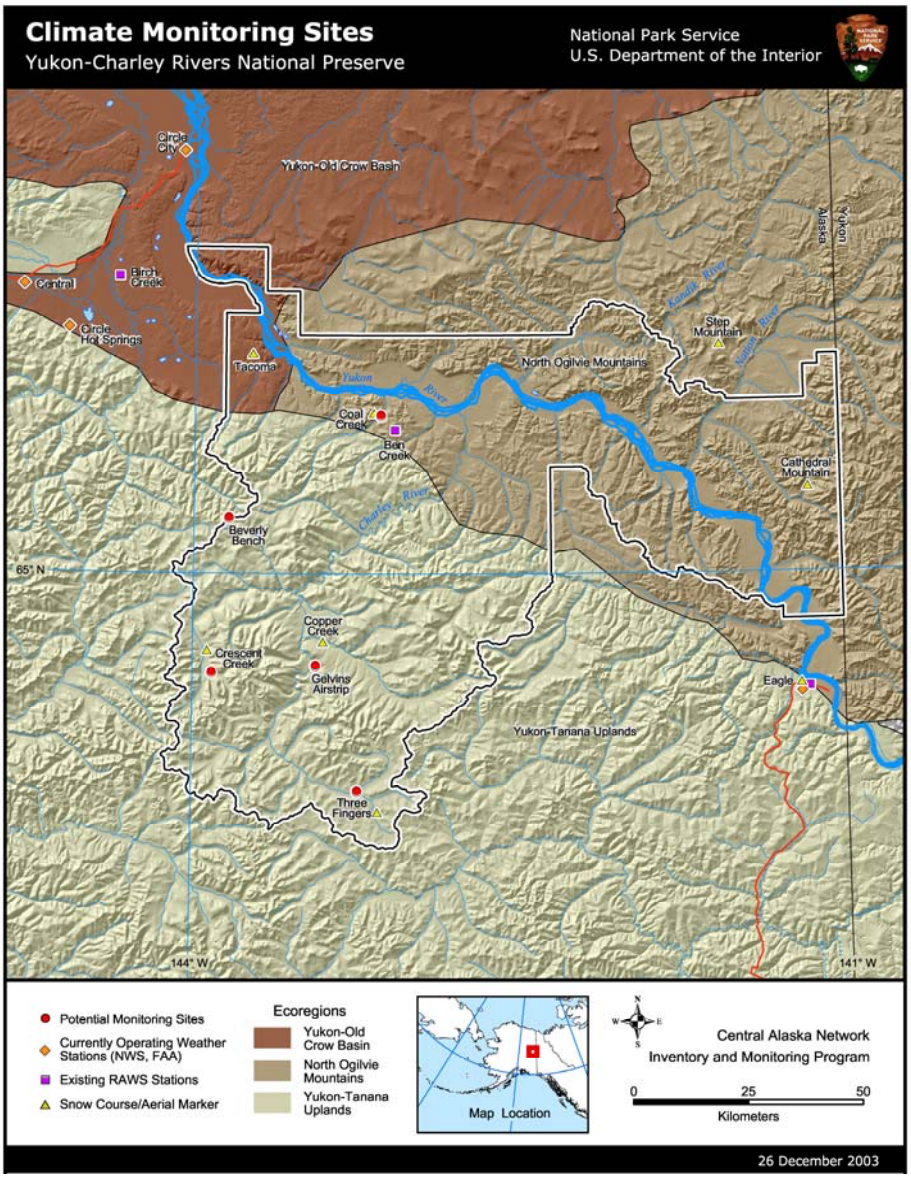

Figure 2 Location of existing and potential climate monitoring sites in relation to Alaska Ecoregions, Yukon-Charley Rivers National Preserve

Denali National Park and Preserve

The climate of Denali National Park and Preserve (DNP&P) is characterized by great spatial variability, and includes both transitional maritime (influenced by the ocean) and continental (influenced by the Alaska Range) climate subtypes. Denali lies approximately 140 miles north of the Gulf of Alaska but the prevailing weather patterns generated by the Aleutian Low significantly affect Denali's climate, bringing considerable precipitation in the form of rain and snow to the windward side of the Alaska Range and moderating the air temperatures. On the north side of the range however, the continental interior climate conditions generated by the Arctic High prevail. Temperature variations from summer to winter are high, and precipitation is low. Although Denali encompasses the boundaries of four ecosystems the Alaska Range ecoregion and the Tanana-Kuskokwim Lowlands dominate the landscape. The Yentna river confluence in the southwest area of the park is part of the Cook Inlet Basin ecoregion, and small sections in the northwest corner of the park in the Minchumina Basin lie within the Kuskokwim Mountains ecoregion. Figure 3 shows the ecoregions of Denali and the potential sites for climate station installations that were evaluated.

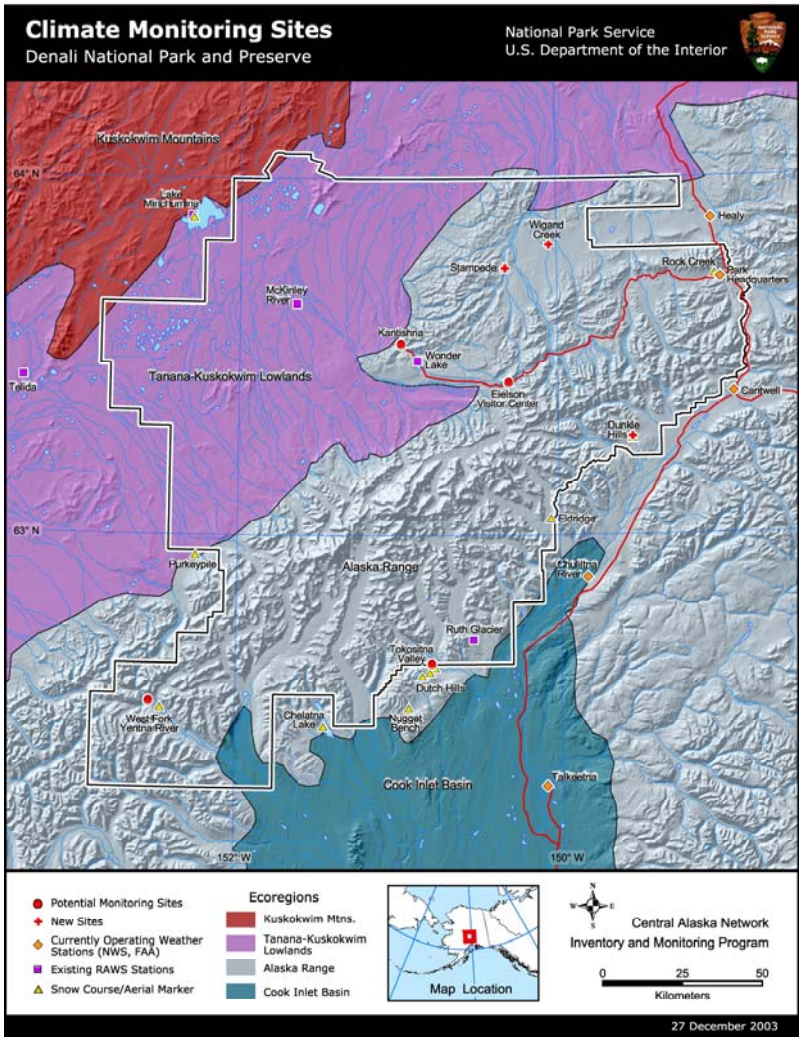

Figure 3 Location of existing and potential climate monitoring sites in relation to Alaska Ecoregions, Denali National Park and Preserve

The site evaluation form (shown below) was completed at each site that was visited. There were generally 3-4 people involved in these preliminary surveys and each took time to describe the site individually. The comments were then compiled in the site evaluation document. At each site, 5-10 photos were taken to describe the setting. This included distant shots for regional perspective and close-up shots of the type of vegetation at the site.

Site Evaluation Checklist

Date/Time:

Area/Transect:

Site Location/Description:

Latitude: Datum:

Longitude:

Elevation:

Flat and anchorable ground?

Pad size? (min 11’ x 20’)

Clearing size? (distance to trees/cliffs)

South exposure (solar)?

South-east exposure (GOES)?

Soil type:

Vegetation type:

Associated snow course / aerial snow marker?

Recommended instrumentation

AT/RH, SR

soil temperatures

wind

precipitation

snow depth

Access:

Photos:

Notes:

Climate Monitoring Protocol for the Central Alaska Network

Standard Operating Procedure (SOP) # 2

Compliance and Permitting

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P. Sousanes	Removed example and added links	Incorporated peer reviewed comments	1.01

This SOP describes the steps necessary to engage in climate monitoring within the National Park Service which is subject to legal justifications of the National Environmental Protection Act (NEPA) of 1969.

> The purpose of NEPA as stated in section 2 of the act that created it is to *"encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation...."*

During the initial planning phase of the project it is necessary to begin the process of permitting and compliance. The permitting and compliance phase could take up to a year for final processing depending on the level of NEPA compliance necessary. It is also possible that the project or upgrades to the project are not congruous with the management policy of the park. Compliance and permitting are constantly evolving; always inquire about current requirements.

Research permits and compliance

1. Determine if the project is already covered under an existing project name in either individual compliance databases for the park or through the U.S. National Park Service Research and Reporting System (http://science.nature.nps.gov/research/ac/ResearchIndex
2. Follow the guidelines for the individual park to initiate the compliance process. This often begins with the application for a research permit which triggers the internal compliance review within each park.

In future years climate stations will most likely be added to the network. Initial compliance has been done for the three parks for the initial stages of the program. The climate station locations described in SOP 1 have all been subjected to compliance reviews in the parks where they will be located. Some discussion still remains over sites located within designated wilderness areas or areas that are

considered suitable wilderness for potential future designation. These lands are subject to more stringent regulations governed under the Wilderness Act of 1964.

> The purpose of the Wilderness as stated in section 2 (a) is to "*secure for the American people of present and future generations the benefits of an enduring resource of wilderness… for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness…*"

Links to NEPA documents related to climate monitoring program:

Yukon –Charley Rivers Environmental Assessment (EA) for climate station installations:
https://pepc.nps.gov/document.cfm?mode=view&projectId=11467&documentId=11766

Wrangell – St. Elias EA for climate station installations:
https://pepc.nps.gov/document.cfm?mode=view&projectId=10930&documentId=11527

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Standard Operating Procedure (SOP) # 3

Initial Climate Equipment List

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/06	P.Sousanes	Added verbiage on sensor replacement	Incorporated peer reviewed comments	1.01

This SOP details the acquisition of a climate station, including a list of equipment, vendor, model numbers, descriptions, 2004 costs, and photos (see SOP #4, "Sensor Specifications" for photos of individual sensors). Technology will constantly evolve, equipment will break and need to be replaced, and instrumentation will improve. It is important to document any and all changes in equipment. If there is a radical change in any sensor design it will be necessary to run the old and the new sensors in parallel for one year to monitor any differences in readings.

Table 1 lists the initial equipment procurement for a single climate station for the Central Alaska Network from Campbell Scientific, Inc. (http://www.campbellsci.com/home.html) and Table 2 lists the power system requirements and 2004 costs.

Table 1. CAKN Climate Station Equipment Procurement - Instrumentation

Description	Item	2004 Pricing
10' tripod tower CM10w/grounding kit	CM10	345.00
CM10 guy Kit		90.00
CR-10X Datalogger	CR10X	1250.00
Extended Temperature testing for CR10X	XT CR10X	125.00
Datalogger Support Software	LoggerNet	395.00
GOES DCP Platform w/ SATHDR GOES transmitter, CH12R power regulator, battery cables, 16"x18" enclosure, 10 Watt solar panel, GPS antenna, GOES Antenna w/coax cable	DCP 100	3575.00
Keyboard/Display	XT-CR10K	280.00
Vaisala HMP45C temperature and Relative Humidity probe/w10'cable	HMP45C – L10	555.00
RM Young 12-plate Gill Radiation Shield for HMP45C	41002	173.00
RM Young 05103 Wind Monitor/w15' cable	05103-L15	885.00

Texas Electronics 8” Tipping Bucket Rain Gage w/25’ cable	TE525WS-L25	370.00
Li-Cor Silicon Pyranometer w/11’ cable	LI200X-L11	295.00
CSI Soil Temperature Probe (3) w/25’cable	107-L25	230.00
Aluminum Crossarm Sensor Mount	019ALU	75.00
LiCor base and Leveling Fixture for LI200X	LI2003S	58.00
CSC Ultrasonic Distance Sensor (Snow Depth) w/15’ cable	SR50-L15	945.00
	Sub-Total	9646.00

Table 2. CAKN Climate Station Equipment Procurement – Power System

PVX 1040T Concorde Battery (2)	320.00
MSX-64 Watt Solar Panel	256.00
Battery Box	215.00
Sub-Total	791.00
Total for Climate Station	$10,437.00*

*This cost does not reflect miscellaneous mounting hardware and tools required for installation.

The tripod stations are shown below in a typical station (Figure 1) and one that is modified for the CAKN Climate Monitoring Program (Figure 2.)

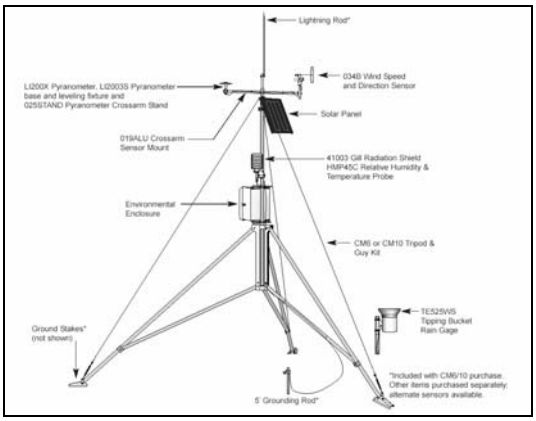


Figure 1 Climate Station diagram from Campbell Scientific, Inc.

Figure 2 CAKN Climate station - design phase installation

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 4

Climate Station Specifications/Sensor Matrix

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P.Sousanes	Added specs on communication and power equipment	Incorporated peer review comments	1.01

This SOP outlines the specifications of the sensors and equipment used on a CAKN climate station. These specifications are for the Campbell Scientific, Inc. instrumentation. It also provides the guidelines for sampling frequency, measurement and processing intervals, and sensor placement above ground level.

Datalogger

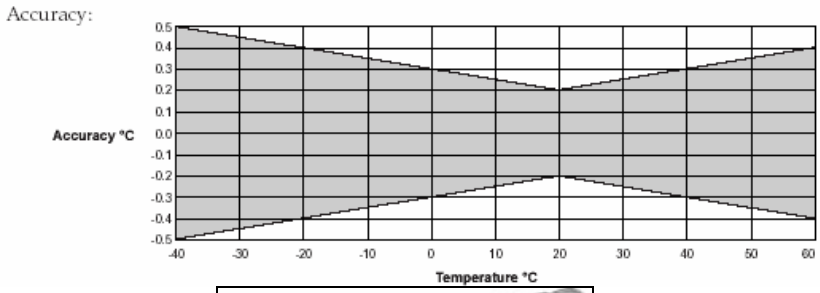
Model CR10X

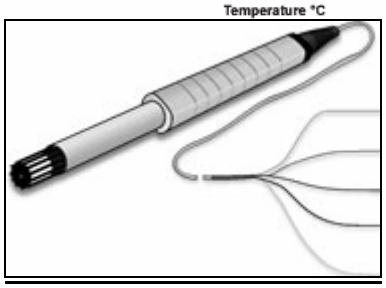
Extended temperature Range: -55° to +85° C
Mbytes additional memory
Program execution rate: Up to 64 Hz
Number of Channels: 6 differential inputs, 2 pulse counters, 3 excitation, and 8 control ports
Power requirements: 9.6 – 16 volts
Current drain: 1 mA quiescent, 13 mA processing, 46 mA analog measurement
Data Storage: 62,000 data points

Air Temperature and Relative Humidity

Model HMP45C

Sensors: Temperature 1000 Ω PRT
Relative humidity - HUMICAP® H-Chip
Relative Humidity range: 0.8 to 100% RH, non-condensing
Relative Humidity accuracy: ±2% RH (0-90%)
±3% RH (90-100%)
Temperature Range: -39.2° to +60°C
Temperature Accuracy:





Soil temperatures

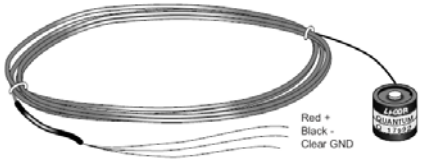
Model 107B soil temperature probe

Sensor: Thermistor
Range: -35° to 50°C
Accuracy: typically ±0.2°C

Solar Radiation

Model LI2100X silicon pyranometer

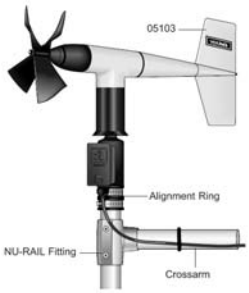
Sensor: Silicon photocell
Sensitivity: 0.2 kW m-2 mV-1
Requirements: LI2003S base and leveling fixture



Wind Speed and Direction

Model 5103 Wind Monitor

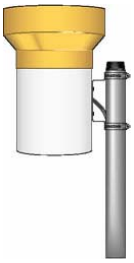
Sensors: Propeller vane
Temperature range: -50° to +50°C
Wind Sped Range: 0 to 134 mph, gust survival 220 mph
Wind Speed threshold: 2.2 mph
Wind Speed distant constant: (63% recovery): 8.9 ft.
Wind direction delay distance (50% recovery):4.3 ft
Vane range: 360° mechanical, 355° electrical
Vane threshold: 2.0 mph @ 10° displacement, 2.9 mph @ 5° displacement



Precipitation

Model TE525WS Tipping Bucket Rain Gauge

Sensor: magnetic switch
Orifice: 8” diameter
Sensitivity: 0.01”/tip

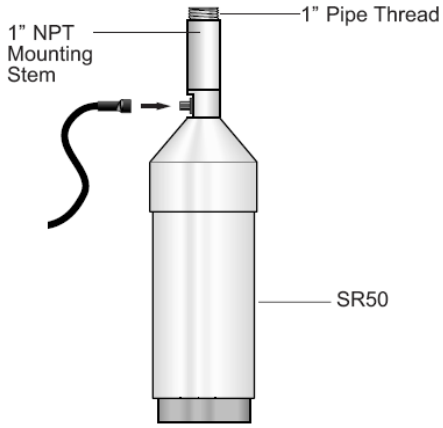


Snow Depth

Model SR50 ultrasonic distance sensor

Power requirements: 9 to 16 VDC
Power consumption: 2mA (quiescent), 250mA (measurement peak)
Measurement range: 0.5 to 1.0
Accuracy: ±1 cm or 0.4% of distance to target w/external temperature compensation resolution: 0.1mm

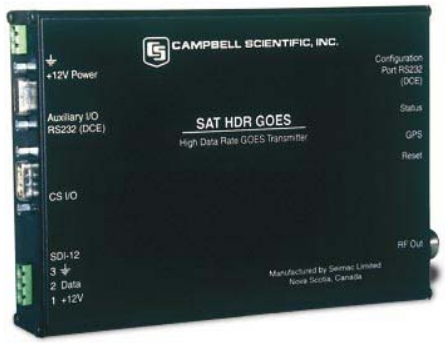
Beam acceptance angle: approximately 22°



Communication

SAT HDR GOES transmitter

On-Board memory: Non-volatile flash for setup parameters. 16Kbytes for self-timed data
Power requirements: 9.6 to 16 VDC, 1 mA quiescent, 350 mA during GPS fix and less than 4 Amps during transmission.
Transmit power: 7.9 watts for 100 and 300 bps, 15.9 watts for 1200 bps
Temperature Rating: -40° to 50°C



There is a list of additional equipment that is necessary when using a GOES transmitter including a GOES antenna, GPS antenna, and appropriate cables. Inquire with the manufacturer to ensure you have the complete system.

Power

Battery

These stations are powered by battery with solar panels as the charging mechanism. Two 100 amp hour 12 Volt batteries are used in the power set–up and run in parallel. The station does not require this much power, but if one battery goes bad there is another one to run the station. A deep-cycle battery is preferred.

Solar Panels

The stations will run on a 10 Watt solar panel, but as a precaution against cloudy days and the long Alaska winter a 50 Watt (or higher) solar panel is used on the climate stations.

Charging Regulator

A charging regulator is necessary to ensure the batteries are only charged to capacity and not above. The CH100 charging regulator is available for Campbell Scientific, Inc. and is set-up to work with the cable connectors from the GOES transmitter and the datalogger power connections.

Table 1 represents the type of sensor used, the location of the sensor in relation to the ground surface, the sampling frequency, measurement processing and recording intervals.

Parameter	Instrument	Sampling Frequency	Measurement processes and Recording Interval	Remarks
Air Temperature (°C) Relative Humidity (%)	*Vaisala HMP35C/HMP45C* Temperature/RH Probe	Every 60 seconds	Average, Minima, and Maxima stored hourly °C	Sensor housed inside 12-plate gill radiation shield 2 m above ground level
Wind Speed (m/s) Wind Direction (°)	*RM Young Wind Monitor* 05103	Every 60 seconds	Mean horizontal WS in, unit vector mean WD, max WS, max WS direction stored hourly	3 m above ground level or 10 m above ground for existing tower stations
Solar Radiation (W/m²)	*Li-Cor LI-200S* Pyranometer Sensor	Every 60 seconds	Averages stored hourly	3 m above ground level
Precipitation (mm)	*Texas Electronics 525WS* Tipping Bucket	Every 60 seconds	Hourly totals stored hourly	Collected when temps are mostly >0°C
Soil Temperature (°C)	Temperature Probe 107	Every 60 seconds	Averages stored hourly	0 (surface), 50 and 100 cm below ground level
Snow Depth (m)	CSC Ultrasonic Distance Sensor	Every 60 seconds	Average stored hourly	Above max snow depth
Battery Voltage	12 V - 100 Amp Hour External Battery	Every 60 seconds	Minimum recorded hourly	Housed in insulated battery box

Table 1. Sensor Matrix, Intervals, and Standard Placements

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 5

Datalogger Software Instructions

Version 1.01 (December 2006)

Revision History Log:

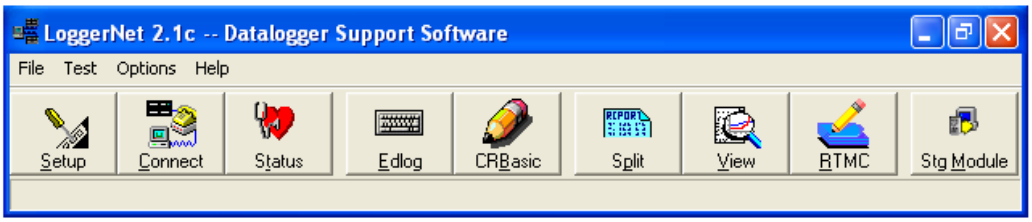
Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/06	P. Sousanes	Minor word changes for clarification	Incorporated peer reviewed comments	1.01

This SOP outlines a brief overview of the datalogger programming software needed to program a CR10X datalogger. The software that supports the Campbell Scientific, Inc. (CSI) CR10X datalogger is called Loggernet. Loggernet supports programming, communications, and data retrieval between the CR10X and a PC. It is possible to connect this software directly to a running datalogger, but due to the remote nature of the stations in the CAKN network this is not feasible, therefore the software is used primarily for programming.

The programming can be done in the office or in the field. It is recommended that the programming done in the office, and only done in the field if necessary. The software should be loaded onto all PCs and portable laptop computers that may be used for programming climate stations. It is imperative that the CSI website is checked before any field work for any updates to the current software version. The LoggerNet Instruction Manual is included in any purchase of Loggernet software.

The following instructions outline the basic steps in configuring the datalogger, sending programs to the datalogger, and viewing data collected from the datalogger. There are a number of other tools within the software that will not be described in this SOP, but are available in the manual or online at http://www.campbellsci.com/software.html.

Once LoggerNet is loaded onto a PC or laptop the toolbar below is used to navigate through the various functions.



LoggerNet Overview

- **Setup:** Describes the configuration of COM ports, modems, dataloggers, and other devices; sets up the data collection protocols and schedules.

- **Connect**: Connects to each automated weather station configured in the "setup" option; synchronizes datalogger clock with the computer's clock; collects data and downloads .DLD files to dataloggers from a PC; views collected data and graphs real-time measurements.

- **Status:** Checks the communication and data collection status of all stations in the network; shows station names, whether or not a specific station is on line, error rates, time and date when the last data collection was attempted, how much data was collected, and the next call schedule.

- **Edlog**: Creates and edits datalogger programs for the CR10X.

- **CR Basic:** Creates and edits programs for the CR5000 and CR9000 dataloggers.

- **Split**: Used to separate mixed array data files into individual files based on the array ID. Split can also be used to create files in custom reports.

- **View:** Used to look at data files. The data is displayed in either comma separated or tabular format by record or array.

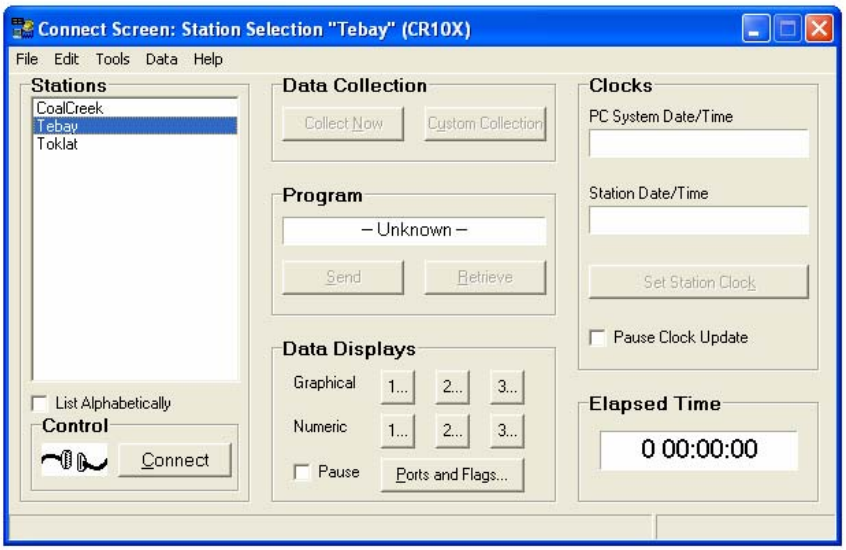
- **RTMC:** Real-Time Monitor and Control creates and displays real-time graphic display screens using the data collected form the dataloggers by LoggerNet.

- **Stg Module:** Retrieves files from storage modules via either a CR10X and PC Cards or the CSMI/MCRI interface or directly from a PCMCIA slot in the computer with separate tab settings for the categories "setup", "programs", "data", and "erase".

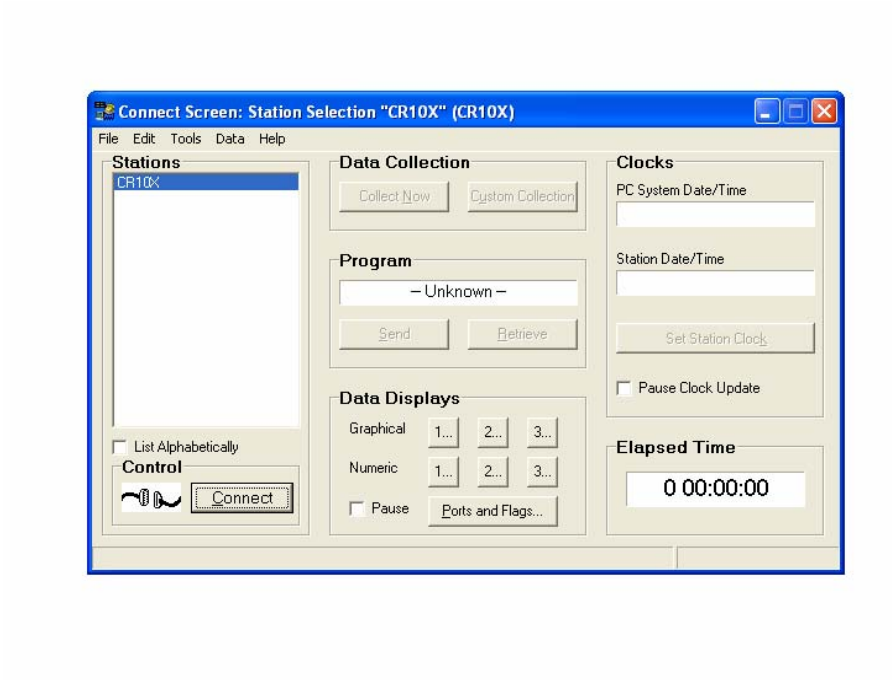
Details on application for the CAKN Climate Monitoring Program:

1. **Setup**: The Setup button is used to define the communications paths between the computer and the dataloggers. It serves other functions, but this is the one necessary for programming. To connect the datalogger to the PC you need to address the nine pin communication port (Com Port) that will be used. The default is Com Port1. Add the datalogger to the setup screen by clicking the Add button, this allows you to choose CR10X from a list of possible datalogger choices. At this point you can choose to name the station, however the sample uses the default name of "CR10X". The datalogger name then appears under the Com Port 1 tab as shown in the screen below. Hit the Apply button to save the edits. In the near future comm. Ports might

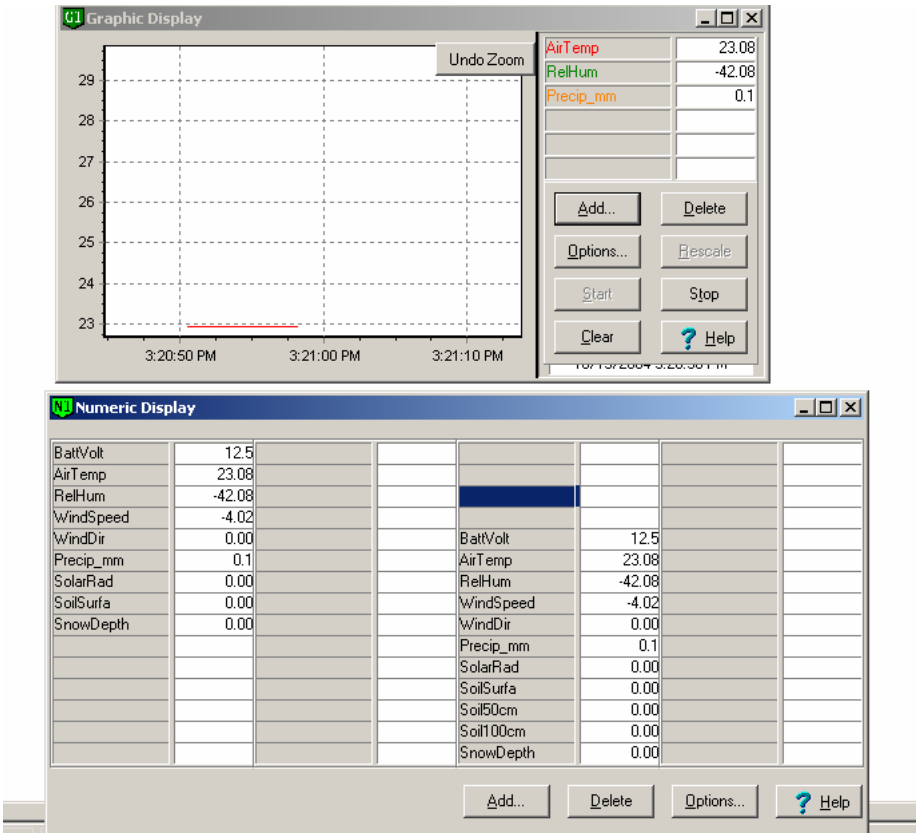
be obsolete. The use of USB connections is becoming the standard. The USB connection can be made by adding the datalogger to Com Port XX.



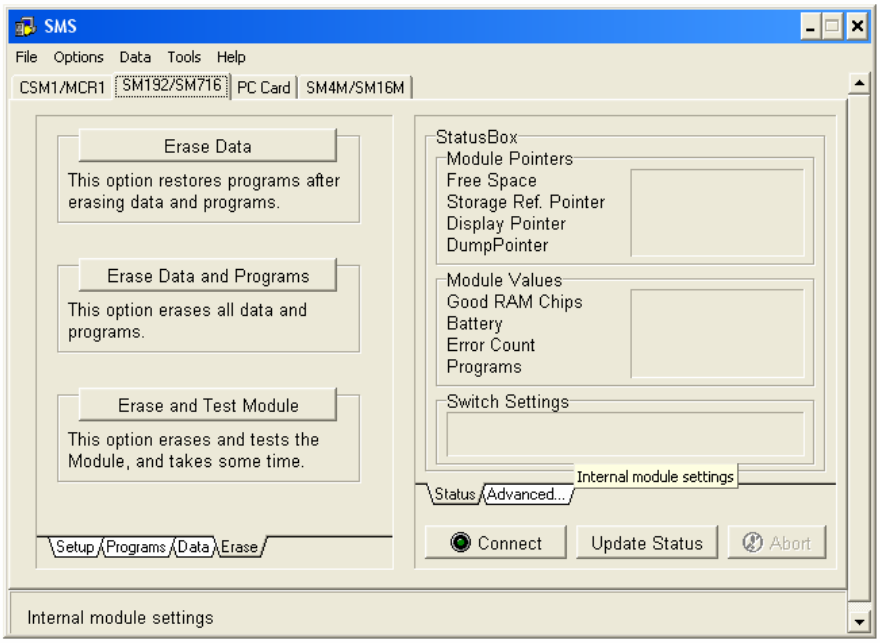
2. **Connect:** The Connect button is used to connect the computer to the data logger for the main purpose of transferring a program file and viewing the data. This button can also be used to transfer the data from the datalogger to the computer if a laptop is taken into the field on a site visit. Choose the station name (default on the sample screen is CR10X) and then click on connect. To collect data from a station slick on Collect Now under the Data Collection tab and it will retrieve all of the data from the datalogger and store it under the name of the connection. Use the standard name for the station so that the data files are easily found. To send a program to the datalogger, click on Send under the Program box and it will allow you to browse through your files. Select the program you want to send and click send again. It will send the file and compile the program. A warning message will appear before you send the program alerting you that all data will be lost if you send a new program. because of this make it a standard practice to collect all the data from the datalogger before sending any new programs.



If you use LoggerNet in the field the Data Display tabs can be used to view the current data in either numerical or graphical display as shown below. Click on Data Displays to open the graphs and tables.



3. **Stg Module:** The Stg Module button is used for the stations in Denali National Park that were installed in the early 1990s as part of the Long-term Ecological Monitoring (LTEM) Program. These stations do not have satellite telemetry and the datalogger memory is small, so all data is stored on an external storage module that is manually swapped out at monthly intervals. This button connects the storage module to the computer so the data can be transferred from the module to the computer. The storage module is then erased and used again on the next trip. The storage module is also used to transfer programs to the data logger in the field. There are tabs at the bottom of the page that navigate through the various functions available under this button.



The **Edlog** button is the main button used for programming. This will be described in a separate SOP called “Programming”.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 6

Datalogger Programming

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P.Sousanes	Added reference to testing prior to field deployment	Incorporated peer reviewed comments	1.01

This SOP describes the steps taken to create a climate station program using Edlog the programming software included in the LoggerNet software package from Campbell Scientific, Inc. Standard Operating Procedure #5 describes the basics of LoggerNet, this SOP details the programming aspect of Edlog. All CR10x dataloggers come with the manual titled ***CR10x Measurement and Control System Operator's Manual*** that describes in detail the functions of the datalogger.

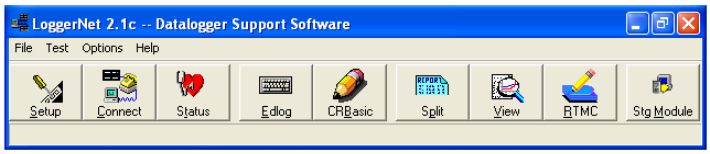
The CAKN dataloggers are programmed to measure the suite of sensors every 60 seconds, store the values, and output the hourly calculation to the satellite transmitter at 5 minutes after the hour every hour. In order for the data stream to be processed by the National Interagency Fire Center in Boise, ID the output has to follow the RAWS-7 data format outlined in the *SAT HDR GOES Transmitter Instruction Manual.*

RAWS-7 refers to the standard file format that is processed by fire weather managers, the RAWS-7 measurements are; precipitation, wind speed, wind direction, air temperature, fuel temperature, relative humidity, and battery voltage. Data values beyond the RAWS-7 are transmitted individually to the satellite transmitter after the first seven are sent as a package. The file format specifies the number of decimal places for each measurement.

The CAKN stations also transmit peak wind direction, peak wind speed, solar radiation, snow depth, minimum air temperature, maximum air temperature, soil temperature at 50 cm, and soil temperature at 100 cm.

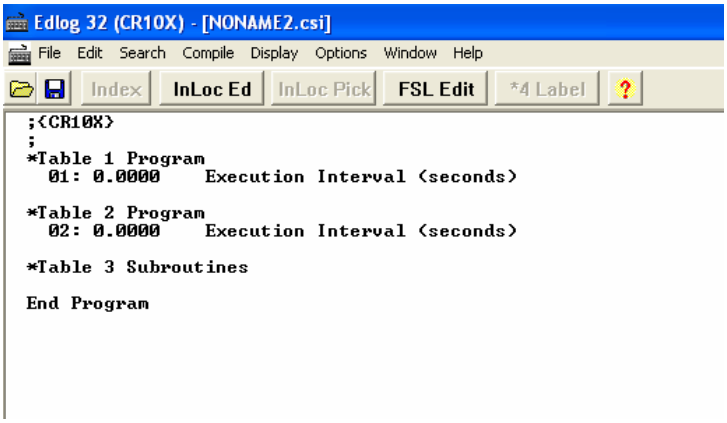
Procedure:

1. To start programming the CR10X open LoggerNet and click on the Edlog button



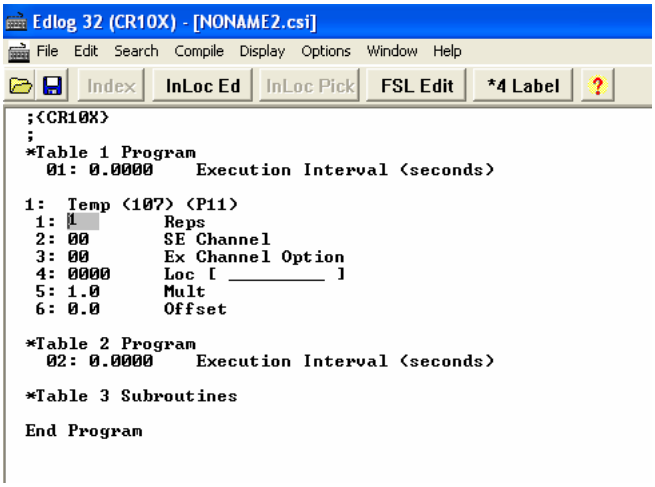
2. The software will open the last program you were working with, to create a new program click on File|New. At this point you will be prompted to enter the type of datalogger you will be using. The screen below shows a new file. The file name for the current program for the climate stations is CAKN_1. The nomenclature for future programming versions should include a date but the file name cannot exceed 8 characters, an example would be V1_12004 where V1_1 is Version 1.1 created in 2004, subsequent versions would increment to the next number, i.e. V1_22005.

3. The first step is to set the execution interval or how often you want the datalogger to run through the program. The CAKN climate station standard is 60 seconds.



4. The next step is to start programming. Instructions can be inserted after the execution interval line in the Table 1 Program. Instructions that cue the datalogger to take a measurement are listed in the CR10X manual and are also detailed in the individual Instruction manuals that come with the sensors.

5. Use the Shift +Insert key to pull up a menu of instructions or type in the number of the instruction after consulting either of the manuals. Each instruction will require a number of inputs including repetitions, signal inputs, excitation channels, location of output, multipliers, and offsets. All of this information is available in the manuals. The screen below shows an example of the instruction used to measure the soil temperature 107 probe.



6. If you add a sensor to the climate station it will require an instruction within the program to measure and record in order for it to be recorded. Some of the sensors require more than one instruction to complete the measurements, for example the HMP45C measures both air temperature and relative humidity and requires a total of five instructions to complete the measurements. The following screens show the measurement instructions for the CAKN_1 program.

Edlog 32 (CR10X) - [C:\CAMPBELLSCI\1PROGRAMS\1PROGRAMS\CAKN_1.CSI]

File Edit Search Compile Display Options Window Help

Index | InLoc Ed | InLoc Pick | FSL Edit | *4 Label

```
;{CR10X}

; RAWS CR10X program for Central Alaska Network Climate Stations
;for DENA, WRST and YUCH
;Program measures Batt. Volt., AT, RH, Precip, WS, WD, Solar Rad,
;| Surface temp, Soil temp at 50cm and 100cm
;and snow depth every 60 seconds.
;  2004

;Set program interval to mesaure sensors every 60 seconds

*Table 1 Program
  01: 60        Execution Interval (seconds)

;Measure battery voltage

1:  Batt Voltage (P10)
 1: 1      -- Loc [ BattVolt   ]

; Measure temp (deg C) and RH (%) (HMP45C)

2:  Do (P86)
 1: 41       Set Port 1 High

3:  Excitation with Delay (P22)
 1: 1        Ex Channel
 2: 0        Delay W/Ex (0.01 sec units)
 3: 15       Delay After Ex (0.01 sec units)
 4: 0        mV Excitation

4:  Volt (SE) (P1)
 1: 1        Reps
 2: 5        2500 mV Slow Range
 3: 1        SE Channel
 4: 2        Loc [ AirTemp    ]
 5: 0.1      Mult
 6: -40      Offset

5:  Volt (SE) (P1)
 1: 1        Reps
 2: 5        2500 mV Slow Range
 3: 2        SE Channel
 4: 3        Loc [ RelHum     ]
 5: 0.1      Mult
 6: 0.0      Offset

6:  Do (P86)
 1: 51       Set Port 1 Low

; Measure Wind Speed (m/s) and Direction (RM Young 05103)

7:  Pulse (P3)
 1: 1        Reps
 2: 1        Pulse Input Channel
 3: 21       Low Level AC, Output Hz
 4: 4        Loc [ WindSpeed ]
 5: 0.0980   Mult
 6: 0.0      Offset

8:  Excite-Delay (SE) (P4)
 1: 1        Reps
 2: 5        2500 mV Slow Range
 3: 3        SE Channel
 4: 2        Excite all reps w/Exchan 2
 5: 2        Delay (units 0.01 sec)
 6: 2500     mV Excitation
 7: 5        Loc [ WindDir    ]
 8: 0.142    Mult
```

```
;Measure precipitation (mm)

9:  Pulse (P3)
 1: 1         Reps
 2: 2         Pulse Channel 2
 3: 2         Switch Closure, All Counts
 4: 6         Loc [ Precip_mm ]
 5: 0.254     Mult
 6: 0         Offset


; Measure Solar Radiation (W/m2) (LI200X)

10:  Volt (Diff) (P2)
 1: 1         Reps
 2: 22        7.5 mV 60 Hz Rejection Range
 3: 3         DIFF Channel
 4: 7         Loc [ SolarRad  ]
 5: 200       Mult
 6: 0         Offset

;Measure soil temps at surface and depth of 50cm and 100cm

11:  Temp (107) (P11)
 1: 3         Reps
 2: 7         SE Channel
 3: 3         Excite all reps w/E3
 4: 8         Loc [ SoilSurfa ]
 5: 1.0       Mult
 6: 0.0       Offset

; Measure/Calculate Snow Depth (m)

12:  If time is (P92)
 1: 0         Minutes (Seconds --) into a
 2: 60        Interval (same units as above)
 3: 30        Then Do

     13:  SDI-12 Recorder (P105)
      1: 0         SDI-12 Address
      2: 1         Start Measurement (aM1!)
      3: 2         Port
      4: 11        Loc [ SnowDepth ]
      5: -1.0      Mult
      6: 0.0       Offset

     14:  Z=X+F (P34)
      1: 2         X Loc [ AirTemp   ]
      2: 273.15    F
      3: 12        Z Loc [ TempK     ]

     15:  Z=F x 10^n (P30)
      1: 273.15    F
      2: 0         n, Exponent of 10
      3: 13        Z Loc [ RefTemp   ]

     16:  Z=X/Y (P38)
      1: 12        X Loc [ TempK     ]
      2: 13        Y Loc [ RefTemp   ]
      3: 14        Z Loc [ SnowMult  ]

     17:  Z=SQRT(X) (P39)
      1: 14        X Loc [ SnowMult  ]
      2: 14        Z Loc [ SnowMult  ]
```

```
      18:  Z=X*Y (P36)
       1: 11        X Loc [ SnowDepth ]
       2: 14        Y Loc [ SnowMult  ]
       3: 11        Z Loc [ SnowDepth ]

 ; Height of sensor above bare-ground level

      19:  Z=X+F (P34)
       1: 11        X Loc [ SnowDepth ]
       2: 1.95      F
       3: 11        Z Loc [ SnowDepth ]

 ; Set snow depth values less than 1cm to zero

      20:  If (X<=>F) (P89)
       1: 11        X Loc [ SnowDepth ]
       2: 4         <
       3: 0.01      F
       4: 30        Then Do

           21:  Z=F x 10^n (P30)
            1: 0         F
            2: 0         n, Exponent of 10
            3: 11        Z Loc [ SnowDepth ]

      22:  End (P95)

 23:  End (P95)
```

7. The next step involves some preliminary processing and calculations. It is common to eliminate negative solar radiation values and relative humidity values above 100%. This can be accomplished by using processing instructions. It is also necessary to store values of measurements beyond the RAWS-7 data points such as peak wind speed and direction at peak and minimum and maximum air temperatures in an intermediate storage location, the following screens show the calculations and processing for this next step.

```
 ;*************************************************
 ; Calculations/processing sent to input locations


 ; Set negative solar radiation values to zero

 24:  If (X<=>F) (P89)
  1: 7        X Loc [ SolarRad  ]
  2: 4        <
  3: 0        F
  4: 30       Then Do

      25:  Z=F (P30)
       1: 0        F
       2: 0        Exponent of 10
       3: 7        Z Loc [ SolarRad  ]

 26:  End (P95)

 ; Eliminate RH values greater than 100

 27:  If (X<=>F) (P89)
  1: 3        X Loc [ RelHum    ]
  2: 3        >=
  3: 100      F
  4: 30       Then Do

      28:  Z=F (P30)
       1: 100      F
       2: 0        Exponent of 10
       3: 3        Z Loc [ RelHum    ]

 29:  End (P95)
```

```
30:  If time is (P92)
 1: 0        Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 10       Set Output Flag High (Flag 0)


31:  Set Active Storage Area (P80)
 1: 3        Input Storage Area
 2: 42       Loc [ MaxWindSp ]

32:  Maximum (P73)
 1: 1        Reps
 2: 00       Time Option
 3: 4        Loc [ WindSpeed ]

33:  Sample on Max or Min (P79)
 1: 1        Reps
 2: 5        Loc [ WindDir   ]

34:  Minimum (P74)
 1: 1        Reps
 2: 00       Time Option
 3: 2        Loc [ AirTemp   ]


35:  Maximum (P73)
 1: 1        Reps
 2: 00       Time Option
 3: 2        Loc [ AirTemp   ]


36:  Time (P18)
 1: 3        Store Year,Day,Hr,Min,Sec in 5 consecutive locations
 2: 0        Mod/By
 3: 46       Loc [ Year      ]
```

8. Sending the hourly values to the transmitter is the next step. The CAKN climate stations are set up to calculate hourly averages for air temperature, relative humidity, wind speed, mean vector wind direction, solar radiation, soil temperatures, and snow depth. This program also records hourly precipitation totals and the maximum and minimum air temperatures and peak wind speeds and direction. See the following screens for the programming involved in the data transmission process. This section of the programming is bulky because each measurement needs to be sent individually to the transmitter.

```
;*****************************************************

;Write hourly RAWS-7 data to final storage area 1
;and then send to transmitter
;Order is important, First in-First out.
;Precip (Hourly total)
;Wind Speed
;Wind Direction
;Air temperature (Hourly average)
;Fuel temperature (Hourly average)
;Relative Humidity (Hourly average)
;Battery Voltage (Hourly minimum )
;After RAWS-7 is sent to transmitter append other measurements
;Deg dir max gust, w/s max gust, Solar Rad, snow depth
;Min Air temp, Max Air Temp,
;Temp 50 cm, temp 100cm


37:  If time is (P92)
 1: 0        Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 10       Set Output Flag High (Flag 0)
```

```
38:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 1        Array ID

39:  Totalize (P72)
 1: 1        Reps
 2: 6        Loc [ Precip_mm ]

40:  Wind Vector (P69)
 1: 1        Reps
 2: 60       Samples per Sub-Interval
 3: 01       S, 01 Polar
 4: 4        Wind Speed/East Loc [ WindSpeed ]
 5: 5        Wind Direction/North Loc [ WindDir   ]

41:  Average (P71)
 1: 1        Reps
 2: 2        Loc [ AirTemp   ]

42:  Average (P71)
 1: 1        Reps
 2: 8        Loc [ SoilSurfa ]

43:  Average (P71)
 1: 1        Reps
 2: 3        Loc [ RelHum    ]

44:  Minimum (P74)
 1: 1        Reps
 2: 0        Value Only
 3: 1        Loc [ BattVolt  ]

;send only the RAWS-7 data to the transmitter using the ASCII RAWS -7 Format

45:  If time is (P92)
 1: 5        Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 30       Then Do

46:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 3        ASCII RAWS-7 Format
 3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

47:  If (X<=>F) (P89)
 1: 15       X Loc [ P126_RC   ]
 2: 3        >=
 3: 1        F
 4: 30       Then Do

     48:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 4        <
      3: 7        F
      4: 30       Then Do

;Try P126 again

          49:  Data Transfer to HDR GOES (P126)
           1: 0        Append to Self-Timed Buffer
           2: 3        ASCII RAWS-7 Format
           3: 15       Result Code Loc [ P126_RC   ]

     50:  End (P95)

51:  End (P95)
```

```
;Send additional measurements including Max wind gust direction, max wind speed
;solar radiation, snow depth, min temp, max temp, soil temp 50, soil temp 100

;send max wind gust direction to GOES use XXX format for NIFC

52:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


53:  Sample (P70)
 1: 1        Reps
 2: 43       Loc [ DirPeakWS ]


54:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 7        ASCII xxx Format
 3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

     55:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          56:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do

;Try P126 again

                57:  Data Transfer to HDR GOES (P126)
                 1: 0        Self-Timed/Append
                 2: 7        ASCII xxx Format
                 3: 15       Result Code Loc [ P126_RC   ]


          58:  End (P95)

     59:  End (P95)


;Send peak wind speed to transmitter

60:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


61:  Sample (P70)
 1: 1        Reps
 2: 42       Loc [ MaxWindSp ]


62:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 7        ASCII xxx Format
 3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

     63:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          64:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do

;Try P126 again

                65:  Data Transfer to HDR GOES (P126)
                 1: 0        Self-Timed/Append
                 2: 7        ASCII xxx Format
                 3: 15       Result Code Loc [ P126_RC   ]


          66:  End (P95)

     67:  End (P95)
```

```
;Send average solar radiation to transmitter

68:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


69:  Average (P71)
 1: 1        Reps
 2: 7        Loc [ SolarRad  ]


70:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 8        ASCII xxxxx Format
 3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

     71:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          72:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 8        F
           4: 30       Then Do

;Try P126 again

               73:  Data Transfer to HDR GOES (P126)
                1: 0        Self-Timed/Append
                2: 8        ASCII xxxxx Format
                3: 15       Result Code Loc [ P126_RC   ]


          74:  End (P95)

     75:  End (P95)

;Send snow depth to transmitter


76:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


77:  Average (P71)
 1: 1        Reps
 2: 11       Loc [ SnowDepth ]



78:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 4        ASCII xxx.x Format
 3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again
```

```
     79:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          80:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do
```

```
;Try P126 again

                81:  Data Transfer to HDR GOES (P126)
                 1: 0        Self-Timed/Append
                 2: 4        ASCII xxx.x Format
                 3: 15       Result Code Loc [ P126_RC    ]


           82:  End (P95)


83:  End (P95)

;Send min AT to transmitter

84:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


85:  Sample (P70)
 1: 1        Reps
 2: 44       Loc [ MinAT      ]

86:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 7        ASCII xxx Format
 3: 15       Result Code Loc [ P126_RC    ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

     87:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC    ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          88:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC    ]
           2: 4        <
           3: 7        F
           4: 30       Then Do

;Try P126 again

                89:  Data Transfer to HDR GOES (P126)
                 1: 0        Self-Timed/Append
                 2: 7        ASCII xxx Format
                 3: 15       Result Code Loc [ P126_RC    ]


          90:  End (P95)

     91:  End (P95)

;Send max AT to transmitter

     92:  Do (P86)
      1: 10       Set Output Flag High (Flag 0)


     93:  Sample (P70)
      1: 1        Reps
      2: 45       Loc [ MaxAT      ]


94:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 7        ASCII xxx Format
 3: 15       Result Code Loc [ P126_RC    ]
```

```
;Check result code for P126; if between 1 and 6, P126 will be executed again

     95:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          96:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do

;Try P126 again

               97:  Data Transfer to HDR GOES (P126)
                1: 0        Self-Timed/Append
                2: 7        ASCII xxx Format
                3: 15       Result Code Loc [ P126_RC   ]


          98:  End (P95)

     99:  End (P95)


;Send soil temp at 50 cm to transmitter



100:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


101:  Average (P71)
 1: 1        Reps
 2: 9        Loc [ Soil50cm  ]


102:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 7        ASCII xxx Format
 3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

     103:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          104:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do

;Try P126 again

               105:  Data Transfer to HDR GOES (P126)
                1: 0        Self-Timed/Append
                2: 7        ASCII xxx Format
                3: 15       Result Code Loc [ P126_RC   ]
```

```
        106:  End (P95)

107:  End (P95)

;Send soil temp at 100 cm to transmitter

108:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)


109:  Average (P71)
 1: 1        Reps
 2: 10       Loc [ Soil100cm ]


110:  Data Transfer to HDR GOES (P126)
 1: 0        Append to Self-Timed Buffer
 2: 7        ASCII xxx Format
 3: 15       Result Code Loc [ P126_RC   ]


;Check result code for P126; if between 1 and 6, P126 will be executed again

     111:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          112:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do


; Try P126 again

               113:  Data Transfer to HDR GOES (P126)
                1: 0        Self-Timed/Append
                2: 7        ASCII xxx Format
                3: 15       Result Code Loc [ P126_RC   ]


          114:  End (P95)

     115:  End (P95)


;Send year, date and time stamp - send first three of the five input locations starting with YEAR

;send year with xxxxx format

     116:  Do (P86)
      1: 10       Set Output Flag High (Flag 0)


     117:  Sample (P70)
      1: 1        Reps
      2: 46       Loc [ Year      ]


      118:  Data Transfer to HDR GOES (P126)
       1: 0        Append to Self-Timed Buffer
       2: 8        ASCII xxxxx Format
       3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

      119:  If (X<=>F) (P89)
       1: 15       X Loc [ P126_RC   ]
       2: 3        >=
       3: 1        F
       4: 30       Then Do

           120:  If (X<=>F) (P89)
            1: 15       X Loc [ P126_RC   ]
            2: 4        <
            3: 7        F
            4: 30       Then Do
```

```
; Try P126 again

                121:  Data Transfer to HDR GOES (P126)
                 1: 0        Self-Timed/Append
                 2: 8        ASCII xxxxx Format
                 3: 15       Result Code Loc [ P126_RC   ]


           122:  End (P95)

      123:  End (P95)

;send julian date

      124:  Do (P86)
       1: 10       Set Output Flag High (Flag 0)


      125:  Sample (P70)
       1: 1        Reps
       2: 47       Loc [ Date      ]

      126:  Data Transfer to HDR GOES (P126)
       1: 0        Append to Self-Timed Buffer
       2: 8        ASCII xxxxx Format
       3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

      127:  If (X<=>F) (P89)
       1: 15       X Loc [ P126_RC   ]
       2: 3        >=
       3: 1        F
       4: 30       Then Do

           128:  If (X<=>F) (P89)
            1: 15       X Loc [ P126_RC   ]
            2: 4        <
            3: 7        F
            4: 30       Then Do


; Try P126 again

                129:  Data Transfer to HDR GOES (P126)
                 1: 0        Self-Timed/Append
                 2: 7        ASCII xxx Format
                 3: 15       Result Code Loc [ P126_RC   ]


           130:  End (P95)

      131:  End (P95)

; send hour minute in xxxxx format

      132:  Do (P86)
       1: 10       Set Output Flag High (Flag 0)



      133:  Sample (P70)
       1: 1        Reps
       2: 48       Loc [ Hour      ]
```

```
     134:  Data Transfer to HDR GOES (P126)
      1: 0        Append to Self-Timed Buffer
      2: 8        ASCII xxxxx Format
      3: 15       Result Code Loc [ P126_RC   ]

;Check result code for P126; if between 1 and 6, P126 will be executed again

     135:  If (X<=>F) (P89)
      1: 15       X Loc [ P126_RC   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do

          136:  If (X<=>F) (P89)
           1: 15       X Loc [ P126_RC   ]
           2: 4        <
           3: 7        F
           4: 30       Then Do


; Try P126 again

               137:  Data Transfer to HDR GOES (P126)
                1: 0        Self-Timed/Append
                2: 8        ASCII xxxxx Format
                3: 15       Result Code Loc [ P126_RC   ]


          138:  End (P95)

     139:  End (P95)

;End of measurement transmissions
;*********************************************
```

9. The last part of the programming is for diagnostics regarding the satellite transmissions. The datalogger registers the number of times it attempts to send the data to the transmitter and sends and error code if something is wrong. This step helps in the diagnostic phase if the transmissions are interrupted.

```
;*********************************************

; Read GOES last message status and error register

     140:  HDR GOES Status (P127)
      1: 2        Read Last Message Status
      2: 17       Result Code Loc [ P127_RC21 ]

     141:  HDR GOES Status (P127)
      1: 4        Read Error Register
      2: 31       Result Code Loc [ P127_RC41 ]

142:  End (P95)

; Store P127 GOES Last Message Status (without lat/longs) and Error Register
; to Final Storage Area 2 every hour at 10 minutes past the hour

143:  If time is (P92)
 1: 10       Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 10       Set Output Flag High (Flag 0)

144:  Set Active Storage Area (P80)
 1: 2        Final Storage Area 2
 2: 0201     Array ID
```

```
;*********************************************

; Read GOES last message status and error register

     140:  HDR GOES Status (P127)
      1: 2        Read Last Message Status
      2: 17       Result Code Loc [ P127_RC21 ]

     141:  HDR GOES Status (P127)
      1: 4        Read Error Register
      2: 31       Result Code Loc [ P127_RC41 ]

142:  End (P95)

; Store P127 GOES Last Message Status (without lat/longs) and Error Register
; to Final Storage Area 2 every hour at 10 minutes past the hour

143:  If time is (P92)
 1: 10       Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 10       Set Output Flag High (Flag 0)

144:  Set Active Storage Area (P80)
 1: 2        Final Storage Area 2
 2: 0201     Array ID

145:  Real Time (P77)
 1: 1220     Year,Day,Hour/Minute (midnight = 2400)

146:  Sample (P70)
 1: 14       Reps
 2: 17       Loc [ P127_RC21 ]

147:  Sample (P70)
 1: 10       Reps
 2: 31       Loc [ P127_RC41 ]

; Clear Error Register if any errors are registered

148:  If time is (P92)
 1: 10       Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 30       Then Do

     149:  If (X<=>F) (P89)
      1: 32       X Loc [ P127_RC42 ]
      2: 3     -- >=
      3: 1        F
      4: 30       Then Do

          150:  HDR GOES Status (P127)
           1: 5        Clear Error Register
           2: 41       Result Code Loc [ P127_RC5  ]

     151:  End (P95)

152:  End (P95)

*Table 2 Program
  02: 0         Execution Interval (seconds)


*Table 3 Subroutines

End Program
```

10. After the programming is complete, the entire file is compiled and checked for errors and then saved in multiple file formats. Clicking on the save button automatically initiates these functions. The file is then ready for transfer to the data logger.

The programming will be changed over time as technology advances. Documentation of program changes should be included with the metadata for the program. Version numbers will help clarify what was changed and when it was changed. It is important to run new program versions prior to field deployment to ensure the programming is correct.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 7

Obtaining a GOES/DCS ID

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P. Sousanes	Added new GOES ID #s acquired in 2005.	Acquired 13 new GOES IDs	1.01

This SOP describes the process of obtaining an ID number that will put a climate station online for satellite telemetry. Data cannot be transmitted without first acquiring an ID. Use of the GOES Data Collection System (DCS) is regulated, by law, to the collection of environmental data by U.S. federal, state, and local government agencies, and by international government agencies and research organizations with a U.S. government sponsor.

A prospective user must first apply for and be granted a System Use Agreement (SUA) by NESDIS, which is typically renewable every 5 years (2 years for manufacturers). Once the SUA has been approved and signed, the user must purchase equipment that has been certified to be compatible with the GOES DCS.

The initial System Use Agreement for the CAKN climate monitoring program was filed in 2002 for the thirteen GOES/DCS IDs listed below: All are Channel 172 and are 1 hourly with 10 second window.

Primary Address	Transmission Time
3960060C	00:32:30
3960157A	00:32:40
396020E0	00:32:50
39603396	00:33:00
39604506	00:33:10
39605670	00:33:20
396063EA	00:33:30
3960709C	00:33:40
39608018	00:33:50
3960936E	00:34:00

3960A6F4	00:34:10
3960B582	00:34:20
3960C312	00:34:30

A second set of GOES IDs were requested in 2005 to allow growth in the program:

Primary Address	Transmission Time
3960D064	00:38:10
3960E5FE	00:38:20
3960F688	00:38:30
396104F6	00:38:40
39611780	00:38:50
3961221A	00:39:00
3961316C	00:39:10
396147FC	00:39:20
3961548A	00:39:30
39616110	00:39:40
39617266	00:39:50
396182E2	00:40:00
39619194	00:40:10

An application form with the policies governing the use of the GOES system can be found at the NOAA GOES Data Collection System (DCS) website at: http://noaasis.noaa.gov/DCS/index.html.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 8

Programming the HDR GOES Transmitter

Version 1.0 (October 2004)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP details the steps for programming the SAT HDR GOES transmitter for the CAKN climate stations. This protocol will describe the steps required to program the transmitter. It is suggested that the programming be done in the office and tested prior to field installation. A transmitter in the field can be upgraded or reprogrammed by bringing a laptop with the DCPComm software and the proper cable connection.

Overview of the Transmitter Functions

The SAT HDR GOES transmitter supports one-way communication, via satellite, from a Campbell Scientific datalogger to a ground receiving station (Figure 1). The transmitter utilizes non-volatile memory to store configuration information, such as platform ID, transmission baud rate, channel number, scheduled transmission time, offset time, and message window length. The clock is maintained with a GPS receiver.

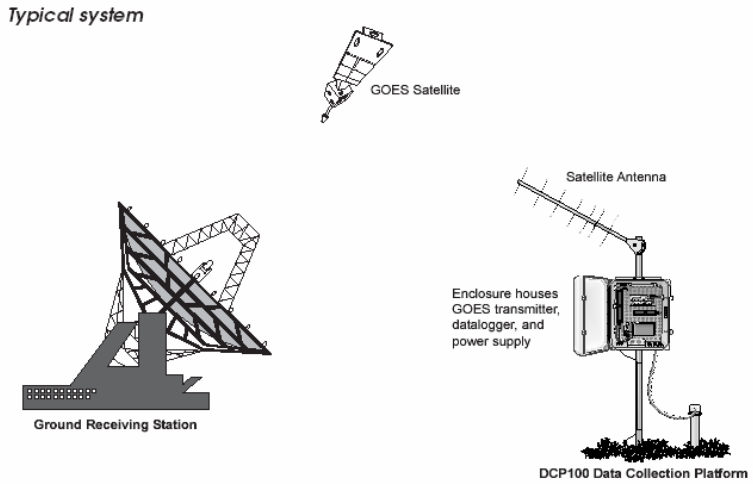


Figure 1 GOES System communication links

The DCP transmitter sends data via Geostationary Operational Environmental Satellites (GOES). GOES satellites have orbits that coincide with the Earth's rotation, allowing each satellite to remain above a specific region. The GOES system is administered by the National Environmental Satellite Data Information Service (NESDIS). NESDIS assigns addresses, uplink channels, and self-timed/random transmit time windows. Self-timed windows allow data transmission only during a predetermined time frame. Alaska is positioned to use the GOES West satellite.

The Campbell Scientific, Inc. Instruction Manual for the SAT HDR GOES transmitter outlines in detail the GOES system, transmitter functions, using the software DCPComm, programming the Datalogger, and Field Installation. This manual is available online at http://www.campbellsci.com/satellite.html#goes.

Programming the Transmitter

There is certain information that is unique to each transmitter. This setup information includes: platform ID, transmission baud rate, channel number, scheduled transmission time, offset time, and message window length. This setup information is entered in the SAT HDR GOES with a computer running DCPComm software.

The following steps are taken from the SAT HDR GOES Instruction Manual with additional notes that pertain directly to the setup of the CAKN climate stations.

Step 1.

Install DCPComm. Inquire with Campbell Scientific, Inc. to ensure that the latest version of the software is being used.

Step 2.

Load the configuration file. The configuration file contains the information unique to the transmitter, i.e. platform ID. A unique configuration file can be saved for each DCP in service. The default configuration file is GOESTerminalVersion3.0.

Only the white fields in the configuration can be changed, the others are set at the factory.

2.1 Platform ID

Starting from the top of the file select the “value” field for terminal ID Number and enter one of the thirteen assigned IDs for the Central Alaska Network. It is important to keep a log with the IDs used in the network so a platform ID is not duplicated.

2.2 Mode

The mode is the data type. The CAKN stations will use ASCII format, so enter a 1 in this field.

2.3 Message Window

The message window is the length of the assigned self-timed transmission window. The value entered for the CAKN climate stations is 8 even though the transmission window assigned is 10. This allows a few seconds leeway so the message doesn’t overlap the assigned time

window. The data stream transmitted for CAKN takes approximately 4 seconds to transfer.

2.4 Minimum Voltage Supply

Leave this value as the default 96 (9.6 volts).

2.5 Timed Configuration

The interval must be set for self timed transmissions. Four values must be entered. Select 0 days, 1 hour, 0 minute, 0 seconds.
The offset is the time after midnight of the first transmission of the day. This is the transmission time that is assigned with the platform ID. In the example for Stampede it is 0 hours, 34 minutes, and 10 seconds.

2.6 Timed Channel

The timed channel is also assigned with the platform ID. All of the CAKN stations are currently on channel 172.

2.7 Baud rate

The Baud rate must also match your channel assignment. The baud rate assigned to the CAKN climate stations is 300.

2.8 Interleaver

The interleaver can be used to provide some error correction to the data transmission, however the number of bytes transmitted will increase, therefore CAKN stations have a 0 value entered here to leave the interleaver off.

2.9 Random Configuration

The CAKN stations are on self timed transmissions so these values are left at 0.

2.10 GPS Fix time Out

The default settings work fine for this section.

2.11 Communication Port Type

The communication port type sets the active port on the transmitter. The CSI port is used with Campbell Scientific dataloggers. Enter a 3 in this field.

2.12 Serial Time Out

The serial time out is set long enough for all data to be copied from the datalogger to the transmitter before the time out expires. The default setting of 20 for serial time out and 5 for wait before sleep should be entered.

2.13 SDI-12 Settings

These fields are not used for the CAKN stations – leave the default values.

2.13 Debug

Leave default settings for debug and Allow test mode.

Below is an example from the Stampede climate station in Denali:

File Sensor configuration DCP Communications Terminal SDI-12 Factory Tests Password Window Help

Start U.I.Mode | Cfg | Exit UI mode

Sensor name and number		Item name	Value
GOES Transmitter	1	Terminal ID number	3960a6f4 H
	1	Mode (ASCII=1 Pseudo=3)	1
	1	1200 baud AGC level	c00 H
	1	100/300 baud AGC level	900 H
	1	Message window (seconds)	8
Transmit Limits	2	SWR max	94
	2	SWR min	56
	2	Minimum supply voltage (1/10 volts)	96
	2	RF max	ff H
	2	RF min	0 H
Timed Configuration	3	Interval Days	0
	3	Hours	1
	3	Minutes	0
	3	Seconds	0
	3	Offset Hours	0
	3	Minutes	34
	3	Seconds	10
	3	Channel	172
	3	Baud rate(1=100 2=300 3=1200)	2
	3	Interleaver(0=none 1=small 2=large)	0
Random Configuration	4	Interval Hours	0
	4	Minutes	0
	4	Seconds	0
	4	Channel	0
	4	Baud rate(1=100 2=300 3=1200)	1
	4	Interleaver(0=none 1=small 2=large)	0
GPS	5	Fix timeout (seconds)	300
	5	First fix timeout (seconds)	1200
	5	Fix attempt interval	3600
	5	Max time without GPS fix - 100/300 baud	9000
	5	Max time without GPS fix - 1200 baud	18000
Communication	6	Port type (0=SDI 2=AUX 3=CSI)	3
	6	Config port baud rate	25
	6	Aux/CSI baud rate	96
	6	Serial timeout (seconds)	20

File Sensor configuration DCP Communications Terminal SDI-12 Factory Tests Password Window Help

Start U.I.Mode | Cfg | Exit UI mode

Communication	6	Port type (0=SDI 2=AUX 3=CSI)	3
	6	Config port baud rate	25
	6	Aux/CSI baud rate	96
	6	Serial timeout (seconds)	20
	6	Wait before sleep (seconds)	5
SDI Sensor 1	7	Sample Interval (seconds)	3600
	7	Offset from midnight (sec)	0
	7	Address	0
	7	Command	NNN
SDI Sensor 2	8	Address	1
	8	Command	NNN
SDI Sensor 3	9	Address	2
	9	Command	NNN
SDI Sensor 4	10	Address	3
	10	Command	NNN
SDI Sensor 5	11	Address	4
	11	Command	NNN
SDI Sensor 6	12	Address	5
	12	Command	NNN
SDI Sensor 7	13	Address	6
	13	Command	NNN
SDI Sensor 8	14	Address	7
	14	Command	NNN
SDI Sensor 9	15	Address	8
	15	Command	NNN
SDI Sensor 10	16	Address	9
	16	Command	NNN
Factory Setups	17	Clear debug entries	E007D00E007
	17	Debug (1=on 0=off)	0
	17	Allow test mode (1=yes 0=no)	0
	17	TCXO Real time clock equipped	0
	17	Set TCXO table to defaults	DDDDDDD
	17	Calculate checksum	WWWWWW

Step 3.

Transferring the configuration information to the SAT HDR GOES

The configuration port is an RS232 port utilizing a DB9 female connector. Figure 2 shows the location of the configuration port (and other ports) on the transmitter. The DCPComm software communicates with the transmitter through the configuration port. Use this port to transfer the configuration file from the computer to the transmitter. You must have the proper cable that was included with the purchase of DCPComm. Connect one end to the Com Port on your PC and one end to the Config Port on the transmitter

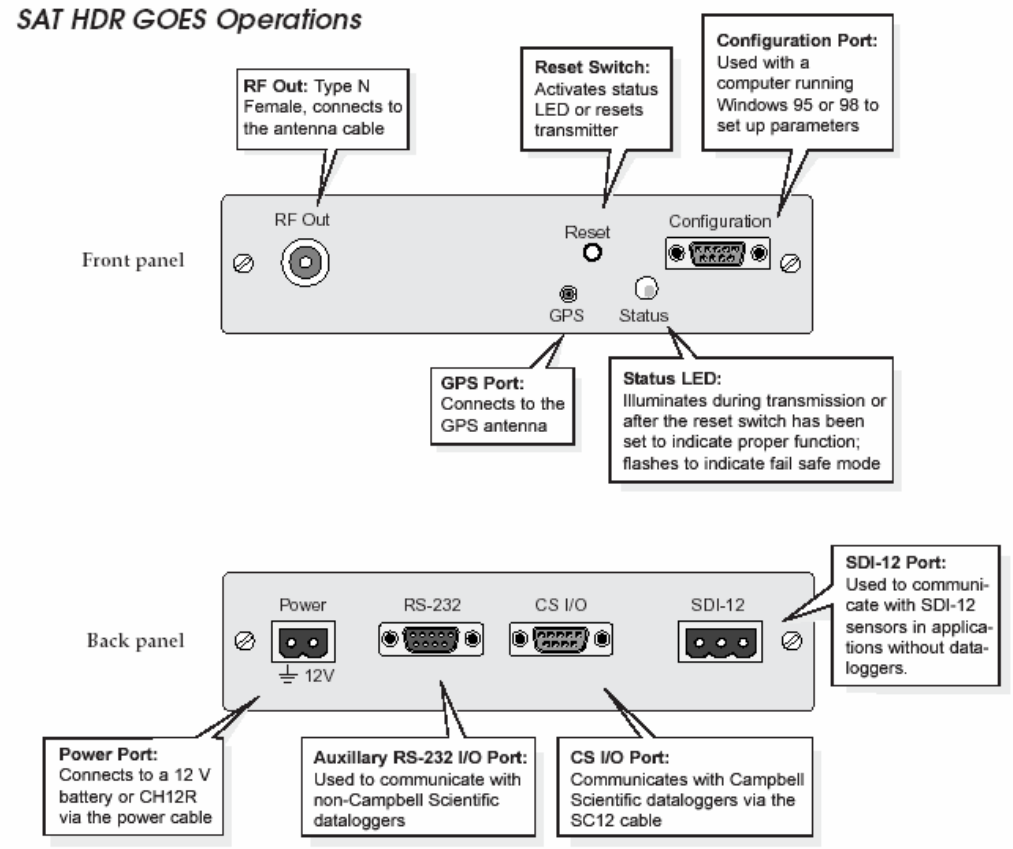


Figure 2 SAT GOES Transmitter ports

Edit and save the configuration file under the station name before transferring it to the transmitter. Open DCPComm and then open the configuration file you wish to send. From the main menu select “DCP Communications/Start User Interface”. You will receive a message that the user interface mode started. From the main menu, select “DCP Communications/Send Configuration”. Wait for the message “Configuration Sent”. From the main menu, select “DCP Communications/Stop User Interface Mode”. After the configuration file is sent it is ready to be installed in the field.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 9

Station Deployment Equipment List

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P. Sousanes	Minor edits: added park to radio and digital to camera in equipment list.	Incorporated peer review comments	1.01

This SOP lists the equipment required for a complete climate station deployment and suggests methods of packaging the equipment for transportation to a remote site via fixed-wing aircraft or helicopter.

Equipment Checklist

√	**Station Equipment**	**Weight lbs.**
	Tripod tower/mast	75
	Guy kit	10
	Specialized Battery enclosure	15
	2 12V Batteries	140
	Lightning rod	5
	NEMA enclosure	25
	Wind monitor	5
	Pyranometer	5
	AT/RH sensor	5
	Snow Depth Sensor	5
	GOES antenna	5
	GOES GPS antenna	5
	GOES coax cable	5
	Solar panel (64 watt)	25

	AT shield	5
	Tipping bucket	10
	Tipping bucket pipes (1)	5
	Tipping bucket conduit	5
	Wind/Pyranometer	5
	Wind pipe extension	2
	Pyranometer stand	5
	Lightning rod cable (black)	2
	Lightning rod cable (green)	2
	Battery cable	2
	Battery cable conduit	5
	Battery cable bifurcating Y	2
	Tower rebar pegs	5
	Extra long rebar pegs	5
	Enclosure putty	2
	Desiccant	5
	CR10X Datalogger	5
	CR10KD Keypad	2
	Datalogger Ribbon cable	2
	GOES transmitter	5
	Charging regulator	5
	Humidity indicator card	2
	Platform under battery box	10
	Platform for standing	10
	(2) 24” X 24” plywood (for snow depth sensor surface)	20
	(2) 1”x 4” x 48” cedar planks	5
	Channel Unistrut (2) 2’, (1) 4’ and (1) 6’ piece	15
	Nuts, Bolts and Washers for Unistrut construction	5

√	**Tools Needed for Deployment/Maintenance**
	Tape measure
	Teflon tape/Pipe Dope
	Straight Bit Screwdriver
	Philips Head Screwdriver
	Needle Nose Pliers
	Pliers
	Pocket Knife
	Wire cutters

	Wire strippers
	Nut drivers 3/8”, 5/16”
	Hex wrench set
	Open Ended Wrenches: 3/3”, 7/16”, ½”, 9/16”
	Socket Wrench and 7/16” deep well, 9/16” and ½” sockets
	Adjustable Wrench
	Electrical tape
	Tie-wraps
	Level
	Small sledgehammer
	Pipe wrenches (2 – 12”)
	Rock bar
	Step ladder (4 or 6’)
	Shovel
	Drill
	Soil Auger
	Weed Whip
	Loppers
	Tool Box with nuts/bolts/washers/ turnbuckles/screws

√	**Miscellaneous Equipment/Tools Listed**
	Thermometer (°C)
	Voltmeter
	Park radio and batteries
	Satellite Phone
	Pencil
	Calculator
	Sharpie
	Compass w/known magnetic declination of area
	Inclinometer
	GPS unit for marking location
	Digital camera and extra batteries
	Binoculars
	Bungee cord
	Station checklists
	CR10X wiring diagrams
	CR10X program
	CR10X prompt sheet
	GOES program
	Desiccant packs

	Palm PDA w/cables w/PC Connect
	Laptop w/LoggerNet and DCPComm

√	**Personal Equipment**
	Warm Clothing
	Waterproof Jacket and Pants
	Small Tarp
	Food
	Sunscreen
	Personal Protective Equipment for aircraft (if applicable)
	Bear spray (follow OAS regulations for transporting in aircraft)
	Watch

Hazardous Material
Batteries are sealed lead-acid batteries. For transport in aircraft follow the NPS guidelines for aviation safety. Do not have battery terminal bolts exposed. Use electrical tape to cover the terminals to avoid contact with any other items in the aircraft. It is preferable to have them transported within the original box they were shipped in if possible. Bear spray is also hazardous. Ensure that it is stowed in a secure box, preferably in a cargo area that is not attached to the cockpit.

Packaging recommendations
See above figure for recommended packaging for transport in aircraft.

Equipment in the Battery Box: Tipping Bucket, Conduit, Snow Depth Sensor, Battery Cables, Soil Temperature Probes (Figure 2)

Figure 1 Equipment in battery box

Equipment in NEMA Enclosure: Guy kit, pyranometer, AT/RH Sensor, GOES GPS, GOES Cable, AT Shield, wind pipe extension, pyranometer stand, lightning rod cable (black and green), battery cable, battery cable conduit, desiccant, ribbon cable, power regulator, humidity indicator,

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 10

Climate Station Installation

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P. Sousanes	Removed SOP 10a and added link to manual instead	Redundant info available elsewhere	1.01

This SOP describes the steps for installing a climate station installation which is almost solely based on the Campbell Scientific Inc. Tripod Weather Station Instruction Manual. The manual is available at http://www.campbellsci.com/towers.html

There are certain steps of the installation process that were tailored for the CAKN climate stations. These deviations from or additions to the CSI Instruction Manual are described below. They pertain to the following topics:

- Mounting device for snow depth sensor and AT/RH sensor.
- Mounting of solar panel
- Attaching the external battery

Mounting device for snow depth sensor and AT/RH sensor
Channel unistrut was used to create a mounting device for the AT/RH sensor and the snow depth sensor in order to distance the sensors from the large solar panel mounted to the tripod. The mounting device consists of a 6’ length, a 5’ length and (2) 2’ lengths for support. Figure 1 shows the mounting set up on a CAKN climate station.

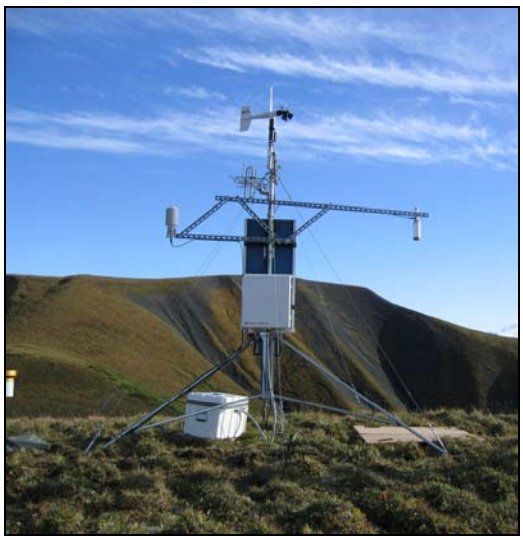


Figure 1 CAKN station

The channel unistrut is attached with bolts and large flat washers. The radiation shield attaches to the unistrut directly via the two existing holes on the shield, and the snow sensor is attached with a 1" B-Line clamp. See the Figure 2 below for detailed views for building the mounting device.

Figure 2. Close up shots of mounting devices on CAKN stations

Mounting Device for Solar Panel

Due to the location of the CAKN climate stations (60-65° latitude) they require solar panels ≥ 50 watts. The CAKN stations have been equipped with 64 Watt solar panels plus a 10 watt solar panel. The larger panels are approximately 2' x 4'. Custom mounting brackets were designed for the panel with two holes in the center for a u-bolt attachment to the tripod. The drawing for the design is shown below. Two of these brackets are attached with bolts to the frame of the solar panel. The actual size of the mounting hardware will be determined by the size of the frame surrounding the individual panel.

1 ½" x ¼" Flat Steel

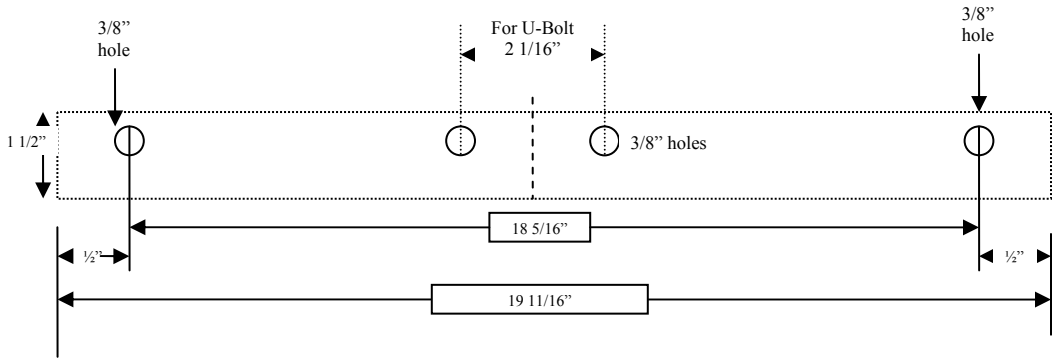


Figure 3. Detailed drawing of solar panel mounts

The solar panel is mounted flush to the south side of the tripod using U-bolts to attach the panel to the mast. Figure 4 shows of a 64 watt solar panel attached to a climate station.

Figure 4. Solar panel mounted to CAKN station

Attaching the External Battery

Two 12 volt 100 amp hour batteries are used at each climate station. The batteries can be purchased from a number of local dealers or procured on the web. The batteries need to be connected to the CH12R charging regulator with the connector supplied by Campbell Scientific, Inc. This battery cable needs to be put in a metal conduit so that it is protected from wildlife. The conduit is attached to the battery box with conduit fittings shown in the photos below. A 90° elbow is used at the battery box and a ring clamp is used to secure it to the enclosure. Battery terminal connectors are placed on the end of the wire, the red wire is attached to the positive terminal and the black wire is attached to the negative terminal. The batteries are connected in parallel with battery terminal connectors. Attach the red connector to the positive terminal of each battery, and the black connector to the negative terminal of each battery. Figure 5 shows detailed photos of attaching a battery to the system.

Figure 5. External battery connection

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 11

Links to Instruction Manuals

Version 1.0 (October 2004)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP lists the Campbell Scientific, Inc. (CSI) Instruction Manuals used for the installation of a CAKN climate station. The sensor manuals should be included in the maintenance kit for site visits. The manuals include individual measurement sensor manuals, software manuals, and manuals describing cable functions. The items in bold are used on the older Long-term Ecological Monitoring (LTEM) program climate stations in Denali National Park and Preserve. Some of the equipment being used on these older stations have been replaced by newer models but are still supported by CSI.

Campbell Scientific, Inc. Instruction Manuals

1. Datalogger
    - CR10X Overview ftp://ftp.campbellsci.com/pub/outgoing/manuals/cr10x-ov.pdf
    - **CR21X** Retired datalogger status – Request manual from CSI
2. Data collect onsite
    - SC32B – Connects PC to Datalogger: ftp://ftp.campbellsci.com/pub/outgoing/manuals/sc32b.pdf
    - SC929 RS232 – Connects battery powered laptop to datalogger: ftp://ftp.campbellsci.com/pub/outgoing/manuals/sc929.pdf
    - SC-USB – Connects datalogger to PC with USB connection: ftp://ftp.campbellsci.com/pub/outgoing/lit/b_sc-usb.pdf
    - **SC532A** – Connects PC to peripheral device (Storage module) Retired, but manual and repairs still available.
3. Data Storage
    - **SM192/SM716** – Storage modules used on CR21X
4. Power Supplies
    - CH12R or CH100 charging regulator. Manual available via CSI request
5. Sensors

- Air temperature/Relative Humidity HMP45C
  ftp://ftp.campbellsci.com/pub/outgoing/manuals/hmp45c.pdf
- **Air temperature/relative Humidity HMP35C**. Retired but still supported
- Soil temperature Probe
  ftp://ftp.campbellsci.com/pub/outgoing/manuals/107.pdf
- SR50 Ultrasonic Distance Sensor _ Snow Depth
  ftp://ftp.campbellsci.com/pub/outgoing/manuals/sr50.pdf
- Tipping Bucket Rain Gauge 525WS – Precipitation
  ftp://ftp.campbellsci.com/pub/outgoing/manuals/te525.pdf
- LI200X Pyranometer Solar radiation
  ftp://ftp.campbellsci.com/pub/outgoing/manuals/li200x.pdf
- Wind Monitor 05103
  ftp://ftp.campbellsci.com/pub/outgoing/manuals/05103.pdf

6. Software
   - LoggerNet – PC to Datalogger capabilities
     ftp://ftp.campbellsci.com/pub/outgoing/manuals/loggernet2-1.pdf
   - PConnect – Palm handheld device to datalogger capabilities
     ftp://ftp.campbellsci.com/pub/outgoing/manuals/pconnect.pdf
7. Communications
   - GOES HDR Satellite transmitter
     ftp://ftp.campbellsci.com/pub/outgoing/manuals/sathdrgo.pdf
8. Tripods and Towers

   CM10 – Tripod Installation (included as SOP10a)
   ftp://ftp.campbellsci.com/pub/outgoing/manuals/tripod.pdf
   UT10 and UT30 Tower Installation
   ftp://ftp.campbellsci.com/pub/outgoing/manuals/ut10.pdf
   ftp://ftp.campbellsci.com/pub/outgoing/manuals/ut30.pdf

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 12

Climate Station Data Collection -PDA

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/19/2006	P.Sousanes	Added reference to cold weather usage	Incorporated peer review comments	1.01

This SOP describes the procedure to download data from a CR10X datalogger in the field. This can be accomplished in two ways, with a laptop or with a Palm Personal Digital Assistant (PDA). Both laptops and PDAs perform poorly when the temperature is below zero, it is recommended that data downloads be performed in warmer temperatures. The following is a summary of the procedures involved in collecting data via a Palm handheld. Detailed descriptions can be found in the Campbell Scientific, Inc. ***PConnect for the Palm Handheld Instruction Manual***, available with the purchase of PConnect or available online at ftp://ftp.campbellsci.com/pub/outgoing/manuals/pconnect.pdf

Procedures:

1. Obtain PConnect from Campbell Scientific, Inc. and load the software on a PC. PConnect software allows you to connect your Palm handheld to a CR10X datalogger to perform all of the standard datalogger support functions, including:
    - Send and receive datalogger programs
    - View and edit input locations
    - Collect data
    - View data in tabular and graphical form

2. Once PConnect is loaded on your PC a Palm device can be connected to the PC and the PConnect program will be transferred to the Palm by using the HotSync button. The HotSync button is the method of transferring files between the Palm device and your PC. Files stored in the PConnect folder will be transferred to the Palm device. Datalogger program files can be stored in this file. The file name can be no longer than 8 characters for the transfer to be successful.

Connecting the Palm device to the datalogger

1. The Palm handheld connects to the datalogger via the communications port on the bottom of the device and terminates with the 9-pin (female) serial port

connector. The cable is specific to the Palm OS handheld model and needs to be purchased directly from Palm.

2. After connecting the cable to the PDA use the supplied PDA to CS I/O adapter to connect the datalogger's CS I/O port. See photo below.

3. Start the PConnect software on the Palm handheld by double clicking on the icon. In order to connect to a station you need to give it a name. Use the name of the station as a naming convention. This is critical. Once the data is downloaded from the station it will be stored under this file name. To edit the default name hit the EDIT button. Click OK when done.
4. Select the station name and hit CONNECT. The current measurements will appear on the Palm handheld. If there is an error connecting, make sure the cable is connected properly to the Palm handheld. This is a loose connection and can disconnect easily.

To Collect Data

1. To collect the data touch the menu in the upper right hand corner of the screen on the Palm PDA. Choose **Collect Data**. Next choose **Collect All** from the pull down menu. The palm will start to transfer the data from the datalogger. This can take a few minutes. The Palm will beep when it is finished collecting the data and display the message **Data Has Been Successfully Collected.** Hit **OK**
2. To view the data you just downloaded first hit **Disconnect.** Choose the name of the station from the list on the left and instead of hitting **Connect** hit **View Data.** There will be two storage areas for the CAKN stations, select final storage area 1. The data will be displayed in columns. From the pull down menu choose the array ID number. There will be only 1 array ID number in final storage 1. The columns will be displayed again. To graph a column double click on the column heading.

3. Once the data is collected to the Palm handheld use the HotSync cradle and HotSync the Palm to your PC. All of the files from the handheld will be transferred to the PConnect file and appended to the data file on the PC named after the station from which it was retrieved.

To Transfer a Program

1. To transfer a program from the Palm handheld touch the menu in the upper right hand corner and select **Transfer Program**.
2. The pull down menu on the next screen will list the programs that were transferred from your PC to the PDA when you used the HotSync button as described above. Choose the name of the program you want to transfer, i.e. the program for the CAKN climate stations is currently CAKN_1. Select the program and hit **Send**. A message will appear asking if you are sure you want to do this. Once a new program is sent the existing program and memory will be erased. The program will be transferred and compiled

Reference

2002. Campbell Scientific, Inc. *PConnect for the Palm Handheld Instruction Manual.* Software Support for Campbell Scientific Dataloggers. Version 2.0, Revision 6/02.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 13

Climate Station Data Collection -LoggerNet

Version 1.01 (December 2006)

Revision History Log:

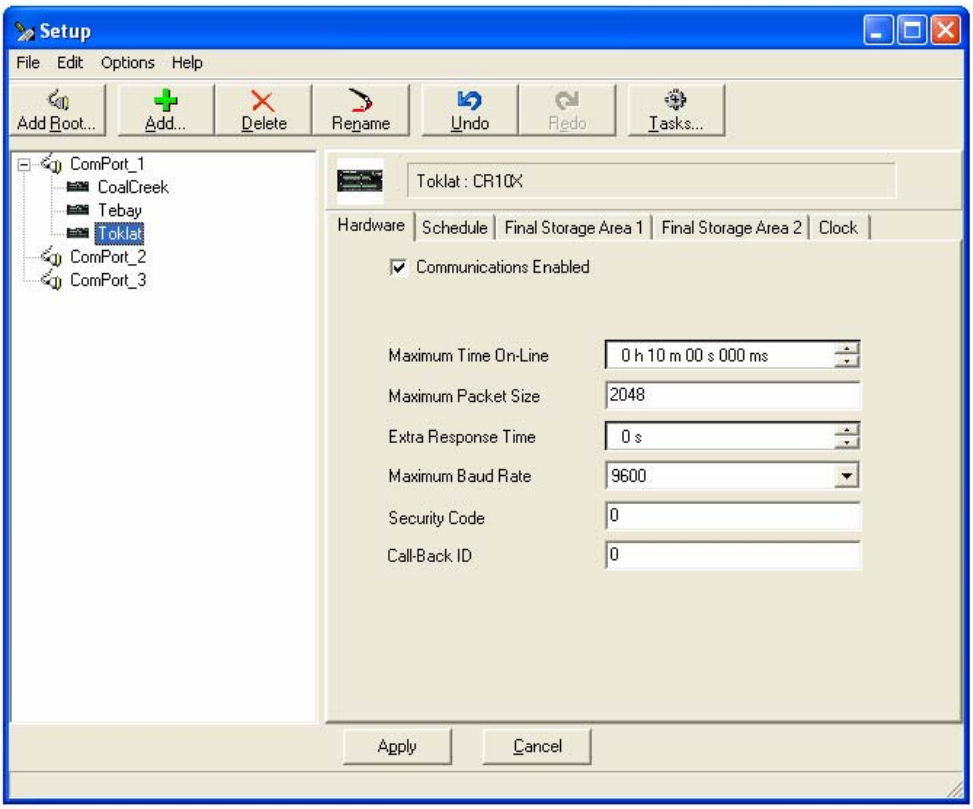
Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Added reference to temperature limitations and changed title to match narrative	Incorporated comments from peer review and made edits	1.01

This protocol describes the procedure to download data from a CR10X datalogger in the field. This can be accomplished in two ways, with a laptop or with a Palm PDA. The following is a summary of the procedures involved in collecting data via a laptop with Campbell Scientific, Inc. LoggerNet software installed. Laptops and PDAs do not work well at temperatures below 0°C, if possible schedule downloads in warmer seasons.

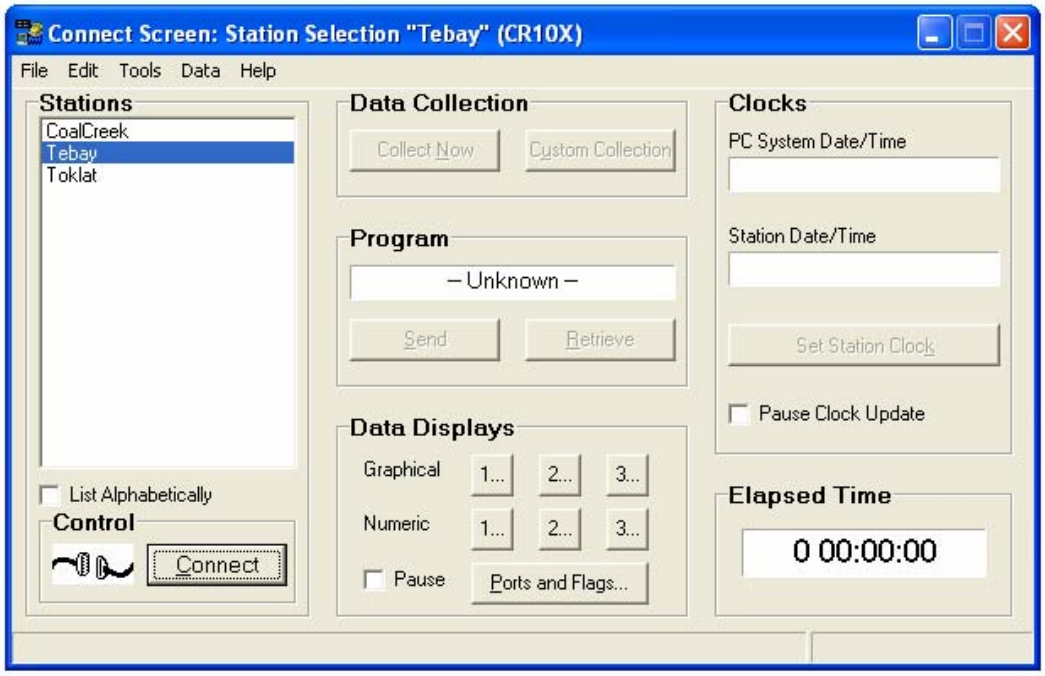
Procedures
For a full description of the LoggerNet software refer to SOP #5 Datalogger Software Instructions

Collecting data in the field

1. Connect the datalogger to the laptop using the 9-pin CSI serial cable for battery powered laptops.
2. In LoggerNet hit the **Setup** button and add the name of the station you are visiting under ComPort_1. The default will say CR10X. Click the **Rename** button up top and then **Apply**. It is important to name the station at this point.
3. Click **Connect** on the LoggerNet toolbar. The station name should appear in the box on the left. If it doesn't go back to **Setup** and add the station. Click on the station and then click **Connect** at the bottom of the screen.



4. The icon at the lower left should show that you are connected and the elapsed time indicator will start.
5. Click on **Collect Now** under **Data Collection.** The data from the datalogger will be collected and stored in a file named *stationname*.dat in the LoggerNet file under the Campbellsci folder**.**


Connect Screen: Station Selection "Tebay" (CR10X)
File Edit Tools Data Help
Stations
CoalCreek
Tebay
Toklat
List Alphabetically
Control
Connect
Data Collection
Collect Now
Custom Collection
Program
– Unknown –
Send
Retrieve
Data Displays
Graphical 1... 2... 3...
Numeric 1... 2... 3...
Pause
Ports and Flags...
Clocks
PC System Date/Time
Station Date/Time
Set Station Clock
Pause Clock Update
Elapsed Time
0 00:00:00

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 14

Climate Station Data Collection -Storage Module

Version 1.0 (October 2004)

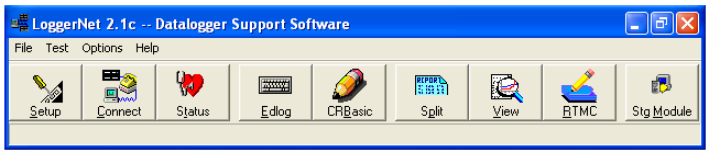
Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

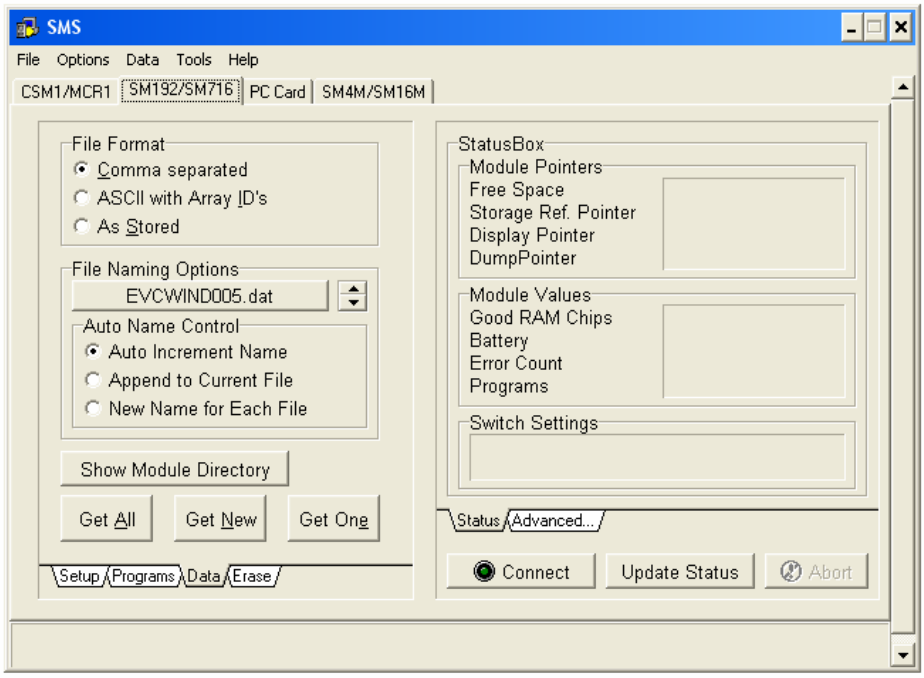
This SOP describes the procedures for storing data onsite with a Campbell Scientific, Inc. (CSI) SM192 or SM716 storage module. The number of the storage module refers to the amount of storage available on the module. These modules are considered retired products according to CSI, but are still supported. These modules are used on the Long-term Ecological Monitoring (LTEM) climate stations at Denali National Park and Preserve.

Procedures

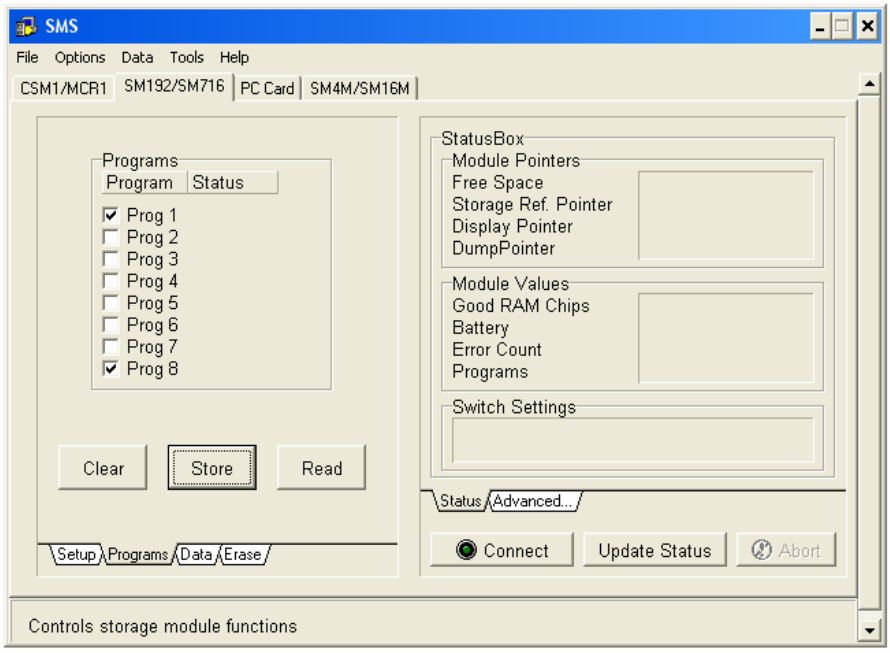
1. The storage modules are connected to the datalogger using a CSI ribbon cable to connect the 9-pin serial port on the storage module with the serial port on the datalogger.
2. The station must be programmed to send the data that is stored in final storage to the storage module every hour using a P92 command in the EDLOG programming software. SOP 6 gives an example of a programmed used on the 21Xs.
3. During a bi-monthly site visit the storage module is swapped for a fresh module. This swap can occur at anytime except for on the hour. This is when the data are being transferred.
4. The full module is downloaded back at the office using an SC 532 which enables communication between the storage module and a PC with LoggerNet software installed.
5. Open LoggerNet and select Stg Module



6. On the Stg Module toolbar select the SM192/SM716 tab. Select the Setup tab to set the connection between the storage module and the PC. The default setting is COM 1 (Communication Port 1) at 9600 baud.
7. Select Connect to enable the connection between the two devices.



8. Next select the **Data** tab on the bottom. Under the **File Format** select **Comma separated**. Under file naming options name the file with the following naming convention: 2 letter station abbreviation, 3 number Julian day, and two number year, i.e. PF13204 would be Permafrost station, Day 132 of year 2004. The following is the list of the two letter abbreviations for the LTEM stations in Denali:
    - Forest-FO
    - Permafrost – PF
    - Treeline – TL
    - Lower Ridge – LR
    - Upper Ridge – UR
9. After the file has been named select **Get All** from the bottom left. Depending on the amount of stored data this could take a few minutes.
10. Once the data are transferred check to make sure the file is complete. At this point make a copy of the entire data file and export it into an Excel spreadsheet with the same naming convention. The original file format will be an ASCII supported file type on the PC, i.e. Surfer. Verify that there are two copies of the file on the PC.
11. Select the **Erase** tab on the bottom of the Stg Module Toolbar. Select **Erase data and Programs**. This will clear the storage module and it will be ready for the next site visit. These storage modules can be used on any of the stations.
12. Programs can be stored in the Storage Module and transferred to the datalogger in the field using the keypad on the datalogger. To store a program select the **Programs** tab on the bottom of the Stg Module toolbar. Select **Prog 1** and **Prog 8** and then select **Store.** This window allows you to browse through your PC to locate the program for the station. Find the program and double click on the file. The same file will be loaded into both Program 1 and 8. Verification of the transfer can be done by selecting **Read** and naming the file. Naming this file check or test will make it easier to find for verification.



13. After the download is complete and the data and programs are erased select **Disconnect.**

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 15

Station Maintenance / Calibration Schedule

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Added details to all items. Added new Therm-X temp sensor instructions.	Incorporated peer review comments	1.01

This SOP describes the calibration schedule for the standard sensors used on the CAKN climate stations. Refer to the sensor manuals (SOP #4) for calibration instructions. It is a good idea to check with Campbell Scientific, Inc. (CSI) on a regular basis regarding any changes to their products. Their web site is also a good source of information http://www.campbellsci.com/index.cfm. The suggested maintenance schedule is outlined below:

Six Months (where applicable, for some remote sites the frequency may be limited to once a year because of funding and time)

1. Download data from datalogger (See SOP # 12, 13, or 14 for instructions)
2. Check the pyranometer for level and clean if necessary
3. Check tipping bucket for debris and level the bucket
4. Clean the radiation shield.
5. Clean the enclosure
6. Replace desiccant inside enclosure

One year

1. Download data from datalogger (See SOP # 12, 13, or 14 for instructions)
2. Swap the HMP45C probe. Send to CSI for calibration in spring before next field season. CAKN currently has enough sensors for a full swap of all stations each year.
3. Swap the Therm-X temperature probe (See SOP# 11). CAKN currently has enough sensors for a full swap of all stations each year.
4. Calibrate the rain gage in the field according to sensor manual.
5. Change desiccant in SR50 according to sensor manual.
6. Replace desiccant in enclosure
7. Tighten guy wires

Two years

1. Swap the LI 200X pyranometer. Send to CSI for calibration in spring before next field season.

Three Years

1. Swap the RM Young wind sensor. Send to RM Young for calibration. Because these are expensive sensors stagger the rotation so that there are only 2-3 being calibrated per year.
2. Swap the CR10X datalogger. Check with CSI before sending. Because these are expensive stagger the rotation so that there are only 2-3 being calibrated per year.
3. Swap the SR50 depth sensor. Because these are expensive sensors stagger the rotation so that there are only 2-3 being calibrated per year.

Five years

1. Replace sensor cables as necessary. Look for animal chew marks or general wear.
2. Replace batteries

Five to ten years

1. Replace soil temperature probes
2. Replace GOES transmitter. Because this is an expensive piece of equipment, stagger the rotation so that there are only 2-3 being calibrated per year.

General maintenance

1. Inspect station
2. Check guy wires, rebar, and all nuts and bolts on station.
3. Check sensor leads for damage
4. Ensure that tripod is level and plumb
5. Check alignment of GOES antenna and tighten bolts.
6. Clean glass on solar panel

This is general guidance for equipment replacement. Technology will continue to change and regular upgrades to sensors and equipment will inevitably occur that may not coincide with this schedule.

Replace anything on the station that has not been changed after 10 years. The exception would be the solar panel, the tripod, the sensor arms, and the grounding rod. Of course, if these items are damaged or look worn replace them as well. Regular upkeep, calibration and maintenance are critical to the quality of the data being produced.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 16

Station Maintenance Checklist

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Calculator was listed twice. Explained use of silicone	Incorporated peer review comments	1.01

This SOP describes the items needed for a maintenance visit to a CAKN climate station. Each station needs to be visited a minimum of once a year, two times a year is preferable if the budget allows.

Climate Station Toolbox

√	**Tools Needed for Deployment/Maintenance**
	Tape measure
	Teflon tape/Pipe Dope
	Straight Bit Screwdriver
	Philips Head Screwdriver
	Needle Nose Pliers
	Pliers
	Pocket Knife
	Wire cutters
	Wire strippers
	Nut drivers 3/8”, 5/16”
	Hex wrench set
	Open Ended Wrenches: 3/3”, 7/16”, ½”, 9/16”
	Socket Wrench and 7/16” deep well, 9/16” and ½” sockets
	Adjustable Wrench
	Electrical tape
	Tie-wraps
	Level

	Extra nuts/bolts/washers/screws
	Enclosure putty

Equipment needed, but not carried in toolbox

√	**Equipment/tools**
	Silicone spray (to loosen bolts if necessary)
	Hacksaw
	Pipe wrench 12”
	Small sledgehammer
	Rock bar
	Step ladder (4’ or 6’)
	Shovel
	Drill
	Soil Auger
	Weed Whip
	Loppers
	Paper towels
	Thermometer (°C)
	Voltmeter
	Park radio and batteries
	Satellite phone
	Calculator
	GPS
	Sharpie/Pencil
	Compass w/known magnetic declination of area
	Inclinometer
	Camera and extra batteries
	Binoculars
	Bungee cord
	Station checklists
	CR10X wiring diagrams
	CR10X program
	CR10X prompt sheet
	GOES program
	Desiccant packs
	Palm PDA w//PC Connect and cables
	Laptop w/LoggerNet and DCPComm and cables

Personal safety and survival gear

√	**Personal Equipment**
	Warm Clothing
	Waterproof Jacket and Pants
	Small Tarp
	Water/Food
	Sunscreen
	Personal Protective Equipment for aircraft (if applicable)
	Bear spray
	Watch

The following is the maintenance checklist required for each station visit:

Site Checklist

Central Alaska Network Climate Monitoring Program

Site: _____
Operator: _____
Date: _____ Time: _____

Year		
Time (AST)		
Battery Voltage		
Air Temperature		
Relative Humidity		
Wind Speed		
Wind Direction		
Precipitation		
Solar Radiation		
Snow Depth		
Soil Temperature 1		
Soil Temperature 2		
P126 Transmit Code :		
Transmit Counter		
P127 Status Code		
P127 Error Register		
*B AAA – # E08 Count 04:		Reset? (Key 88)
A – # Overrun Count 05:		Reset? (Key 88)
AAA – Lithium Batt Volt08:		> 2.9?
A – Low 12V Batt Count09:		Reset? (Key 88)
Battery / Solar Panel OK? (Y/N)		
Desiccant Changed? (Y/N)		
HMP45C Swapped		Serial # In: Serial # out:
LI200X Swapped		Serial # In: Serial # out:
Wind monitor Swapped		Serial # In: Serial # out:

Other service/maintenance performed:

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 17

Photographical Documentation

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Adopted SOP created for NPS I&M by WRCC	Consistency among networks for photographic documentation	1.01

This SOP was taken directly from the document created for the NPS Inventory and Monitoring Program by Greg McCurdy in 2006.

This Standard Operating Procedure (SOP) explains the procedures for proper photographic documentation of a weather station and its surroundings. This SOP also provides a diagram illustrating photograph locations and the directions in which to take each photograph. This diagram is intended to assist the user in the photographic documentation process. A list of necessary tools and equipment is provided, along with a list of example photographs from selected weather stations in the western United States.

I. Introduction

Photographic documentation of a weather station and its surroundings allow users of the station data to more accurately interpret readings. In addition, repeat station photography documents evidence of physical changes occurring over time at the site that may affect station data. For example, vegetation growth over time or changes such as buildings or parking lots may alter temperature or wind patterns. Photographs also show station placement in relation to surrounding features that maps can not illustrate.

The procedures outlined below provide a method for consistently capturing the exposures and overall physical setting of a station.

II. Digital Camera Settings

Specific camera settings will vary between camera manufacturers, models and change with different circumstances and exposures. The following guidelines will require referring to the camera manual for determining specific settings.

1. Photo size setting may be any size, but the ideal settings are 1280x960 or 1600x1200 with normal resolution or compression. This will create an image that is about 200-400 Kb. This provides a good quality image and allows for timely network transport.
2. Methodology instructions are for a camera with a 35mm lens. Many digital cameras are capable of a zoom setting. Do not zoom in. Set lens at widest angle possible for the standard photo positions. This will provide a consistent lens setting for each standard position photo. Additional photos that highlight a feature or setting not captured from the standard photo positions are encouraged. Specialty lens (such as fish-eye lens) may also be used for additions photos, if desired. Notes of camera settings and location for non-standard position photos will be useful at future dates.
3. Auto focus and auto shutter may be used. Set auto shutter to expose the terrain, not necessarily the sky. Most digital cameras allow this by pointing at an object at the same distance as the weather station (probably down at the base of the station), gently pressing the button to the first depression, then re-centering the photo (releveling) and pressing the button the remainder of the way to take the picture. It will be noticed that the first depression will fix the shutter and the focus.
4. Unlike photographic film, digital memory is cheap and can be reused. Taking multiple pictures from each position is suggested.
5. Ideal conditions are a clear day, with the sun high in the sky, (2 hrs. after sunrise to 2 hrs. before sunset).

III. Method

1. Using a compass or GPS, identify positions that are between 50-100 feet from the station in each of the cardinal directions (N,S,E,W) and secondary directions (NE,SE,SW,NW).
2. Begin at north cardinal direction, labeled as N (1) on accompanying station map (Figure 1).
    a. Check your distance and orientation. Again, the position should typically be at a distance of 50 to 100 feet from the station. If a cliff or other unnavigable obstruction does not allow the ideal distance, the photo should be taken at the best reasonable distance (cliff edge or cliff wall). Some directions may not have the station obviously visible in the photo.
    b. Take picture in landscape orientation (not portrait).
    c. The weather station structure should occupy 50-70% of the vertical frame.
    d. Try to take photograph as level (both vertically and horizontally) as possible, even if the station is positioned above or below the photograph center position. Take 2-5 photos varying exposure as noted in camera settings #3.
    e. Note your location relative to the station (the attached sheet should be used for this purpose). Items that should be noted here include the photo sequence and number of photos.
3. Go to the next position (labeled NE (2) on Figure 1), checking your distance and orientation, and repeat step 2.
4. Repeat steps 2-3 until station photographs have been taken at all 8 positions.
5. Return to the same cardinal compass point (labeled N (2) on Figure 1) as you started at in step 2, but now orient yourself so that the weather station is 5 to 10 feet behind you and aim away from the station.
    a. Take picture in landscape orientation.

   b. Photo should be level to horizon, even if there is a tree, cliff, wall, other obstacle, or open horizon.
   c. Double-check where the camera is being aimed. Without a subject (weather station) it can be easy to point at another subject and not toward the compass direction desired.
   d. Note your location relative to station and record same information as in step 2e.
6. Repeat step 5 for each of the 8 positions. It is best to go around these positions in the same order as in steps 2, 3.

Take photos from all positions unless absolutely, physically impossible (i.e. 2000' cliff, 10 feet from station), even if small variations of above protocol is required. For example, if a wall or tree is physically in the position where a photo would be taken, move slightly to obtain the photo. Keep in mind that the photo is to tell the story of the setting of the station and measuring equipment.

Additional photographs: Additional photographs may be taken that show any element of interest that might not have been captured in the sequence. These may include photos from a greater distance that illustrate the station exposure. Make every effort to ensure that the weather station is visible in the station photos (or at least identifiable) and not hidden.

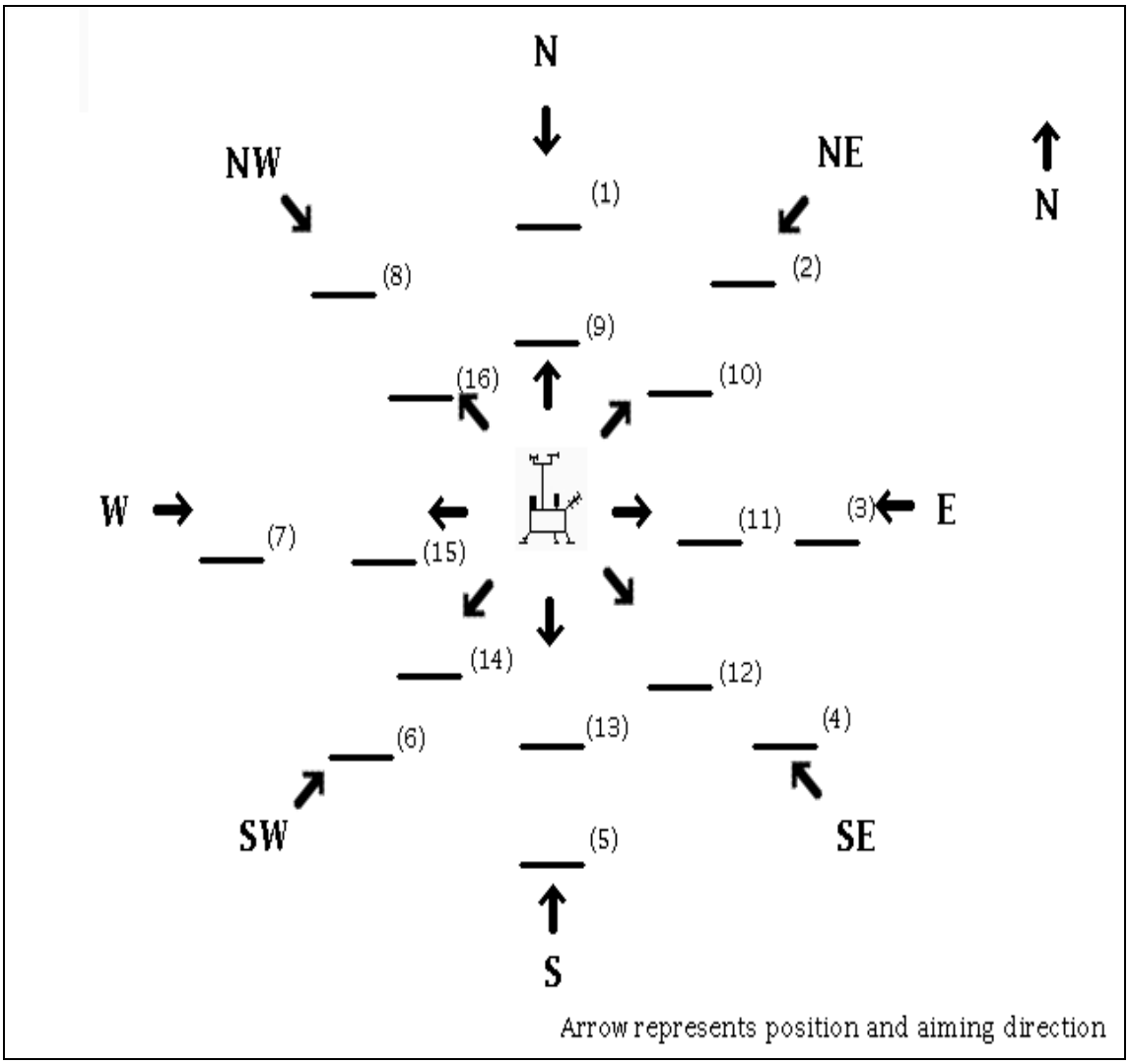
Movie clips: Many new digital cameras are capable of taking short streaming video or .avi format video clips. A short (45-70 sec. duration) video clip can be taken to give a 360 degree (panoramic) sweep of the station setting. To do this, select a location in proximity to the station (usually 100 to 200 feet away). Typically this location would be at an elevated vantage point relative to the station. Begin by aiming due north, start the .avi exposure and slowly rotate in a clockwise direction until again aiming north, pause briefly (~1 sec.) then stop the exposure. To avoid 'video blur', the speed of rotation will require about 60 seconds to complete the 360 degree sweep. If the station is in a heavily forested area, try to select a location with optimum exposure where the station is still visible. For tall tower sites, this might actually be on the weather station tower.

IV. Required Tools and Materials:

1. Camera
2. Extra Batteries for camera or means to recharge
3. Computer to download pictures from camera
4. Sunshade (Hat with brim) to view camera LCD.
5. Compass or GPS receiver with compass capability
6. Blank copies of photo documentation key map.

V. Examples:

http://www.wrcc.dri.edu/cgi-bin/wea_info.pl?caclab	Los Banos, California
http://www.wrcc.dri.edu/cgi-bin/wea_info.pl?cacleo	Leo Carillo, California



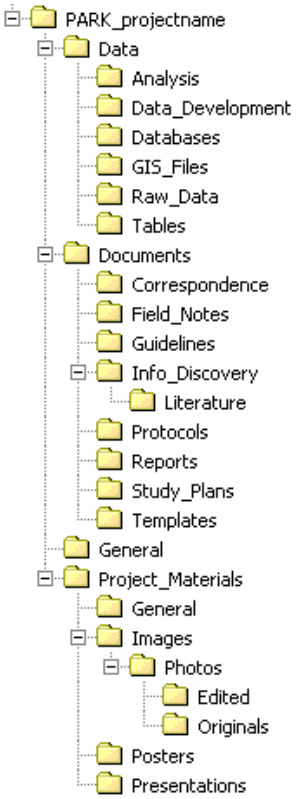
Fill blank with photo number or photo sequence.

Station:_____
Date:_____
Photographer:_____
Photographer Contact Info:_____
Other Remarks: _____
_____

Figure 1. Photo documentation key map

VI. Archive

These photos should be sent to the Western Regional Climate Center by file transfer protocol (FTP) to post under the station description on the web under metadata. The photos should also be filed at the park under images in the file structure suggested in the CAKN Data management Plan.



Reference:

McCurdy, Greg, 2006. Photographic Documentation of Weather/Climate Stations. (Still Photos). Prepared for National Park Service Inventory and Monitoring Program. Western Regional Climate Center, Reno, NV. 7 pp.

Wilder, D., editor, 2004. Data Management Plan, Central Alaska Network. National Park Service. Inventory and Monitoring Program, Fairbanks, AK. xx pp.

NOAA Climate Reference Network, Photographical Documentation Checklist for USCRN Site, 2004.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 18

Keeping Maintenance Logs

Version 1.01 (December 2006)

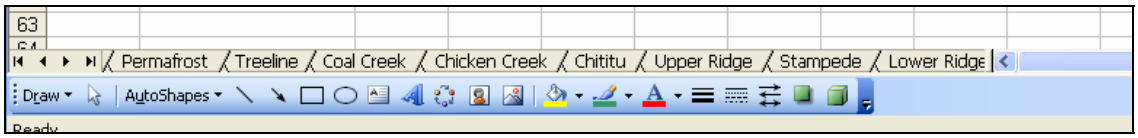
Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Added comments from peer review on database use and clarified calibration instructions.	Incorporated peer review comments	1.01

This SOP outlines the procedures for maintaining a log for all CAKN climate station site visits. The log is currently a Microsoft Excel file. The peer review of this SOP suggested an alternative database, such as Microsoft Access to use for tracking sensor serial numbers. This suggestion will be adopted in the future as a useful tool for maintaining good records.

Procedure:

1. Create an Excel spreadsheet with individual climate station names on individual worksheets.



2. After returning from the field, use the site checklist to update the maintenance log. Not all of the information needs to be transferred, but critical information like sensor replacements and maintenance should be entered into an electronic log for easy reference. An example is shown below.

9/9/2003		Installed 2 soil probes 1 at 50 cm and 1 at 100cm. Located NW of station straight out from W facing leg.
		Downloaded data
		Replaced dessicant
		Loaded CAKN soil program
5/24/2004		Transmissions not working due to leap year bug but station is still collecting data.
		Swapped transmitter: In: 53988, Out: 18655
		Swapped AT/RH Sensor: In: 3410056, Out 3410052
		Checked for transmission with Wallops - All good
		Downloaded all station data.
8/13/2004		upgrade station
		Swap AT/RH In: Y2410067
		Add snow depth sensor
		Add 2nd battery
		Download data with Palm

Wigand / Dunkle / Forest / Tundra / Permafrost / Treeline / Coal Creek / Chicken Creek / Chit

3. In another worksheet keep a log of the sensor calibration schedule for all of the stations. For example, record that the Dunkle station air temperature and relative humidity sensor was swapped on 8/5/2004. See example below. The CAKN currently has a full suite of air temperature sensors to do a full swap at all stations each year. All other sensors will need to be staggered so that they are not all being swapped in the same year. Set-up a rotation schedule so that approximately 8-10 stations get pyranometers swapped each year. For all other sensors the stock is limited, so stagger replacements accordingly.

Sensor Swap Out Log

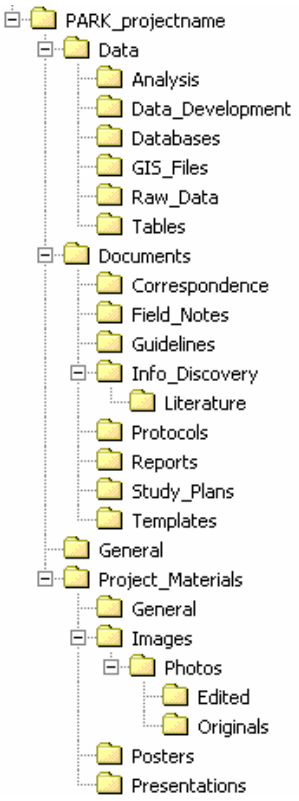
Site	Forest	Permafrost	Treeline	Lower Ridge	Upper ridge	Dunkle	Stampede	Wigand	Chititu	Chicken Creek	Coal Creek
AT/RH	11/5/2001	5/30/2001	8/27/2002	7/16/2001	7/16/2001	8/1/2002	9/24/2002	8/1/2003	8/1/2004	8/1/2004	9/1/2004
	5/29/2003	5/29/2003	6/5/2003	8/6/2003	8/6/2003	8/5/2004	8/13/2004	8/13/2004			
	8/31/2004	6/21/2004									
Pyranometer	7/12/2000	5/30/2001	5/30/2001	7/16/2001	7/16/2001	8/1/2002	9/1/2002	8/1/2003	8/1/2004	8/1/2004	9/1/2004
	9/26/2002	9/8/2003	8/6/2003	8/7/2003	8/6/2003	8/22/2004					
	8/26/2003										
Wind	7/17/2002	7/22/2002	8/11/2002	8/15/2000		8/1/2002	9/24/2002	8/1/2003	8/1/2004	8/1/2004	9/1/2004
Battery	7/2/2003	8/7/2003	8/7/2003	8/7/2003	7/1/2000	2/5/2004	new 20003	new 2003	8/1/2004	8/1/2004	9/1/2004

Stampede / Lower Ridge / Sensor Log / Sensor Cal / Road Study / Inventory

4. In another worksheet keep a running log of the serial numbers and calibration dates for each sensor. See example below. The sensors will be sent in to Campbell Scientific, Inc. for calibration in the early spring – this will ensure the sensors are calibrated right before being deployed in the field. Upon return from CSI the sensor will have a calibration certification, keep those in a file. This documentation can be useful to track the performance of the sensor over time. If there is a significant drift of values for a few calibration cycles it is time to replace the sensor.

4/27/2004	HMP35C Calibrations
	636996, 3845ORC2, 467151, 3845ORC1,
	HMP45C Calibrations
	X3410043, X3410044, Y2410067, X3410055, X3410056, X3410061, X3410049, X3410060, X3410057, X3410062,
	X3410063, X3410059,
6/9/2004	LiCor pyranometer calibrations
	PY45239, PY46219, PY46238, PY18075, PY36882, PY43204, PY43090, PY43169, PY43040, PY43110, PY43206,

5. File the field checklists in a file as a hardcopy backup within the file structure set up for CAKN_Climate Monitoring shown below. The maintenance logs would fit under Documents/Field_Notes.



Reference:
Wilder, D., 2004. Data Management Plan, Central Alaska Network. National Park Service. Inventory and Monitoring Program, Fairbanks, AK. xx pg.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 19

Data Quality - Accessing ASCADS

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Editing of 1st paragraph for clarity	Incorporated peer reviewed comments	1.01

This SOP describes the procedure for the computer setup requirements and procedures to follow that will allow access to the Automated Sorting, Conversion and Distribution System (ASCADS). The National Interagency Fire Center (NIFC) Remote Automated Weather Station (RAWS) Depot in Boise, Idaho operates ASCADS. The procedures below provide guidance in acquiring and installing the necessary software (SecureNet Term 5.4.3.0) required to gain access to ASCADS. The ASCADS system is used to log all of the maintenance information and sensor data from climate station maintenance visits.

The following procedure must be followed to access ASCADS:

STEP 1:

In order to access ASCADS, you must first obtain a logon ID and password.

- Access Profile Request (included as part of SOP)
- Users must also read and understand these access guidelines. Also included as part of SOP.

  PLEASE NOTE: You will not be contacted about your logon information. Once you have set your computer up to access ASCADS, you must call the BLM's Remote Sensing Fire Weather Support Unit (RSFWSU) to obtain your logon information. Do not call RSFWSU until you have your computer set up properly (STEP 2).

STEP 2:

Contact Kolleen Shelley kshelley@fs.fed.us or Linnea Keating lkeating@fs.fed.us to obtain the instructions on setting up your computer to access ASCADS.

Please include the following information in your request:

Name
Email Address
Telephone Number
Reason for Requesting ASCADS Access
Incomplete requests will not be honored.

GENERAL RULES AND GUIDELINES GOVERNING THE USE OF BUREAU OF LAND MANAGEMENT COMPUTER SYSTEMS

According to the Department of Interior Manual 375 DM 19.10B, "*It is the responsibility of each employee to report all suspected, actual or threatened incidents involving automated information systems to the authorities indicated below*."

$ **Bureau of Land Management (BLM) employees shall report observed computer security incidents or suspected computer security violations immediately to the Installation Information Technology (IT) Security Manager and to their supervisors.**

$ **The BLM Installation IT Security Manager may recommend the removal of any individual's User ID and password from any BLM computer system and/or application system in the event of a security incident.**

$ **Unauthorized access or misuse of BLM computer systems may subject violators to criminal, civil or administrative action. Criminal Penalties include fines and/or imprisonment of up to 20 years. Disciplinary action for administrative violations of the following rules may range from a verbal or written warning, removal of system access for a specific period of time, reassignment to other duties, or other action as deemed appropriate.**

Violations of the following rules are considered computer security incidents:

1. **CLASSIFIED INFORMATION.** No classified National Security information will be entered into any BLM computer system.

2. **GOVERNMENT PROPERTY.** Computer hardware, software, and data of the BLM are considered to be the property of the U.S. Government. BLM computer systems shall be used for official business only. No games, personal software, private data, unlicensed proprietary software, or otherwise non-government information will be used on or entered into any Government-owned computer system. Any use of computers, software or data for other than official business is expressly prohibited, except as permitted by the BLM Internet Acceptable Use Policy.

3. **PROPRIETARY PROPERTY.** Commercially developed and licensed software shall be treated as proprietary property of its developer. Title 17 of the U.S. Code states that "It is illegal to make or distribute copies of copyrighted material without authorization." The only exception is the user's right to make a backup for archival purposes, assuming one is not provided by the manufacturer. It is illegal to make copies of software for any other purpose without permission of the publisher. Unauthorized duplication of software is a Federal crime. Penalties include fines of up to $100,000 per infringement and jail terms of up to 5 years.

4. **ACCOUNTABILITY.** Individual User IDs and passwords shall be assigned only to persons having a valid requirement to access BLM computer systems. All activity accomplished under this User ID is directly attributable to the user to whom it is assigned.

GENERAL BUSINESS PRACTICES, which if not followed can lead to security incidents, are listed below. Noncompliance with these practices may result in removal of access and/or disciplinary or legal action being taken, consistent with the nature and scope of such activity.

1. **INDIVIDUAL USER IDs AND PASSWORDS.** Do not share your individual User IDs and passwords. They are to be used only by the individual owner. User IDs and passwords should not be written down except on the original assignment document. Once memorized, this document should be destroyed or, at a minimum, be kept in a locked safe or cabinet.

Under no circumstances should User IDs and passwords be posted ANYWHERE! Nor should they be kept in accessible locations. Never use personal information (e.g., telephone numbers, names of family members, pets, etc.) or dictionary words for your passwords. Passwords should be eight characters in length and consist of at least one numeric character, a special character, and both upper and lower case letters. Passwords should be changed at required intervals. If you believe your User ID and password have been compromised, change your password, notify your supervisor, and report the incident to the Installation IT Security Manager.

2. **UNAUTHORIZED ACCESS.** Access to BLM computer systems requires management approval. Do not attempt to gain access to any Information Technology system for which you do not have an approved and authorization to access.

3. **LOG OFF** when not actively working on the computer system. At a minimum, lock your workstation when leaving your work area for short periods of time or invoke the computer system's locking screen saver. **Remember, you are responsible for all activity logged under your User ID.**

National Interagency Fire Center
Office of Fire and Aviation

Circle One

ASCADS COMPUTER ACCESS / INFORMATION CHANGE / TERMINATION REQUEST

Full Name, Phone # and Email are all that's required for a login termination request.
Full Name, Phone # and Email along with changes are that's required for a information change request.

Applicant:

Name: _____ ,
Last First MI

Email Address:

Short Name / System Login Name: _____ ie. jdoe

Phone #: _____-_____-_____ extension: _____

Federal Employee: YES / NO ?

Contractor: YES / NO ?

Agency / Organization / Company:

Agency:_____ Unit or Forest Name: _____

Region: _____

Address: _____

_____

Is this a temporary (Detail) assignment: YES / NO ? If yes give estimated date of termination:_____

Maintenance:

Will you be doing weather station repairs: YES / NO ? If yes, will you be entering maintenance history in ASCADS narrative & updating sensor serial numbers: YES / NO ? If repairing weather stations. Do you work on the entire Region, Forest or a single weather station? _____

Please initial to acknowledge you have read the General Rules and Guidelines Governing The Use of BLM Computer Systems Form 1264-3. The rules & guidelines apply to **ALL ASCADS USERS.** Not just BLM employees.

Applicant's initials:_____ Supervisor's Initials:

Special Instructions or requests:

Immediate Supervisor or **Other Responsible Official:**

I acknowledge that the above individual needs an account on the ASCADS system.

Agency / Organization:

Address:

Email address:

Phone #:

Print Name

_____

Signature Date

Depot Use Only: Please forward to NIFC IT Security Manager
Login Name: Date Added:

Please Fax signed form to the RSFWSU Depot at 208-387-5397

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 20

Entering Metadata into ASCADS

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Edits for clarification about reporting timeliness	Incorporated comments from peer review	1.01

This SOP describes the use of the National Interagency Fire Center (NIFC) Automated Sorting, Conversion and Distribution System (ASCADS). If you need additional assistance call the Remote Sensing Support Unit at (208) 387-5475, and they can help with the software and access issues.

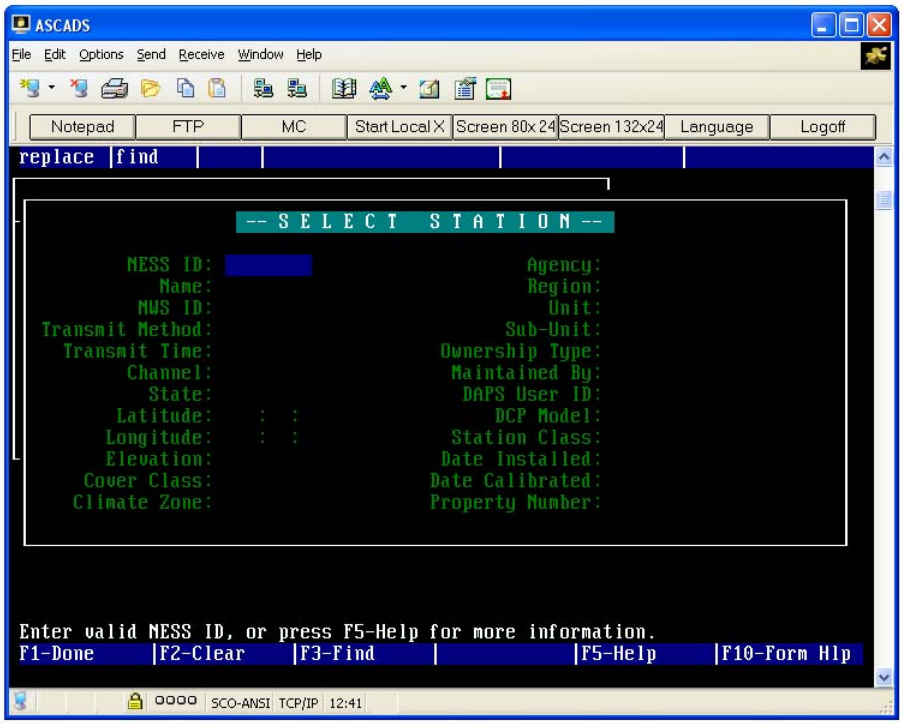
ASCADS is a user-friendly, menu driven interface that gives users the most current information on individual climate stations that have been integrated into the system. If a new station is installed, alert Boise at the number above, and they can add it to the system. It is important to update the information in the system each time a site is visited. By keeping the system up to date the metadata associated with the station can be stored accurately and consistently. It is important to enter information into ASCADS in a timely manner. Enter any manipulations to the station within one to two weeks of returning from the field.

Access to ASCADS is through Secure Net Term. The procedures for installing Secure Net term on a PC are provided to you when you set up for an account which is outlined in SOP #15 – Accessing ASCADS.

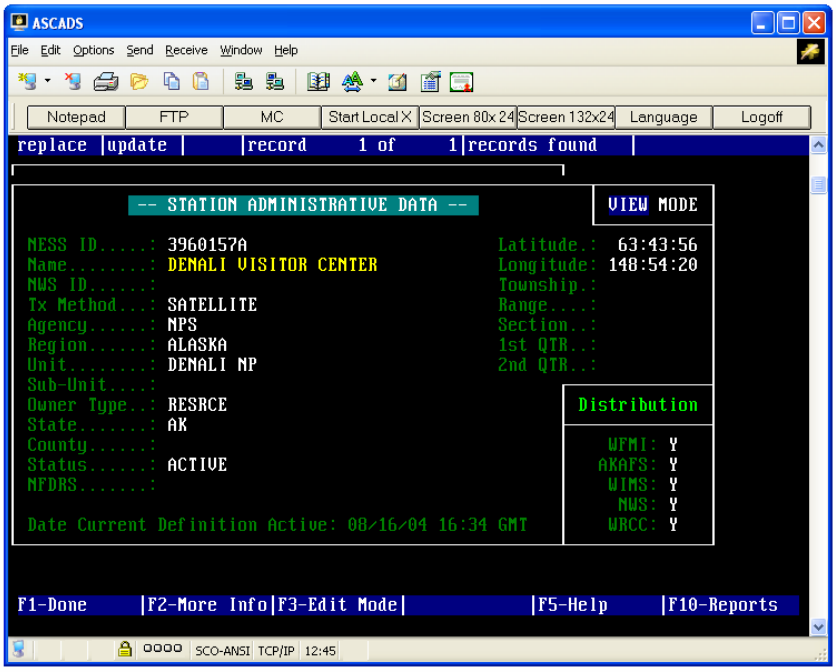
Procedures for using ASCADS:

1) Open Secure Net Term. Select **File│Connect**. A box will pop up and prompt you for your User ID, a second box will prompt you for your Password.

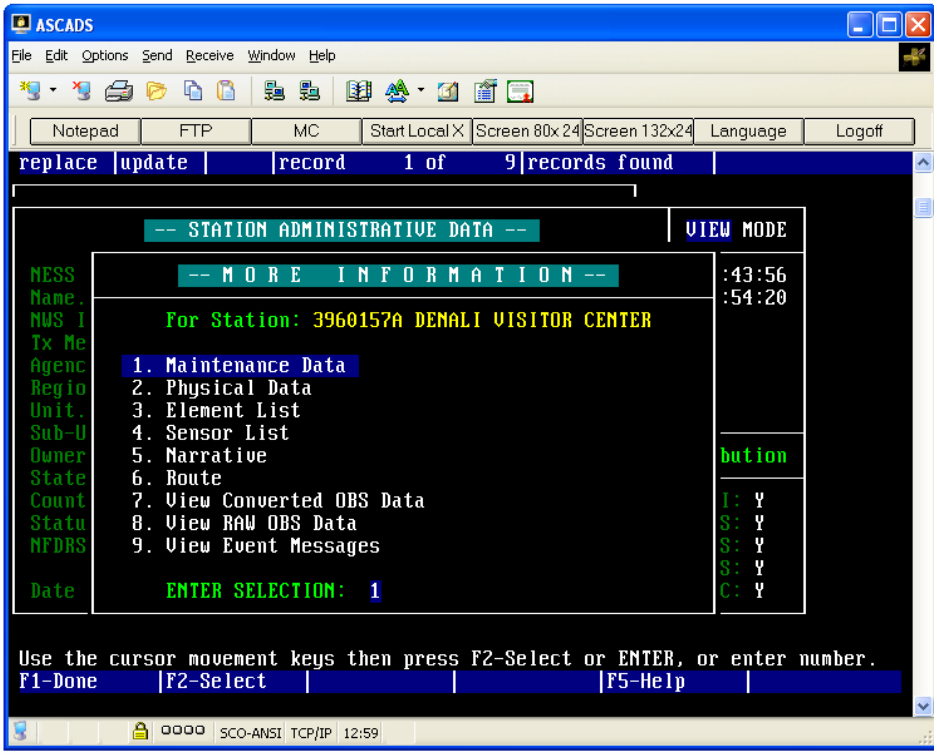
2) Press Enter two times to get through the introductory screens. The next screen (shown below) prompts you to enter either a NESS ID or station name. Type in the first three letters of the station name and hit F3. Navigate through the pages by using the Function keys at the bottom of the screen. F5 is always available as Help.



3) Once you have entered the name of the station it displays the administration information describing the station. Some of these fields can be edited and some are set in Boise. Use the F3 for edit mode.



4) To access more information about the station, select F2 – More Info. This brings up the menu screen shown below. The selections are described below.



a) Selection 1. Maintenance Data - This page shows the annual maintenance date for the station. When the station is due you will receive a Watchdog warning generated by the system alerting you that it is time for the annual maintenance trip. Other information on this page includes: datalogger type, owner, Goes transmission time and window length, GOES channel, interval, and GOES antenna angle and azimuth settings.
b) Selection 2. Physical Data – includes information such as station elevation, slope angle, aspect, and site description.
c) Element List – This is filled in at Boise and describes the measurements recorded at the station and the units used.
d) Sensor List – provides the list of sensors and model numbers.
e) Narrative - Text describing the station or the program the station is affiliated with can be added in this space.
f) Route – This page is set up in Boise when the station is first integrated into the system.
g) View Converted OBS – This page displays the current data after it has been processed by ASCADS. The CAKN climate data comes into the system in metric units and is converted to Standard units for dissemination to the fire weather programs.
h) View Raw Obs Data – this page displays the current data in RAW format
i) View Event messages – Displays the time and date of each error, including missed transmissions, data outliers, data stream problems, etc. These messages are compiled and a weekly Watchdog message is sent to the operator.

5) When all of the information is updated exit the system by using the F1 key until it prompts you with the question Exit ASCADS? Enter Y and Enter to close the session.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 21

Data Access and Archiving

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Added last line to 1st paragraph	Incorporated comments from peer review	1.01

This SOP describes the locations and frequency of data archiving and provides links for both real-time climate data access and climate data archives for the Central Alaska Network climate monitoring program. Currently all data are archived with the Western Regional Climate Center. Back-up datasets are kept on CD/DVD and in an Access database with the climate program manager.

1. Data Archiving

Archive Location	Data Format	Data resolution	Archiving Frequency
Western Regional Climate Center	ASCII Delimited Columnar Excel HTML	Hourly Daily Weekly Monthly	Daily
Alaska State Climatologist	ASCII	Hourly	In development
WIMS	ASCII	Hourly	Daily
Alaska Fire Service	ASCII	Hourly	Daily
NWS/NOAA/NCDC	ASCII	Hourly	In development

2. Data Access

Data	Method	Who Can Access
Real Time	Western Regional Climate Center http://www.wrcc.dri.edu/	Anyone
	Alaska Fire Service –Weather Link http://fire.ak.blm.gov/	Anyone
	University of Utah Dept. Of Meteorology	Anyone

	http://www.met.utah.edu/mesowest/	
	National Weather Service http://www.arh.noaa.gov/obs.php	In Development
	University of Alaska Fairbanks Alaska Climate Research Center http://climate.gi.alaska.edu/	In Development
Daily Reports	Western Regional Climate Center http://www.wrcc.dri.edu/	Anyone
Monthly Reports	Western Regional Climate Center http://www.wrcc.dri.edu/	Anyone
RAW Data	Western Regional Climate Center http://www.wrcc.dri.edu/	Anyone

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 22

Climate Data Analysis

Version 1.0 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP describes the procedures for annual data analysis for reporting purposes. The details of the analysis are being developed concurrently with the protocols through a contract, and will be finalized in 2006. Some analysis tools are also being developed through a cooperative agreement with the Western Regional Climate Center. This SOP will be fully developed in 2007 following the completion and review of a number of tasks outlined in cooperative agreements and contracts that will include the following:

WRCC Agreement:

- Develop web based tools for analysis of CAKN climate data. Products may include capabilities to produce and analyze data derived from original climate data, including departures from normal, interim averages and trends, trends and manipulations (averages, etc) of individual data streams. An ability to compare data with derived data. Chart and table production and download capability (in common file formats). A packaged report suite that could serve as a period report for CAKN parks (i.e.: “annual station report for CAKN” might include charts parameter with all stations on the chart, a table of station averages and departures from normal, comparisons to longer-term Alaska stations (FAI, ANC).)

Climate Data Analysis Contract

- Analyze existing data – mean, maxima, and minima temperatures, diurnal temperature ranges, and total precipitation for all sites using statistical methods most suitable to the dataset which may include, linear trends using time series modeling, spectral analysis, quadratic regressions, Autoregressive (AR) and Autoregressive Integrated Moving Average (ARIMA) models using an iterative process, Autocorrelation functions (ACF) and Partial Autocorrelation functions (PACF). Produce climate norms for weather stations with data sets with 30+ year records, and highlight years where there were marked shifts from the norm. A full narrative description of the steps involved in the analysis will be included in the findings.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 23

Climate Monitoring Reporting

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/20/2006	P. Sousanes	Changed SOP from 22 to 23	Placeholder for SOP 22 on data analysis	1.01

This SOP details the procedures for producing an annual report. The details of the analysis are being developed concurrently with the protocols through a contract, and will be finalized in 2006. The general reporting theme will remain the same, but the content might vary. The reporting tools are also being developed through a cooperative agreement with the Western Regional Climate Center. This SOP will need to be revised in 2007 following the completion of a number of tasks outlined in the above mentioned cooperative agreements and contracts that will include the following:

WRCC agreement:

- Develop web based tools for analysis of CAKN climate data. Products may include capabilities to produce and analyze data derived from original climate data, including departures from normal, interim averages and trends, trends and manipulations (averages, etc) of individual data streams. An ability to compare data with derived data. Chart and table production and download capability (in common file formats). A packaged report suite that could serve as a period report for CAKN parks (i.e.: “annual station report for CAKN” might include charts parameter with all stations on the chart, a table of station averages and departures from normal, comparisons to longer-term Alaska stations (FAI, ANC).)

Climate data Analysis Contract

- Analyze existing data – mean, maxima, and minima temperatures, diurnal temperature ranges, and total precipitation for all sites using statistical methods most suitable to the dataset which may include, linear trends using time series modeling, spectral analysis, quadratic regressions, Autoregressive (AR) and Autoregressive Integrated Moving Average (ARIMA) models using an iterative process, Autocorrelation functions (ACF) and Partial Autocorrelation functions (PACF). Produce climate norms for weather stations with data sets with 30+ year records, and highlight years where there were marked shifts from the norm. A full narrative description of the steps involved in the analysis will be included in the findings.

An example of a climate monitoring report is included as Appendix E of these protocols.

Climate Monitoring Protocol for Central Alaska Network

Standard Operating Procedure (SOP) # 24

Revising the Protocol

Version 1.01 (December 2006)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.00	12/202006	P. Sousanes	Changed from SOP 23 to 24.	Inserting analysis SOP	1.01

This SOP explains how to make changes to the Climate Monitoring Protocol Narrative and accompanying SOPs, and tracking these changes for the Central Alaska Network. Observers asked to edit the Protocol Narrative or any one of the SOPs need to follow this outlined procedure in order to eliminate confusion in how data are collected and analyzed. All observers should be familiar with this SOP in order to identify and use the most current methodologies.

Procedures:

1. The Climate Monitoring Narrative for the Central Alaska Network and accompanying SOPs has attempted to incorporate the most sound methodologies for collecting and analyzing climate data. However, all protocols regardless of how sound require editing as new and different information and technology becomes available. Required edits should be made in a timely manner and appropriate reviews undertaken.
2. All edits require review for clarity and technical soundness. Small changes or additions to existing methods will be reviewed in-house by Central Alaska Network physical science staff. However, if a complete change in methods is sought, than an outside review is required. Regional and national climate experts with familiarity in climate research and data analysis will be utilized as reviewers.
3. Document edits and protocol versioning in the Revision History Log that accompanies the Protocol Narrative and each SOP. Log changes in the Protocol Narrative or SOP being edited only. Version numbers increase incrementally by hundredths (e.g. version 1.01, version 1.02, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.
4. Inform the Data Manager about changes to the Protocol Narrative or SOP so the new version number can be incorporated in the Metadata of the project database. The database may have to be edited by the Data Manager to accompany changes in the Protocol Narrative and SOPs.
5. Post new versions on the inter-net and forward copies to all individuals with a previous version of the effected Protocol Narrative or SOP.

Reference

Pietz, D.G., S.G. Fancy, L.P. Thomas, B. Witcher. 2002. Bird Monitoring Protocol for Agate Fossil Beds National Monument, Nebraska and Tallgrass Praire National Preserve, Kansas. Praire Cluster Prototype Monitoring Program. Prepared for: National Park Service, U.S. Department of the Interior, 24p.