



Climate Monitoring Protocol for the North Coast and Cascades Network (Mount Rainier National Park, Olympic National Park, North Cascades National Park, Lewis and Clark National Historical Park, Ebey's Landing National Historical Reserve, San Juan Island National Historical Park, Fort Vancouver National Historic Site)

Volume 2. Standard Operating Procedures (SOPs), Version 5/26/2010

Natural Resource Report NPS/NCCN/NRR—2010/241



ON THE COVER

High Elevation Weather Station, Mount Rainier National Park, Sunrise precipitation site
Photograph by: Mark Moore, Northwest Weather and Avalanche Center

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Revision History Log

Protocol Narrative or SOP	Revision Date	Author of Revision and Affiliation	Changes Made, Location in Document	Reason for Change
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Executive Summary

This protocol narrative outlines the rationale, sampling design and methods proposed for monitoring climate in the North Coast and Cascades Monitoring Network (NCCN). The NCCN, one of 32 networks of parks in the National Park System, comprises seven national park units in the Pacific Northwest, including three large, mountainous, natural area parks (Mount Rainier [MORA] and Olympic [OLYM] National Parks, North Cascades National Park Service Complex [NOCA]) and four small historic-cultural parks (Ebey's Landing National Historical Reserve [EBLA], Lewis and Clark National Historical Park [LEWI], Fort Vancouver National Historical Park [FOVA], San Juan Island National Historical Park [SAJH]). This narrative reflects decisions made by the NCCN climate monitoring group, which includes National Park Service (NPS) representatives from each of the large parks in the Network and with the assistance of several agencies including National Oceanic Atmospheric Administration (NOAA), National Resource Conservation Service (NRCS), and the U.S. Forest Service (USFS).

The primary reasons for monitoring climate in the NCCN are:

1. To provide easily accessed, quality climate data for cooperating researchers, park managers and other NCCN monitoring programs
2. To increase the number of measurement locations and better document climate in a region known for extreme spatial variability
3. To organize and manage climate data to be readily accessible and useable for the interpretation of ecosystem patterns and processes

This protocol is published in two volumes, Volume 1. Narrative and Appendices, and Volume 2. Standard Operating Procedures (SOPs) of the Climate Monitoring Protocol for the North Coast and Cascades Network (Mount Rainier National Park, Olympic National Park, North Cascades National Park, Lewis and Clark National Historical Park, Ebey's Landing National Historical Reserve, San Juan Island National Historical Park, Fort Vancouver National Historic Site), Version 5/26/2010.

Acronym List

AC	Alternate Current
ACU	Acquisition Control Unit
AOMC	Automated Operations and Monitoring Center
ACARS	Aircraft Communication Addressing and Reporting System
ACIS	Applied Climate Information System
ARD	Air Resource Division
ASOS	Automated Surface Observation System
BLM	Bureau of Land Management
CASTNET	Clean Air Status and Trends Network
CIG	Climate Impacts Group
CRN	Climate Reference Network
DCP	Data Collection Package
DOD	Department of Defense
EBLA	Ebey's Landing National Historic Reserve
ENSO	El Nino-Southern Oscillation
EPA	Environmental Protection Agency
FGDC	Federal Geographic Data Committee
FOVA	Fort Vancouver National Historic Park
GOES	Geostationary Operational Environmental Satellite
GPS	Global Position System
HCN	Historical Climate Network
I&M	Inventory and Monitoring
LEWI	Lewis and Clark National Historic Park
MORA	Mount Rainier National Park
NCCN	North Coast and Cascades Network
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NCEP	National Centers for Environmental Prediction
NFDRS	National Fire Danger Rating System
NIFC	National Interagency Fire Center
NOAA	National Oceanic and Atmospheric Administration
NOCA	North Cascades National Park Service Complex
NPClimate	Climate Data for Park

Acronym List (continued)

NPS	National Park Service
NRCS	Natural Resource Conservation Service
NWAC	Northwest Weather and Avalanche Center
NWS-COOP	National Weather Service Cooperative Stations
OBS	Observing Systems Branch
OLYM	Olympic National Park
ONPS	Operations of the National Park Service
PDA	Personal Digital Assistant
PDO	Pacific Decadal Oscillation
PNW	Pacific Northwest
PRISM	Parameter Regression on Independent Slopes Model
RAWS	Remote Automated Weather Stations
RF	Radio Frequency
RRS	Radio Replacement System
SAO	Surface Airways Observation
SAJH	San Juan Island National Historical Park
SCS	Soil Conservation Service
SNOTEL	Snowpack Telemetry
SOD	Summary of the Day
SQL	Structured Query Language
SWE	Snow Water Equivalent
USDA	United States Department of Agriculture
USFS	United States Forest Service
VHF	Very High Frequency
WACAP	Western Airborne Contaminant Assessment Project
WSDOT	Washington State Department of Transportation
WIMS	Weather Information Management System
WRCC	Western Regional Climate Center

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 1: National Park Service (NPS) Operated Climate Stations

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Introduction

A network of remote climate stations is maintained by the National Park Service (NPS) to supplement existing climate sites operated by NPS cooperators. These sites are installed within each park to fill gaps in existing climate data and provide a comprehensive understanding of park-wide climate patterns.

The majority of NPS climate stations occur at Olympic National Park. In contrast to other parks within the North Coast and Cascades Network (NCCN), few stations were operated by NPS cooperators at Olympic. In 1998, a joint U.S Environmental Protection Agency (EPA)/NPS global climate change project initiated the installation of remote climate stations along a precipitation gradient within the park. Upon completion of the study, these sites were turned over to the NCCN network to form the core of Olympic National Park's NPS operated climate station network. Additional sites are being added throughout the network as time and funding allows.

Climate Station Instrumentation

All NPS operated climate stations measure a standard suite of climate parameters. As funding becomes available, climate sites may be outfitted with additional or "optional" sensors, determined by specific site requirements and local research studies.

Standard:

- Air Temperature & Relative Humidity
- Precipitation
- Snow Depth (where required, e.g. snow is greater than 5% of precipitation)

Optional (Second Priority):

- Solar Radiation (Total Radiation or Photosynthetic Active Radiation (PAR))
- Wind Speed & Direction (mean wind speed, max wind speed, vector wind direction)
- Soil Temperature (Surface, 30 cm depth) (Optional 5cm and 15cm depth)
- Soil Moisture (Surface, 20–40 cm depth) (Optional 0–20cm and 40–60cm depth)

Site Selection

When determining site locations, the following standards were used to ensure uniformity of climate observations. It should be noted that final placement of stations represented a balance between meteorological representativeness, site accessibility, cost effectiveness, resource & wilderness impacts as well as additional research and park management objectives.

- Climate stations are located in large openings, preferably on level terrain. Sites are representative of the conditions in the general area. Vegetative cover type, topographic features or distinct topographic changes, elevation, micro-climate/local weather patterns are all considered before site selection is made.

- Sites will provide for long-term operation and a relatively unchanged landscape over time. Long term development plans, ultimate sheltering by growth of vegetation and site accessibility are all considered.
- The station is oriented so as to provide environmental data that is representative of the specific area in which the station is situated. Exposure requirements for each instrument in relation to such things as prevailing winds, movement of the sun, topography, vegetative cover, nearby reflective surfaces, and wind obstructions is considered.
- Air temperature and precipitation sensors are situated within large gaps, free of obstructions.
- Wind speed and direction sensors are mounted in the vicinity of other instruments and are usually not indicative of area wind patterns. Rather, these instruments collect data from the immediate area and are primarily used for interpretation of other climate parameters (for further discussion, see Sensor Requirements and Standards, Wind Speed and Direction, below).
- In areas where accurate local wind speed and direction are required, larger or more unobstructed gaps are found and wind instruments are installed separately, away from precipitation gauges.
- Solar radiation sensors are situated in a gap large enough to receive direct solar input during the entire day, year round.
- Soil moisture and soil temperature instruments are placed in terrain and vegetation representative of the dominant ecosystem associated with the climate station location. (i.e. a climate station in a lowland valley would have soil instruments placed in the forest understory rather than a gap, as the old growth forest is most representative of the soil conditions found in that ecosystem).

Weather Station Locations

Nine NPS Climate Stations are currently located within the boundaries of the North Coast and Cascades Network, 8 within Olympic National Park and 1 within Mount Rainier National Park. These include sites at the Bunch Field Quinault, Lewis Ranch Hoh, Ozette Lake, Lake Crescent, Hayes River Elwha, Waterhole, Deer Park Road (mid-elevation) and Deer Park Ranger Station (upper elevation) at Olympic and Carbon River at Mount Rainier (Table 1.1). A temporary NPS station was installed in English Camp at San Juan Island National Historic Park until a permanent location for a Remote Automated Weather Station (RAWS) is determined. Installations are currently planned for 1 more station at Staircase Ranger Station at Olympic National Park (Table 1.2). See Appendix A for locations of existing and proposed NPS climate stations.

Table SOP 1.1. Existing NPS climate stations.

Park	Site Location	Easting (NAD 27)	Northing (NAD 27)
OLYM	Bunch Field Quinault	448718	5265115
OLYM	Deer Park Road	476943	5314219
OLYM	Lewis Ranch Hoh	422072	5296251
OLYM	Waterhole	468072	5310260
OLYM	Lake Crescent	440452	5326803
OLYM	Ozette Lake	375841	5334854
OLYM	Deer Park Ranger Station	480221	5310711
OLYM	Hayes River Elwha	466025	5295203
MORA	Carbon River	583550	5205143
SAJH	English Camp (temporary)	489101	5381301

Table SOP 1.2. Proposed NPS climate station.

Park	Site Location	Easting (NAD 27)	Northing (NAD 27)
OLYM	Staircase	475081	5262572

Continuity of Climate Data

Continuity of climate data is critical to understanding subtle changes over long periods of time. For this reason, changes of location, instrumentation or site characteristics will be avoided whenever possible. If new instruments are introduced or if new locations are required, studies to determine adjustment factors to account for differences between old and new instruments or locations will be made. At a minimum, this will involve collocating instruments or collecting concurrent climate measurements from both sites for a minimum of one full year. The goal is to preserve the continuity of station databases and make the change as seamless as possible in terms of the official climate record.

Field Methods

Sensor Requirements and Standards

The accuracy and resolution standards of all sensors used on NPS Operated Climate Stations support the recommendations of the World Meteorological Organization (WMO) and are consistent with the National Weather Service (NWS) Surface Observing Programs.

To ensure the greatest possible consistency between sites, mounting height, orientation, sensor type and models of sensors are standardized at all climate stations. On occasion, alternative sensors may be used, (usually due to previous availability and/or financial constraints). If this occurs, these instruments will meet the same minimum requirements and sensor performance standards.

Air Temperature/Relative Humidity

Air Temperature refers to the air surrounding the climate station instrumentation. Relative humidity (RH) is the percentage ratio of the actual amount of water vapor in the air to the amount of water vapor required for saturation at existing temperature.

To ensure accurate collection of temperature and RH data, Air temp/RH sensors will meet the following criteria:

- Located at least 100 feet from any extensive concrete or paved surface.
- Located away from areas where rough terrain or air drainage are likely to result in non-representative temperature data.
- Sensors will be mounted 4-6 feet (120-180cm) from the ground. Exceptions will be made in higher elevation sites where winter snow accumulation would bury sensors.
- Sensors will be mounted on the North aspect of all towers (0° True North).
- Sensors will be mounted within an aspirated radiation shield or traditional Cotton Region shelter to allow for ventilation while protecting the instrument from direct sunlight.

Table SOP 1.3. Temperate/relative humidity sensor performance standard (temperature and Relative Humidity Sensor: HMP 45C; temperature Sensor: CS107L).

Parameter	Units	Accuracy	Range	Resolution
Temperature	Celsius	+/- 0.5°	-40° to +60° C	0.1
Relative Humidity	%	+/- 3.0%	.8% to 100%	1%

Calibration

Air Temp Sensors will be factory calibrated annually by Campbell Scientific, Inc. Instruments are calibrated at 25° C using OMEGA type E reference thermocouples with an accuracy of +/- 0.2° C.

Precipitation

Precipitation is the amount of water falling upon the earth as rain, snow, sleet, and hail. It is expressed as the depth of water that would cover a flat surface. At most NPS operated climate stations, rainfall will be measured using non-heated tipping bucket rain gages. Areas subject to large quantities of precipitation (80-180 inches per year) will use high capacity rain gages with siphoning mechanisms. Areas with lower annual rainfall (20-80 inches) will use standard capacity rain gages. In areas subject to winter snow accumulation, a snow depth sensor will be used in conjunction with a model to estimate snow water equivalent during snowfall events.

The exposure of the precipitation gage is of primary importance in the accuracy of precipitation measurements. Whenever possible, climate stations will be placed in sheltered areas such as small forested gaps.

To ensure accurate collection of precipitation, rain gages and snow depth sensors will meet the following criteria:

- The orifice of the gage will be horizontal (i.e. level).
- The gage site will have protection in all directions by trees of a uniform height. These should shelter the gage from wind effects as much as possible without encroaching on the site at more than a 45 degree angle measured out from the gage top (an inverted 45° cone centered on the gage). This site configuration encourages vertical precipitation by reducing the effects of turbulence and eddy currents (which tend to carry away the precipitation).
- If the gage is mounted on a tower, the height of the gage will be 300 cm and the sensor will be mounted on the Northwest aspect of all towers (300°). Height exceptions will be made in higher elevation sites where winter snow accumulation would bury sensors.

Table SOP 1.4. Precipitation gauge performance standard. (TB-4 Hydrologic Services High Capacity 8" tipping bucket rain gage; TE 525 Texas Electronics 6" tipping bucket rain gage; SR 50 ultrasonic distance [snow depth] sensor).

Instrument	Units	Accuracy	Range	Resolution
High Capacity Raingauge	mm	+/-2.0%	25-600 mm/hr	0.1 mm
Standard Capacity Raingauge	mm	+/-1.5%	10-20 mm/hr	0.1 mm
Snow Depth Sensor	cm	+/-5 cm*	0-300 cm	1 cm

*Snow depth sensor accuracy is listed as +/-1 cm, however field tests indicate accuracy closer to 5 cm.

Calibration

Tipping buckets and snow sensors will be field calibrated annually by park staff (see Appendix B).

Solar Radiation

Solar radiation is a measure of the amount of sunlight reaching the earth's surface. Radiation varies significantly among regions. Season and time of day are major considerations but atmospheric conditions, surrounding terrain, elevation, obstructions (e.g. trees) can cause

additional variations among locations in a small area. To limit this variation, remote climate stations are placed in the largest gap possible. It should be noted that forest gaps large enough to allow full sun exposure year round are difficult or impossible to find in many of the NCCN parks. This is primarily due to densely forested lands and steep, rugged topography.

Remote climate stations will be equipped with one of two sensors, either a Pyranometer or a Quantum Sensor.

- Pyranometers measure total solar radiation received and includes both direct beam (global sun) and diffuse sky radiation. The wavelength range is 400 to 1,100 nanometers. The unit of measurement is watts per square meter (W m^{-2}).
- Quantum Sensors measure only a portion of total radiation, the wavelength range of 400 to 700 nanometers. This range is known as photosynthetic active radiation (PAR) and is a measure of the amount of radiation available for plant growth. The unit of measurement is micromoles per second per square meter ($\mu\text{mol s}^{-1} \text{m}^{-2}$).

To ensure accurate collection of radiation measurements, all sensors will meet the following criteria:

- Located in an opening large enough to ensure direct radiation during all daylight hours year round.
- Sensor will be mounted on a level plane where there are no stationary obstructions (including the tower) that reflect sunlight or cast a shadow on the sensor.
- The sensor will be mounted on the south aspect of all towers (180°), extended 75 cm from the tower mast and at a height of 300 cm. Height exceptions will be made in higher elevation sites where winter snow accumulation would bury sensors.

SOP Table 1.5. Solar radiation sensor performance standards (solar radiation: LI 200X Pyranometer; Photosynthetic active radiation: LI 190SB Quantum Sensor).

Parameter	Units	Accuracy	Range	Resolution
Solar Radiation	W m^{-2}	+/-5%	0–1,100 W m^{-2}	1
Photosynthetic Active Radiation	$\mu\text{mol s}^{-1} \text{m}^{-2}$	+/-5%	0–1,600 $\mu\text{mol s}^{-1} \text{m}^{-2}$	1

Calibration

Radiation sensors are factory calibrated every two years.

Quantum sensors are calibrated using working standard quartz halogen lamps, which have been calibrated against reference standard lamps traceable to the U.S. National Institute of Standards and Technology (NIST). Standard lamp current is metered to 0.035% accuracy. Microscope and laser alignment in the calibration setup reduce alignment errors to less than 0.1%. Stray light is reduced to less than 0.1% by black velvet background. The absolute calibration accuracy is limited to the uncertainty of the NIST-traceable standard lamp.

Pyranometer sensors are calibrated against an Eppley Precision Spectral Pyranometer (PSP) under natural daylight conditions.

Wind Speed and Direction

Wind Sensors measure the wind speed, the rate at which air passes a given point, and wind direction, the direction from which the air is moving.

Low altitude wind characteristics are greatly affected by small and large topographic features as well as surface roughness (e.g. complex forest structure vs. grasslands). The result is that measurements of wind parameters can be difficult and the results highly variable, especially in areas of complex mountain topography and densely forested terrain. Therefore, wind instruments require careful placement for accurate interpretation of local patterns. Exposed locations adequate for wind measurements will dramatically increase error of precipitation measurements, meaning that the collocation of instruments is rarely possible. For this reason, NPS operated climate sites do not generally meet WMO or NWS standards* for wind measurements and most wind sensors associated with remote low elevation climate stations are intended for interpretation of associated climate data rather than an understanding of larger scale wind patterns. If an accurate assessment of wind conditions is required for a specific area, such as for the interpretation of air quality data or assessment of fire danger, wind instruments will be placed in an alternative location away from the main climate station.

*Note: National Weather Service standards for wind measurements describe the following:

- Standard height above the ground for wind sensors as 33 feet (10 m). If local restrictions prevent installing the sensors at the 33-foot standard, installation should be no less than 20 feet above the ground.).
- The sensor height must be at least 15 feet above the height of any obstruction within 500 feet. If practical the sensor should be at least 10 feet higher than any obstruction between 500 and 1,000 feet of the sensor. (An object will be considered an obstruction if the object is greater than 10 degrees in horizontal width as measured from the sensor).

To ensure comparability between sites, the following conventions were used in mounting wind instruments:

- The wind sensor is mounted at the height of the associated precipitation gauge, 75 cm from the mast in a northeast (60°) direction.
- The wind sensor is oriented with respect to true north.

SOP Table 1.6. Wind sensor performance standard (Met One 034B Windset).

Parameter	Units	Accuracy	Range	Resolution
Wind Direction	Degrees (from True North)	+/-5°	0–360°	0.5°
Wind Speed	Meters/second	+/-0.12 m/s ⁻¹ (for speeds <10.1 m/s ⁻¹) +/-1.1% of reading (for speeds >10.1 m/s ⁻¹)	0.4–49 m/s	

Calibration

Wind sensors will be serviced and calibrated by the manufacturer annually. This will include replacement of bearings, checking cup speed (frequency) against NIST Standard, checking linearity and alignment of potentiometer to NIST Standard, and return of instrument to original operating specifications.

Soil Temperature

This refers to the temperature of soils adjacent to climate stations. Two factors that greatly affect soil temperature are ambient air temperature and depth from the soil surface. In addition, surface insulation (e.g. duff/snow), solar radiation, soil density and texture, soil moisture, and microbial processes can also contribute to differences in soil temperature. All soil temperature data will have an associated measurement of depth.

To ensure comparability between sites, soil temperature measurements are taken at standardized depths associated with forest and understory growth. These are:

- Surface Soil*
- 5 cm depth
- 15 cm depth
- 30 cm depth

* The surface probe is installed horizontally at the mineral soil/organic layer interface. The 5, 15 and 30 cm probes are then placed at the given depths below this point.

SOP Table 1.7. Soil temperature sensor performance standard (CS 107L Temperature Sensor).

Parameter	Units	Accuracy	Range	Resolution
Temperature	Celsius	+/-0.4°	-35° to +50°C	0.1

Calibration

Soil temperature probes do not require maintenance or periodic calibration. Sensors will be calibrated to a NIST standard before and after installation.

Soil Moisture

A water content reflectometer can be used to acquire a measure of the relative abundance of water in a matrix of soil (the volumetric water content of the soil expressed as a value between 0% to saturation). Soil moisture is affected by a variety of factors including ambient air

temperature, soil temperature, depth from the soil surface, solar radiation, soil texture, soil density, microbial processes, evaporation and transpiration. Along with soil temperature, soil moisture is a limiting factor for forest productivity and can provide an important meter for understanding forest growth and response. It should be noted that soil texture and compaction can negatively influence the accuracy of water content measurements.

To ensure comparability between sites, soil moisture measurements are taken at standardized depths associated with forest and understory growth. These are:

- Surface Soil*
- 0–20 cm depth
- 20–40 cm depth
- 40–60 cm depth

*The surface probe is installed horizontally at the mineral soil/organic layer interface. Subsequent probes are then inserted at a 35° angle starting at the upper depth, to allow an integrated measurement across the 20cm depth range (0–20cm, 20–40cm, 40–60cm).

SOP Table 1.8. Soil water content performance standard (CS 615 & 616 Water Content Reflectometer).

Parameter	Units	Accuracy	Range	Resolution
Volumetric Water Content	%	+/-2.5%*	0 to 50%	0.1%

*Soils with electrical conductivity (silt/clay loams) $\geq 0.5 \text{ dS m}^{-1}$ or bulk density $\geq 1.55 \text{ g cm}^{-3}$ will require the use of a calibration adjustment. For this reason, soil samples should be acquired during installation of equipment and analyzed for electrical conductivity and bulk density.

Calibration

Soil water content probes do not require maintenance or periodic calibration. Sensors will be calibrated to a NIST standard before and after installation.

Datalogger

All NPS operated climate stations will rely on a Campbell Scientific CR10X datalogger for controlling, processing and recording climate data. See Appendix C for an overview.

SOP Table 1.9. Datalogger specifications (Campbell Scientific CR10X).

Features	Specifications
Standard operating range	-25° to +50°C
Power requirements	9.6–16 Volts DC
Program execution rate	Up to 64 Hz
Analog Inputs for measuring voltage levels	6 Differential (12 single-ended)
Switched Excitation Channels for precision excitation of sensors or short-term actuation of external devices	3
Pulse Counting Channels for switch closures, high frequency pulses, or low level ac measurements	2
Digital Inputs/Outputs for output control, sensing status, and reading SDM peripherals or SDI-12 sensors	8
Current drain	1 mA quiescent, 13 mA processing, 46 mA analog measurement
Data Storage	Mixed Array, Table - 1 million data points (non-volatile)
Programming	Edlog

Calibration

Dataloggers will be calibrated to NIST Standards by the manufacturer every 4 years.

Datalogger Programming

Each climate station has a unique program, developed with Edlog, a programming software package provided by Campbell Scientific. Edlog is available with the most recent LoggerNet software package or PC208W, an earlier software package used to interface with the CR10X.

Datalogger programs are created in a standard format, however some variation may occur depending on instrumentation. Each datalogger will be programmed to enable and read instruments on a 5 minute (300 second) interval. This data will be stored in temporary memory and recorded into permanent (non-volatile) memory every hour. Hourly data will be stored as follow

SOP Table 1.10. Hourly measurements.

Measurement	Measurement Interval
Air Temperature	Hourly Average (12 measurements)
Relative Humidity	Hourly Average (12 measurements)
Precipitation	Total Count
Snow Depth	Minimum Value
Solar Radiation	Hourly Average (12 measurements)
Mean Horizontal Wind Speed	Hourly Average (12 measurements)
Vector Wind Direction	Hourly
Standard Deviation Wind Direction	Hourly
Soil Temperature	Hourly Average (12 measurements)
Soil Water Content	Hourly Average (12 measurements)

Each climate station is given a unique 3 letter identifier which is incorporated into a naming convention for programs and raw data files. The naming convention is as follows: {3 letter identifier} + {julian day the program was written} + {the last two digits of the year the program was written}. For example: A program written on 11/01/06 (Julian Day 305) for a climate site at the Hoh Open site in Olympic National Park is named HOO30506.

Changes in datalogger programs can significantly alter data output, by either changing the order of data fields or by changing multipliers which then influence output values from various instruments. For this reason, care will be taken to document all program changes, archive previous versions of programs, and include a “Program ID” field in each program that automatically inserts the version of the program into the data set. See Appendix D, Programming NPS Datalogger, and Appendix E, Example of Datalogger Program for the specific steps to program the datalogger.

Sensor & Equipment Maintenance

National Park Service Operated Climate Stations are routinely exposed to harsh environmental conditions. High winds, snow, heavy rain, flooding and wildlife can damage or compromise sensors, wiring, towers and power supplies. To ensure high quality data and limit data loss, it is important that these remote stations receive regular inspection and maintenance (Appendix F).

All NPS stations will be visited on a quarterly basis (every 3 months) with additional visits as required for emergency repairs.

Each quarterly visit will include the following:

- Download raw data from the datalogger.
- Monitor current values of all sensors and compare to current conditions.
- Check voltage of power supply to ensure adequate reserves for the next 3 months of operation.

- Compare datalogger time with NIST time. Change time if discrepancy is greater than 2 minutes.
- Visually inspect tower and all sensors for damage or irregular function, including:
 - Wind sensor is turning and free of obstructions
 - Rain gage is level and the funnel is free of detritus
 - Radiation sensor is level and clean
 - Soil sensors are buried and not exposed or inundated
- Inspect seals on waterproof enclosure and change desiccant packs
- Document site visit on a site observation form

Once per year, additional maintenance will occur at NPS operated sites, including:

- Battery inspection (replace batteries every 5 years)
- Cleaning of solar panels
- Cleaning and calibration of tipping bucket
- Wiping surface of radiation sensor (replace for factory calibration every 2 years)
- Replacing air temp/relative humidity sensor for factory calibration
- Cleaning aspirated radiation shield with bleach and water
- Replacing wind sensor for factory calibration

Activities and findings from each site visit will be documented on a customized site observation form (see Appendix G). These forms will be referenced during the QA/QC process and then archived.

Data Retrieval & Management

A large network of climate stations, recording hourly data can quickly create vast volumes of data. To ensure that certified data reflects the most accurate information possible, it is extremely important to process data in a standardized and organized manner. Climate data originating at NPS operated stations will follow a standard data handling procedure which includes several layers of quality assurance review and documentation. The data management procedure may be best understood as shown in Figure 1.1.

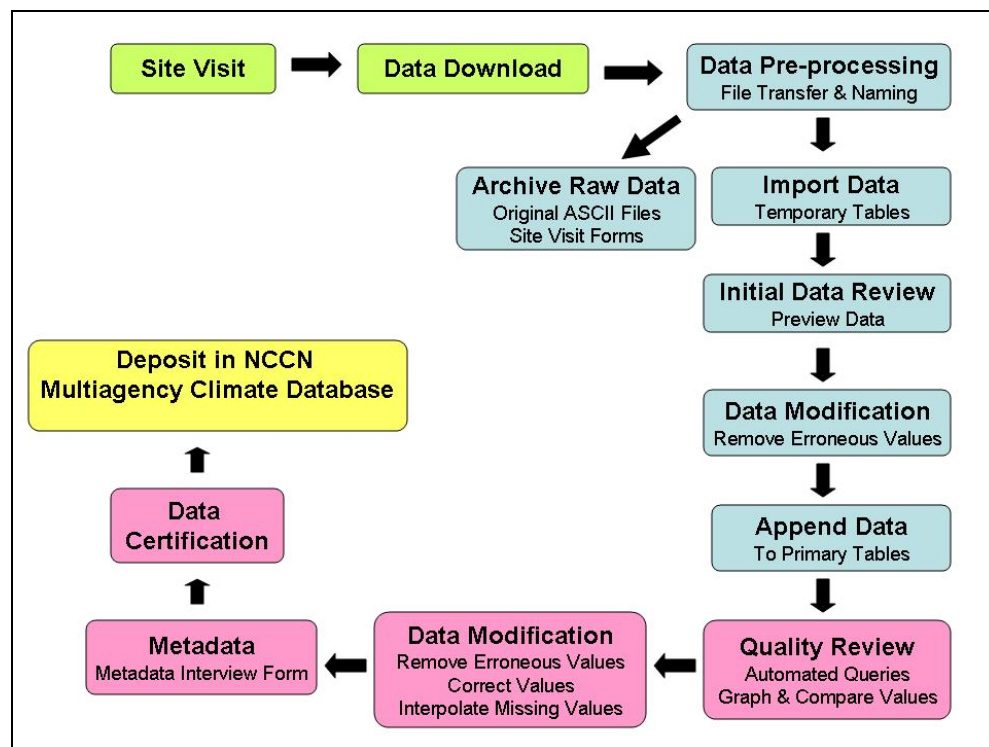


Figure SOP 1.1. Idealized flow schematic of the handling of data from NPS operated climate stations.

Site Visit

Climate Sites will be visited every three months for inspection, maintenance and data acquisition.

Data Download

Data may be transferred from the datalogger in many ways and interfaces may change in the future. Currently, NPS staff are using laptop computers, PDA's or HP200 calculators to download data. Detailed descriptions for each method are available in Appendix H, I and J.

Regardless of method, the resulting data will be collected as a "raw" ASCII delimited file.

Data Pre-Processing / Archiving Raw Data Files

Upon return from the field raw data files will be immediately transferred from portable devices to park network drives (which are backed up daily). Raw files will then be edited and renamed using a standardized naming convention.

- Example: DPF_13403_05204 where the first 3 letters are the acronym for the specific datalogger (DPF = **D**eer **P**ark **F**orest datalogger). The next five digits, separated by an underscore, are the Julian Day and Year of the first row of data in the file. The last five digits represent the Julian Day and Year of the last row of data in the file.

Using a text editor or Excel, the terminating character hex(1A) at the end of the data file is removed and the file extension changed from .dat to .txt to allow for importing into an Access Database. See Appendix I, Data Entry and Verification for database specifics.

The name of the data file is recorded in an index of all raw climate data files associated with the NPS operated stations.

Import Data/Initial Data Review/Data Modification

The first level of data processing and QA/QC will involve importing all data into an Access Database located on a local park network drive. See Appendix K, Data Entry and Verification for specific information about the database.

Raw data files are initially imported into a temporary access table. The program then displays the temporary access table to the researcher for initial review. At this stage, park staff will browse values looking for obvious problems such as out of range values or missing data. Data can be edited in this mode and obviously bogus or flagged data will be removed in this step.

Append Data

Following initial review the data is appended from the temporary table into a permanent repository table with data from earlier downloads.

Quality Review

During this step, data appended into the permanent repository receives careful review.

Automated queries will be run to search for out of range values. These values would be identified and eventually replaced with null values, automatically generated values or interpolated values.

Data will also be exported into Excel formats for efficient display and graphing of each parameter in order to visually review values. The date range displayed will span more than one raw data set to allow for comparison and watch for sudden shifts, or sloping trends of instruments. Data values will also be displayed and compared against similar or associated instruments. Examples of typical comparisons are as follows:

- Air Temperature and Datalogger Panel Reference Temperature
- Precipitation and Surface Soil Moisture
- Solar Radiation over multiple years
- Soil Temperature, comparing values at multiple depths
- Soil Surface Temperature and Air Temperature

- Soil Moisture, comparing values at multiple depths
- Battery voltage trends

Data with unusual values would be identified and replaced with null or interpolated values.

Data recorded during maintenance visits (identified from Site Observation Forms) will be scrutinized for false values from equipment calibration or replacement activities.

Data Modification

As previously described, data identified as having unusual, out of range or false values (due to maintenance) would be flagged and replaced, either with null values, automatically generated values or interpolated values for final data sets. Before modification, site trip reports and data from other local weather stations are checked to confirm decision.

The following data modification guidelines will be followed:

Null Values

Null values will replace all erroneous temperature, relative humidity, wind speed, wind direction and soil moisture measurements.

Automatically Generated Values

Update queries will be used to automatically replace certain out of range values. Examples of this would include:

- Relative Humidity values greater than 100% would be changed to 100%.
- Wind Speed values of .271 m/s (the lowest threshold of the wind speed sensor) would be changed to a value of “0”.
- Radiation values below zero would be changed to zero.
- Malfunctioning sensors may display a standardized “null” value of “-6999” or “-9999”. These would be replaced with a true null value.

Interpolated Values

In some instances, missing or false values will be manually replaced with an interpolated or estimated value. This will only be the case with parameters requiring totalized values for reporting purposes such as precipitation and radiation. The following rules for interpolation will be followed:

- Precipitation: Two methods may be used to replace missing precipitation values. Relationships between existing climate stations are determined in advance of problems. Values from nearby stations are compared to each other using an R squared value derived from a linear regression. Corresponding data from the station with the highest R squared value (i.e. having the most similar pattern of rainfall) is used to replace missing data. This value is also adjusted with the equation from the best fit line. (See Figure 2). If no rain occurred at nearby stations, a value of “0” is used.

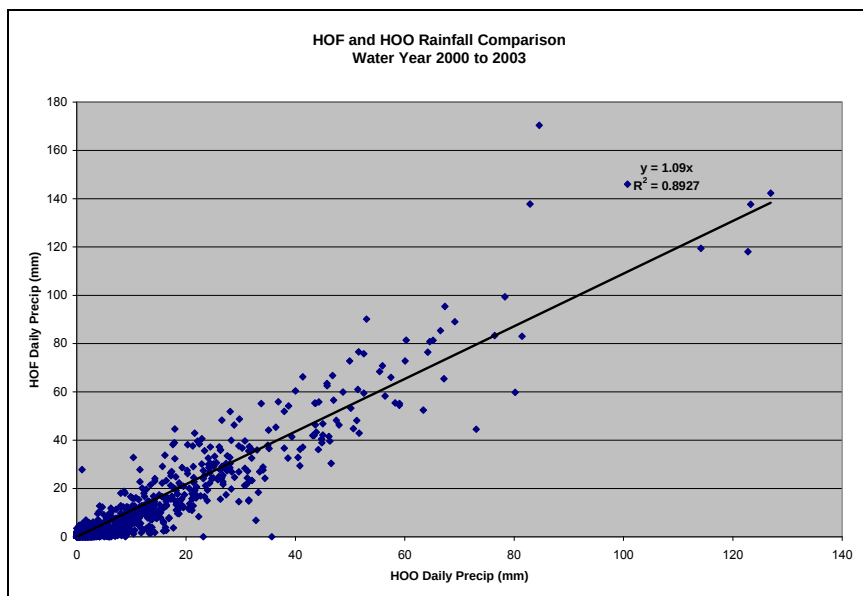


Figure SOP 1.2. Linear regression of nearby NPS climate stations, showing R squared value and the best fit line used to adjust missing values.

- **Radiation:** Three methods may be used to interpolate missing radiation values. If a single hour of radiation data is missing, it will be replaced using the average value of the previous and following hour's data. If several hours of data are missing, radiation will be estimated using a best fit polynomial line (see Figure 3). If an entire day or several days worth of data are missing, values from nearby stations are compared to each other using an R squared value derived from a linear regression, and the corresponding data from the station with the highest R squared value (i.e. having the most similar radiation) is used to replace missing data.

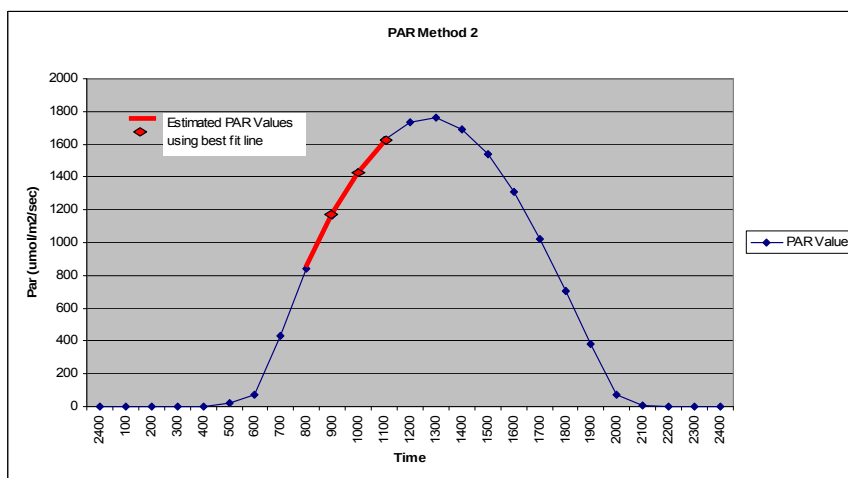


Figure SOP 1.3. Replacement of missing radiation values using a best fit polynomial line.

Data Quality Flags

Through all steps of data review, data will be given a data quality flag with which to track changes to original data. In some instances, data flags will be automatically generated by certain actions within the database (e.g. an update query to change zero values). In other cases, data reviewers will be prompted to associate a specific flag prior to saving, whenever modification or review occurs. Typical data quality flags are described in the following table.

SOP Table 1.11. Data quality flags.

Flag Name	Flag Type	Description
Collection Flags		
Raw Data	Collection	All data imported into the data base from a raw ASCII delimited file
Historical	Collection	Data transferred from excel spreadsheets previously QA/QC'ed.
Missing	Collection	No data collected – Null values inserted
Out of Range	Collection	Data logger posted out of range value – Null values inserted
Vitel Transform	Collection	Value extracted from voltage by transform program HYD_EXE
Review/Modification Flags		
Good	Review	Quality indication assigned upon data review
Fair	Review	Quality indication assigned upon data review
Poor	Review	Quality indication assigned upon data review
Estimated	Review	Value replaced with averaging before & after values
Interpolated	Review	Value replaced by interpolating along a best fit polynomial line.
Least Square	Review	Value replaced by least-square regression equation

Metadata and Data Certification

Once a data set has been completely reviewed and final revisions made, the Project Lead will complete an up-to-date metadata interview form and a NCCN Project Data Certification Form. Details of this process are described in the NCCN Climate Protocol Narrative, Section IV, Data Handling, Analysis and Reporting.

Personnel Requirements and Training

Roles and Responsibilities

The NCCN Atmospheric workgroup is responsible for managing NPS operated climate stations. The NCCN Atmospheric workgroup is comprised of the climate program managers from Mount Rainier National Park, Olympic National Park, and North Cascades National park, and the field technicians from each of those parks.

The program managers from each park with assistance from field staff are responsible for appropriate site selection and placement of future climate stations funded by the Park Service, station maintenance, and assurance that accurate observations are taken. This includes addressing maintenance issues with promptness, and visual checks of data on a frequent basis to assure that station readings are reflective of actual conditions.

The data management aspect of the monitoring is the joint responsibility of the project managers and the designated NCCN data manager. Data QA/QC is the responsibility of the program managers. The program managers will be the technical representative on all contracts related to climate data archiving and dissemination and will stay up to date on technological advances in the field, ensuring that the NCCN climate monitoring program is consistent with other national programs.

The program manager and field staff are also responsible for climate reporting on an annual basis.

Partnerships

A small number of NPS Operated Climate Stations are configured to provide hourly telemetered data. Telemetry is provided through an agreement with the NRCS-SNOTEL group. The NRCS provides the expertise for the installation and operation of meteor burst radio communication systems, posts raw data on an NRCS ftp site and provides data backup for this data.

Qualifications and Training

Installation, programming and operation of remote climate stations requires a high level of technical skill, including an understanding of datalogger programming, electronics, 12V power systems, climate instrument operation and meteorology. Effective troubleshooting must be done in the field to eliminate redundant site visits and ensure accurate measurements. The quality of the data produced is determined by the attention to maintenance details by the program manager and field staff.

Remote sites also require the field skills to access sites year round. In most NCCN parks this will include skiing, snowshoeing, extended backpacking, avalanche safety and helicopter operations.

Annual Workload and Field Schedule

NPS Operated Climate Stations are routinely exposed to harsh environmental conditions. High winds, snow, heavy rain, flooding and wildlife can damage or compromise sensors, wiring, towers and power supplies. To ensure high quality data and limit data loss, it is important that these remote stations receive regular inspection and maintenance.

Non-telemetered stations will be visited on a quarterly basis (every 3 months) to ensure the site is operating normally. Additional visits may be required for emergency repairs. Time required for site visits will vary depending on location and access constraints due to time of year. To increase efficiency of visits, whenever possible, sites visits will be combined with other stations or other activities that take the technician into the area. Timing of site visits, while flexible to ensure efficiency, will follow this general schedule:

SOP Table 1.12. Timing of maintenance site visits.

Period	Activity Highlights
October 1 to November 15th	"Pre-winter" Site Maintenance Download final data for last water year Change, check or supplement batteries Calibrate snow depth sensor
January 1 to February 15th	Site Maintenance Download data for last calendar year
April 1 to May 15 th	Site Maintenance Download data Tipping Bucket calibration Equipment change-out (Factory Calibration)
July 1 to August 15 th	Site Maintenance Download data Equipment change-out (Factory Calibration)

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(<http://www.weather.gov/directives/sym/pd01013002curr.pdf>)

Appendix A. NCCN Climate Station Locations

SOP 1.26

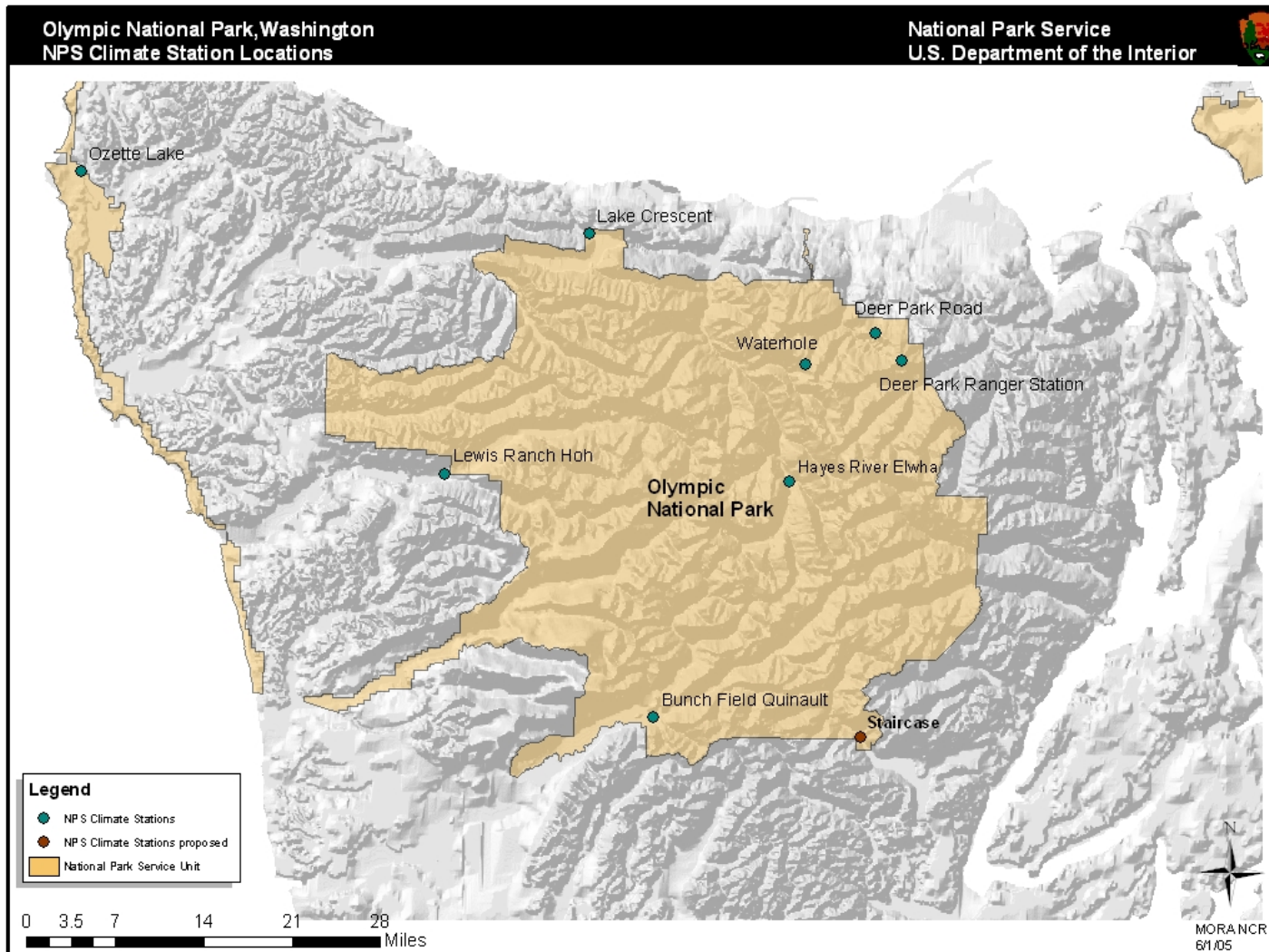


Figure A.1. Olympic National Park existing and proposed NPS climate stations.

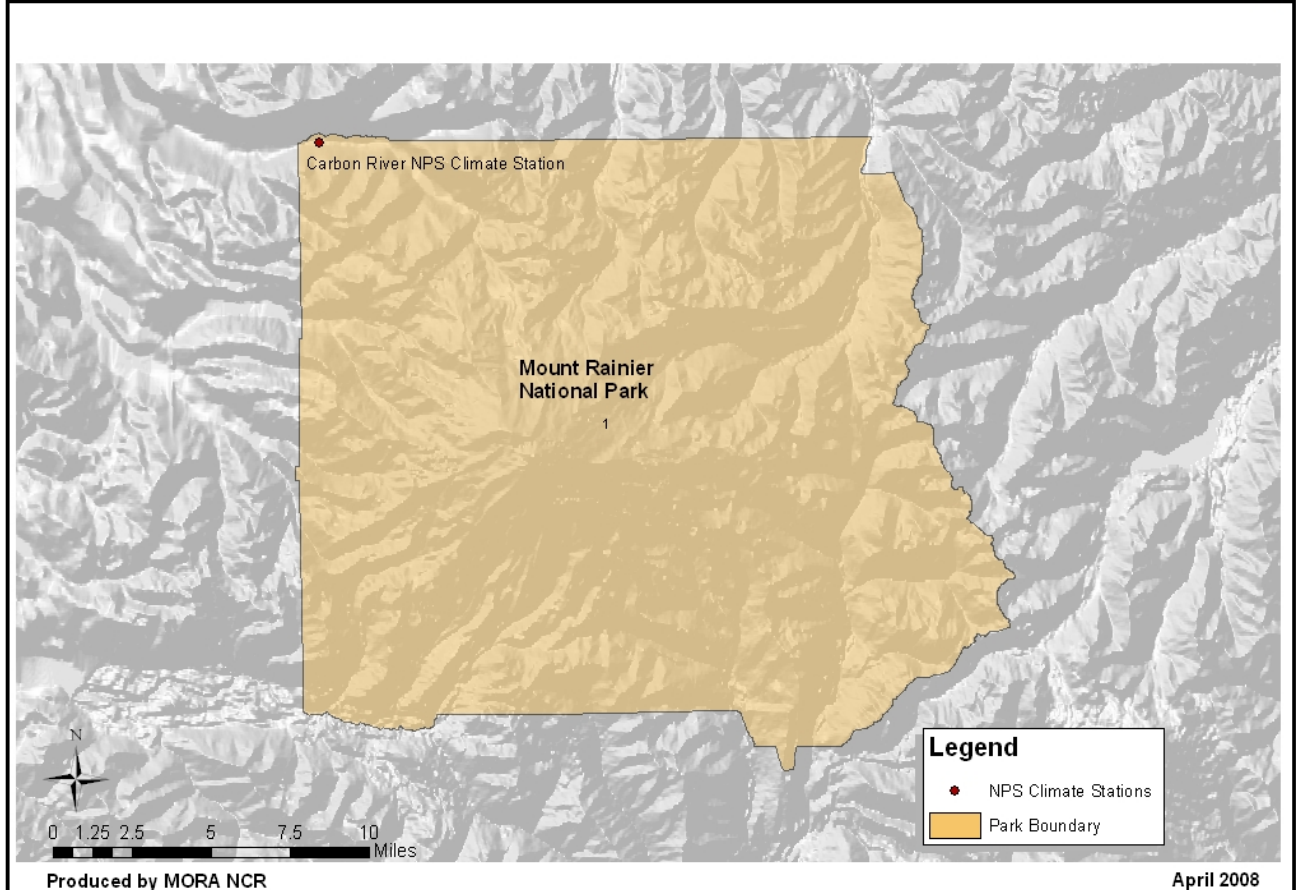


Figure A.2. Mount Rainier National Park NPS climate station.

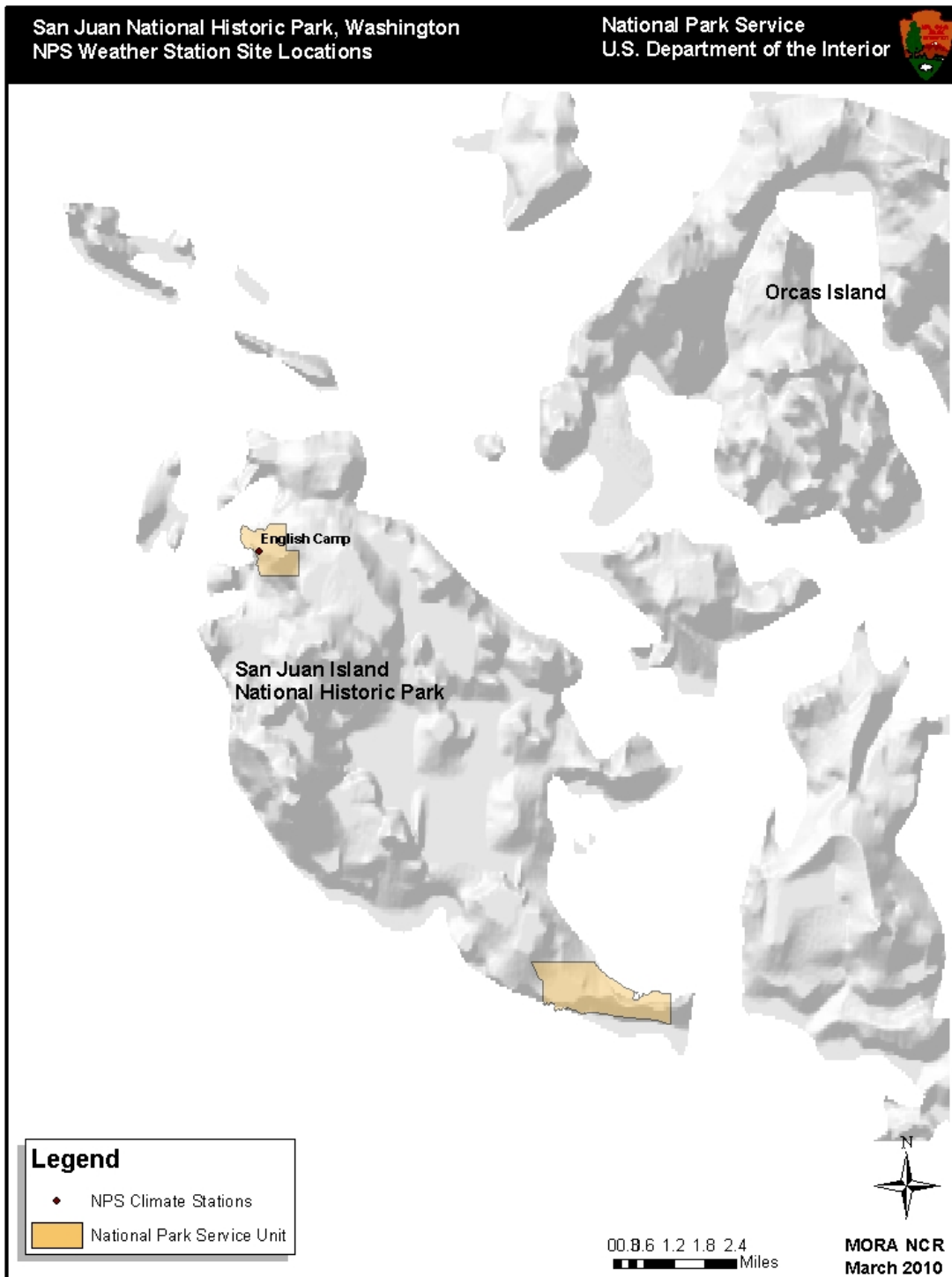


Figure A.3. San Juan National Historic Park proposed NPS climate station site location.

Appendix B. Tipping Bucket Calibrations

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Appendix B. Tipping Bucket Calibrations

Tool List

- Water Bottle
- 50 ml Burette
- 4 mm (5/32 in) hexagonal wrench
- Small Adjustable Wrench
- 8 mm open end wrench
- Level
- Small Phillip's head screwdriver
- Small slot head screwdriver

Hydrologic Services TB3 Tipping Bucket Rain Gauge

Calculate Tipping Bucket Multiplier

1. Check the inside of the tipping bucket enclosure and remove any debris from the funnel. Note this on the site visit form. (Section 1: Site Observations)
2. Using a 4 mm (5/32 in) hexagonal wrench, loosen the 3 screws on the side of the gauge near the base [see Figure 1] and lift the enclosure from the base.
3. Read the bullseye level on the base to ensure that the tipping bucket is level. Note condition (level/not level) on the Site Visit Form. Note: If bucket is not level....Do Not adjust it at this time.
4. Pour a liberal amount of water onto the tipping bucket assembly, making sure that each side is wetted. Tip each bucket down once to drain any captured water remaining in buckets.
5. Fill the burette with water to the zero mark.
6. On a note sheet, record the name of the site, the date, and create 2 header columns, left and right [see Figure 3].
7. Using the burette, slowly fill the left side (as you face the mechanism) of the bucket [see Figure 2]. As it nears the top, slow the flow to individual drips. As the mechanism begins to tip, close the burette to stop the flow. Read the meniscus on the burette and record the amount of water it took to fill the left bucket. Repeat this for the right bucket.

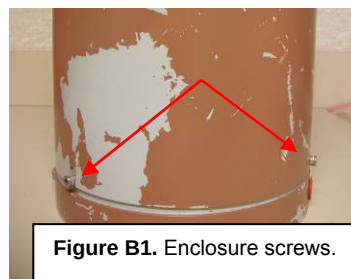


Figure B1. Enclosure screws.

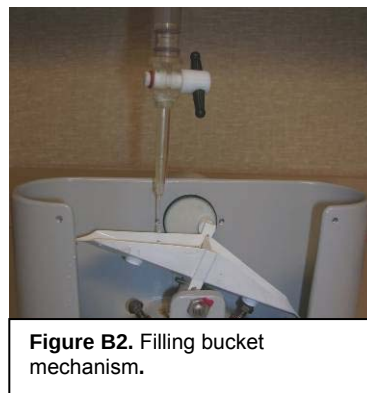
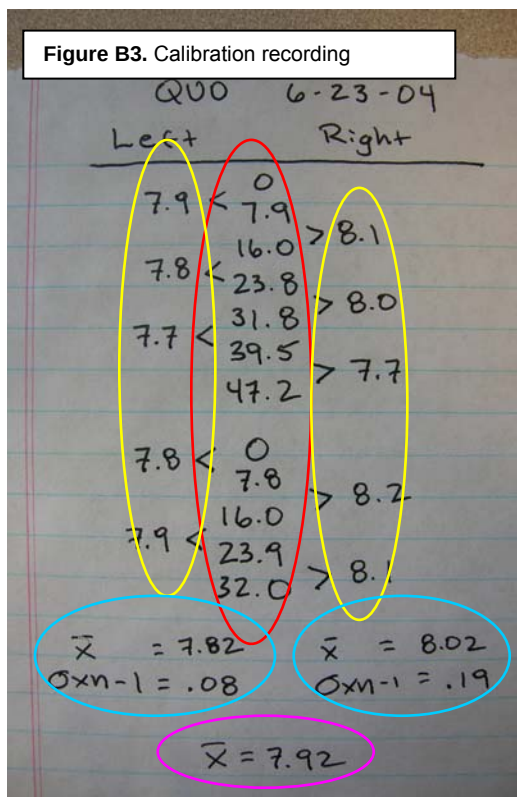


Figure B2. Filling bucket mechanism.

Appendix B. Tipping Bucket Calibrations

8. Repeat this process at least 5 times for each bucket, each time recording the meniscus (center column marked in red). This can then be used to determine the amount of water it took to tip the bucket (left & right columns marked in yellow) [see Figure 3].
9. Calculate the average and standard deviation (σ_{n-1}) of the measured volume for the left and right buckets [see Figure 3, marked in blue].
10. Compare average bucket volume for left and right buckets against factory specifications for the tipping bucket you are calibrating (e.g. 7.98 ml for the TB3). If the average volume is greater or less than .5 ml, adjustment will be required. [In Figure 3: both 8.02 and 7.82 are within .2 ml so no adjustment would be required.]
11. If Standard Deviation of either bucket is greater than .25, repeat Steps 6-10.
12. Compare the volume measurement for left and right buckets. If values are not within .5 ml of each other, adjustment will be required. [In Figure 3: $8.02 - 7.82 = .2$ so no adjustment would be required.]
13. Calculate the average of both buckets combined. This becomes value X. [In Figure B3: value equals 7.92, circled in pink]
14. If 1) the average calibrated volume deviates from the factory specifications by more or less than .5ml or 2) the compared values of left and right tipping buckets are not within .5 ml of each other; You will need to adjust the tipping bucket volumes (described later in this SOP). If all values were within specification, no adjustments or additional calibrations are required.
15. Calculate the “As Found” tipping bucket calibration multiplier using the following formula:

$$\frac{(0.254 \text{ mm})(X \text{ ml})}{7.98 \text{ ml} [\text{factory volume specification}]} = \text{multiplier [mm rainfall per tip]}$$



Appendix B. Tipping Bucket Calibrations

16. Compare this “As Found” multiplier value to the current value in the datalogger program. If the values are within .01 mm, no change to the datalogger program is required. If the value is greater than .01 mm, then change the multiplier within the existing datalogger program.

Leveling Tipping Bucket

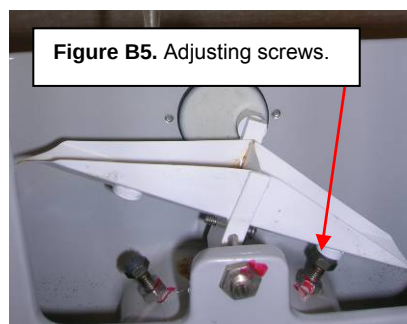
The standard TB3 Tower Mount has 3 threaded shafts over which fits the base of the rain gauge. On these shafts, between the base and the tower mount, 3 steel coil springs 1 cm in length are placed. [see Figure 4]. The base of the TB3 rain gauge is held to the tower mount with 3 nylon threaded lock nuts. Tightening these nuts compresses the springs and lowers the gauge. Loosening these nuts allows the springs to expand and raises the gauge.

1. Adjust these nuts individually, using the bullseye level on the base to evaluate your progress.
2. When the bubble returns to the middle of the bullseye, the rain gauge is level.



Adjusting Tipping Bucket Volumes

The volume of each side of a tipping bucket is determined by the length of an adjusting screw on which rests the opposite tipping bucket. For Example: the lower the adjusting screw on which the right bucket rests, the greater water weight is required in the left bucket to tip the mechanism on its fulcrum. Conversely, the higher the adjustment screw, the less water is required to tip the mechanism.



Appendix B. Tipping Bucket Calibrations

If a tipping bucket volume is too high, the adjusting screw on the opposite side needs to be raised. If a tipping bucket volume is too low, the adjusting screw on the opposite side needs to be lowered.

1. Clean any debris or scum from the inside of the tipping buckets.
2. To adjust the adjustment screw, you must first carefully loosen the locknut at the base of the screw, using an 8 mm open ended wrench and turning it counterclockwise. Turn the nut several turns to ensure there is plenty of room for adjustment.
3. To raise an adjustment screw, using the same 8 mm open ended wrench, turn the top of the adjustment screw counterclockwise.
4. To lower an adjustment screw, turn the top of the adjustment screw clockwise.
5. Adjust the screws $\frac{1}{2}$ turn in the appropriate direction.
6. Tip the bucket back into position where it rests on the screw you just adjusted.
7. Using the burette filled to the point where the meniscus is at the zero mark, decant water into the opposite tipping bucket until it tips. Note: tipping bucket should be wetted before this is done.
8. Observe the quantity of water required to tip the bucket.
9. Repeat adjustments until you are within an appropriate range of factory calibration (7.98 ml).
10. Once you are satisfied with the adjustment, carefully tighten the lower set screw, making sure you do not move the adjustment screw.
11. Once you have completed adjusting tipping bucket volumes, you must calculate a new multiplier and ensure measurements meet calibration specifications. The new multiplier will be recorded as "Adjusted Multiplier".



Figure B6. Loosening locknut.

Cleaning Funnel Filter and Siphon

Before replacing the enclosure onto the tipping bucket base, clean the funnel filter and siphon. Months of collected forest litter, dirt and fine debris can slowly clog the screen and orifice, leading to the overtopping of the funnel.

1. Turn the funnel upside down, and notice the siphon assembly. It is a black textured plastic knob with a hollow, threaded brass tube protruding from it.
2. Unscrew the knob, turning it counterclockwise. It should only be hand tight.
3. Using your other hand, hold the assembly filter, a stainless steel mesh tube on the upper side of the funnel [see Figure 8]. This will be released when the black siphon assembly is unscrewed.
4. Using a nylon toothbrush, scrub the outside and inside of the filter, applying generous amounts of water to ensure loosened debris is washed away.
5. Using a small screw driver, carefully probe the inside of the siphon assembly, removing coarse debris lodged between the brass siphon and the black assembly.
6. Blow through the hollow threaded tube to ensure there is no blockage in the actually siphon and remove any loose debris.
7. If debris is difficult to remove, using an adjustable wrench or a 10 mm open box wrench, you may loosen the brass nut holding the siphon to the assembly [see Figure 7, yellow circle]. Once removed scrub and rinse both pieces and reassemble.
8. Place the siphon filter through the hole in the funnel from beneath. While holding the filter from the topside, screw on the siphon assembly until fully seated and hand tight.



Figure B7. Siphon assembly.



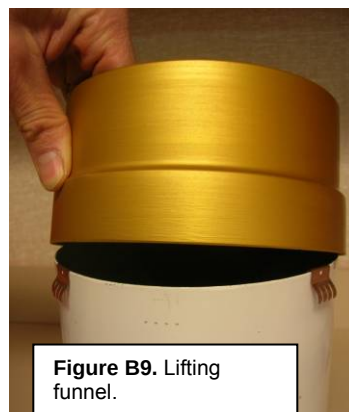
Figure B8. Assembly filter.

Texas Electronics TE525 Tipping Bucket Rain Gauge

Calculate Tipping Bucket Multiplier

1. Check the inside of the tipping bucket funnel and remove any debris from the funnel. Note this on the site visit form. (Section 1: Site Observations)

2. Lift the top funnel straight up and off of the main body of the rain gauge. This funnel is held on by small spring clips. Remove gently so as to not pop these clips off.

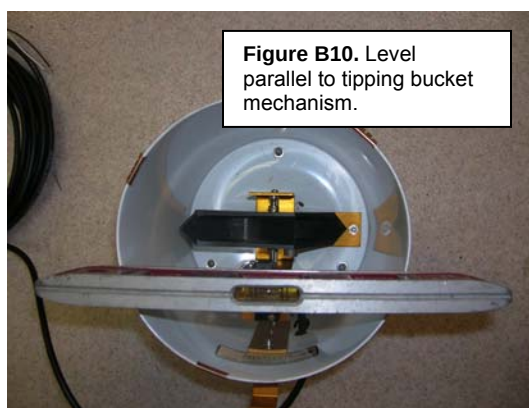


3. Remove debris from funnel orifice with a narrow screw driver. Clean orifice by passing a pipe cleaner through several times.

4. Using a straight level laid across the top of the rain gauge, ensure that the tipping bucket is level. Note: The level should be parallel with the tipping buckets (not perpendicular), as this is the direction important to the fulcrum of the tipping mechanism [see Figure 10]. Record condition (level/not level) on the site visit form. Note: If bucket is not level...Do Not adjust it at this time.

5. Pour a liberal amount of water onto the tipping bucket assembly, making sure that each side is wetted. Tip each bucket down once to drain any captured water remaining in buckets.

6. Fill the burette with water to the zero mark.



17. On a note sheet, record the name of the site, the date, and create 2 header columns, left and right.

7. Using the burette, slowly fill the left side (as you face the mechanism) of the bucket. As it nears the top, slow the flow to individual drips. As the mechanism begins to tip, close the burette to stop the flow. Read the meniscus on the burette and record the amount of water it took to fill the left bucket. Repeat this for the right bucket.

8. Repeat this process at least 5 times for each bucket, each time recording the meniscus and the amount of water it took to tip the bucket.

Appendix B. Tipping Bucket Calibrations

9. Calculate the average and standard deviation of the measured volume for the left and right buckets.
10. Compare average bucket volume for left and right buckets against factory specifications (4.73 ml for the TE525). If the average volume is greater or less than .5 ml, adjustment will be required.
11. If Standard Deviation of either bucket is greater than .25, repeat Steps 6-10.
12. Compare the required volume for left and right buckets. If values are not within .5 ml of each other, adjustment will be required.
13. Calculate the average of both buckets combined. This becomes value *X*.
14. Calculate the “As Found” tipping bucket calibration multiplier using the following formula:

$$\frac{(0.254)(X)}{4.73} = \text{multiplier [mm rainfall per tip]}$$

15. If 1) the calculated volume is greater or less than .5 ml of the factory specifications (4.73 ml) or 2) the compared values of left and right tipping buckets are not within .5 ml of each other, adjust the tipping bucket set screws.
16. If all values were within specification, no adjustments or additional calibrations are required.
17. Compare this “As Found” multiplier value to the current value in the datalogger program. If the values are within .01 mm, no change to the datalogger program is required. If the value is greater than .01 mm, then change the multiplier within the existing datalogger program.

Appendix B. Tipping Bucket Calibrations

Leveling Tipping Bucket

The TE525 may be mounted on 3 legs from the base, or pole mounted from the side. With base mounting, the base of each leg has a nylon threaded hole. A screw passes from below through the tower base and a short steel coil spring, then into the leg. Tightening the screws compresses the springs and lowers the gauge. Backing off these screws allows the spring to expand and raises the gauge.



Figure B11. Base mounting.

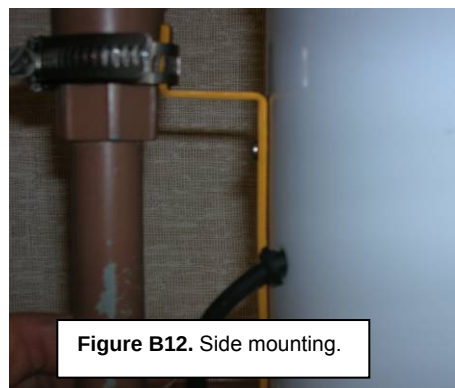


Figure B12. Side mounting.

For base-mounted TE 525 tipping buckets:

1. Adjust these screws individually, using a straight level placed on the top of the gage to evaluate your progress. Note: The level should be placed parallel with the tipping buckets (not perpendicular), as this is the direction important to the fulcrum of the tipping mechanism [see Figure10].
2. When the bubble in the middle of the level is centered, the rain gauge is level.

For side mounted TE 525 tipping buckets:

Less precise adjustments are available for side mounted tipping buckets.

1. Check that the vertical pole is plumb and adjust at base if possible.
2. Place a straight level on the top of the gage. Note: The level should be placed parallel with the tipping buckets (not perpendicular), as this is the direction important to the fulcrum of the tipping mechanism.
3. Using a 5/16th socket or screwdriver, loosen hose clamps holding the rain gage to the vertical arm or tower. Wedge a small plastic or metal shim between the vertical arm and the side mount to adjust the level of the rain gage. Shims placed in the bottom or top attachment of the side mount will each adjust the gage in a different direction. Tighten the hose clamps to hold the shim. Recheck level.

Adjusting Tipping Bucket Volumes

Volume of each side of a tipping bucket is determined by the length of an adjusting screw on which rests the opposite tipping bucket. For Example: the lower the adjusting screw on which the right bucket rests, the greater water weight is required in the left bucket to tip the mechanism on its fulcrum. Conversely, the higher the adjustment screw, the less water is required to tip the mechanism.

Figure B13. Adjustment screws.



If a tipping bucket volume is too high, the adjusting screw on the opposite side needs to be raised. If a tipping bucket volume is too low, the adjusting screw on the opposite side needs to be lowered.

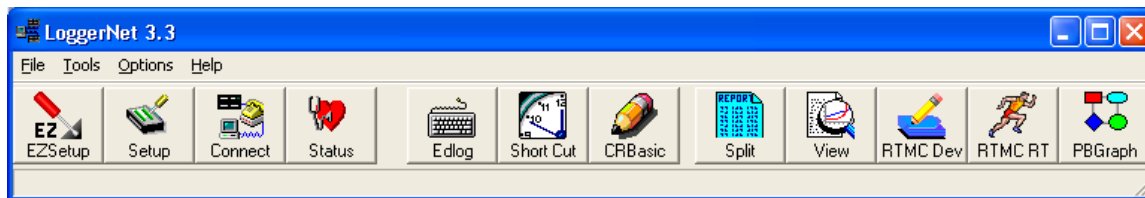
1. Clean any debris or scum from the inside of the tipping buckets.
2. The adjustment screw is accessed from the underside of the rain gage. Use a screw driver to adjust the screw.
3. To raise an adjustment screw, turn the screw clockwise from beneath (i.e. screw in).
4. To lower an adjustment screw, turn the screw counterclockwise from beneath (i.e. screw out).
5. Adjust the screws $\frac{1}{2}$ turn in the appropriate direction.
6. Tip the bucket back into position where it rests on the screw you just adjusted.
7. Using the burette filled to the point where the meniscus is at the zero mark, decant water into the opposite tipping bucket until it tips. Note: tipping bucket should be wetted before this is done.
8. Observe the quantity of water required to tip the bucket.
9. Repeat adjustments until you are within an appropriate range of factory calibration.
10. Once you have completed adjusting tipping bucket volumes, you must calculate a new multiplier and ensure measurements meet calibration specifications. The new multiplier will be recorded as "New Multiplier".

Appendix C. Configuring a Campbell Scientific Datalogger Using LoggerNet

LoggerNet® Overview

Once LoggerNet® is loaded onto a PC or laptop, the toolbar menu shown below is used to navigate through various functions. Following is a brief description of the purpose of each tool in the toolbar. The EZSetup Wizard is a simple method of creating a connection between a PC running LoggerNet® and a Campbell Scientific datalogger. The steps to set up a communication link with a datalogger utilizing the EZSetup Wizard are described in detail in this appendix.

Open LoggerNet® by double clicking on the icon on your desktop. The following tool bar will open



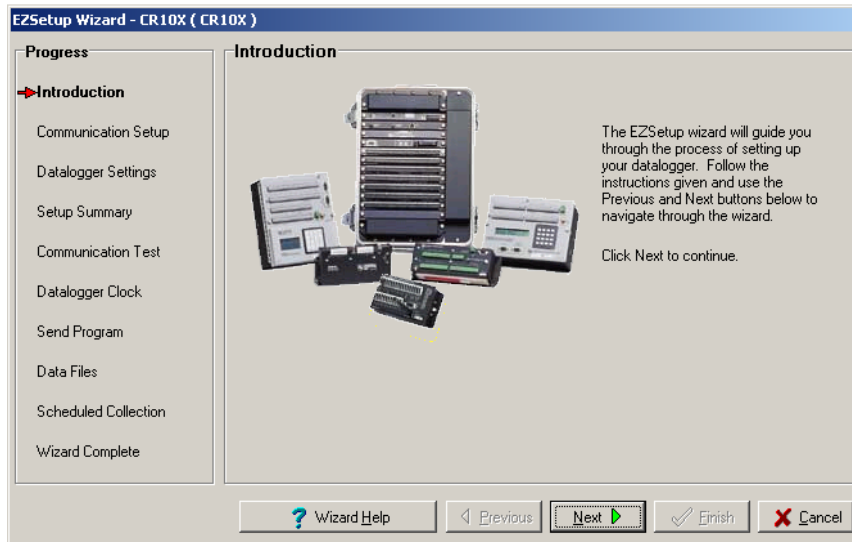
- **EZSetup:** The EZSetup wizard is designed to walk you through the setup and configuration of your datalogger network.
- **Setup:** The Setup button accomplishes the same tasks as EZSetup, but allows the user a bit more control when setting up your network, and allows for more complex network configurations.
- **Connect:** The Connect button is used primarily for initializing or checking operation of a datalogger and manually collecting data. This screen provides near real-time communication with a datalogger.
- **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:** A tool used for creating, editing, and documenting programs for Campbell Scientific 21x, CR10 and CR10X dataloggers.
- **Short Cut:** A user friendly interface for creating simple programs for Campbell Scientific 21x, CR10 and CR10X dataloggers. Designed for the beginner datalogger programmer. Datalogger programs may be created using shortcut and later adapted and edited in Edlog.
- **CR Basic:** The programming language used for CR200, CR5000 or CR9000 dataloggers.
- **Split:** A tool used to analyze data collected from Campbell Scientific dataloggers.
- **View:** Program used to look at any data file collected from dataloggers, regardless of the format (comma separated, table oriented ASCII, binary, or printable).

Appendix C. Configuring a Campbell Scientific Datalogger Using LoggerNet

- **RTMC Dev:** Real-Time Monitor and Control Development is a graphic display editor that is used for real-time data displays of the data collected by the LoggerNet server.
- **RTMC RT:** Real-Time Monitor and Control Run-time available separately from LoggerNet. It allows the user to run forms created in RTMC so that data can be displayed on a remote computer.
- **PBGraph:** Used to visually monitor and retrieve settings from devices in a PakBus network (a networking communication protocol).

EZSetup: Programming the Datalogger

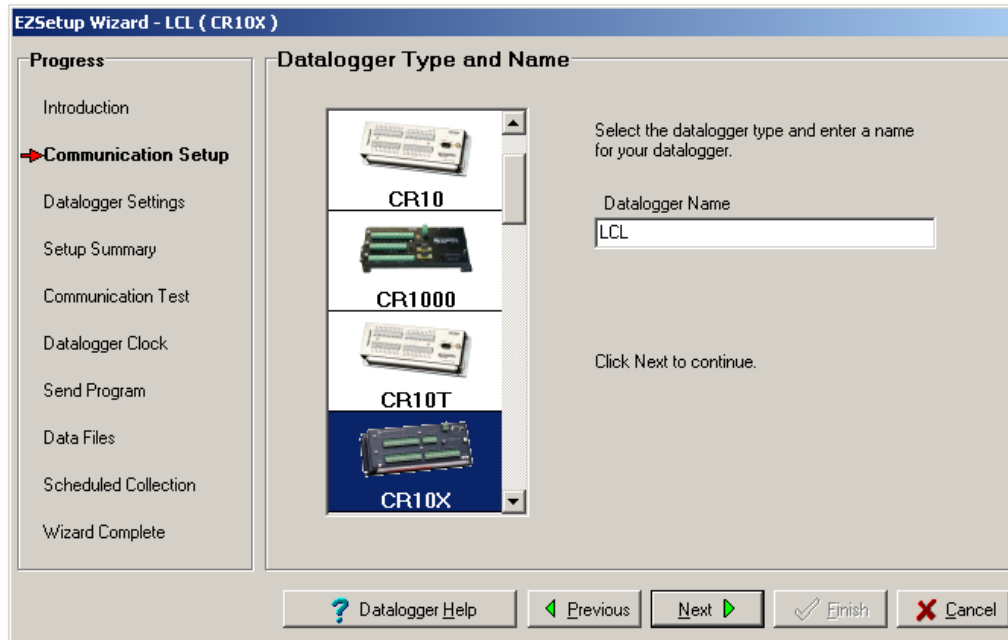
The EZSetup wizard is designed to walk you through the setup and configuration of a datalogger. As you work through the steps for the Wizard, each screen has fields that are completed with the pertinent information about your station. In addition to setting up a new station, the EZSetup Wizard can be used to edit an existing Station. EZSetup wizard is opened from the Toolbar screen.



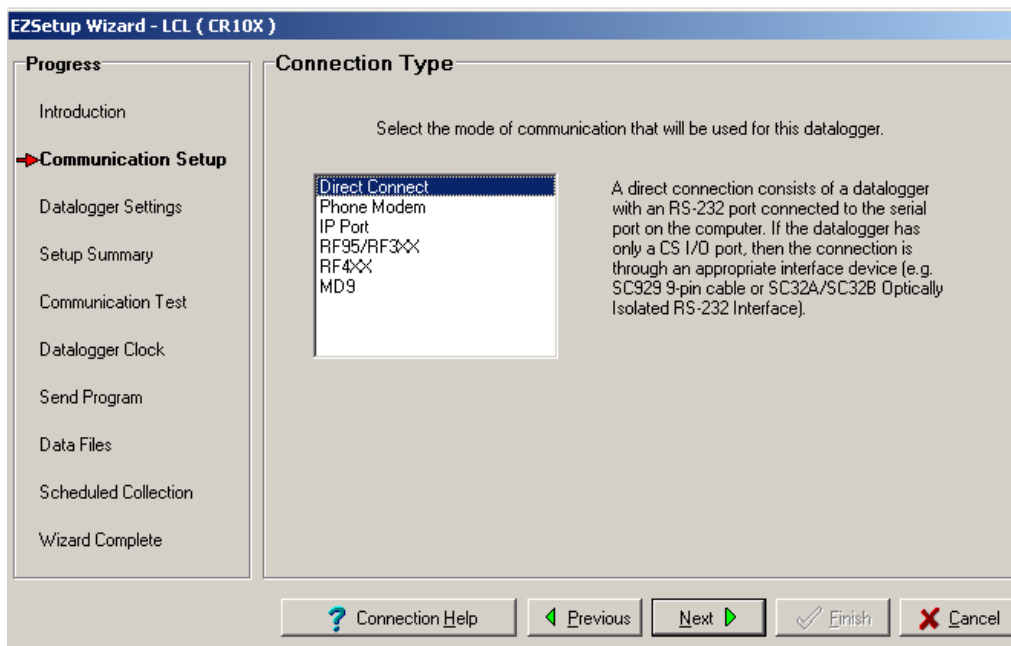
Communication Setup

This screen allows you to select the datalogger type and give it a name, define the configuration of COM ports, modems and communications settings such as phone numbers and RF radio addresses. The communications setup begins with the screen below. For setting up a telemetry based system, see Appendix H, Automated Data Transmittal.

Appendix C. Configuring a Campbell Scientific Datalogger Using LoggerNet



Click on the appropriate Datalogger Type (e.g. CR10X) and give the Datalogger a unique name appropriate for the location. Click Next. Highlight Direct Connect (see below) to connect directly to the datalogger using a serial cable and an RS-232 interface. Hit the NEXT button.

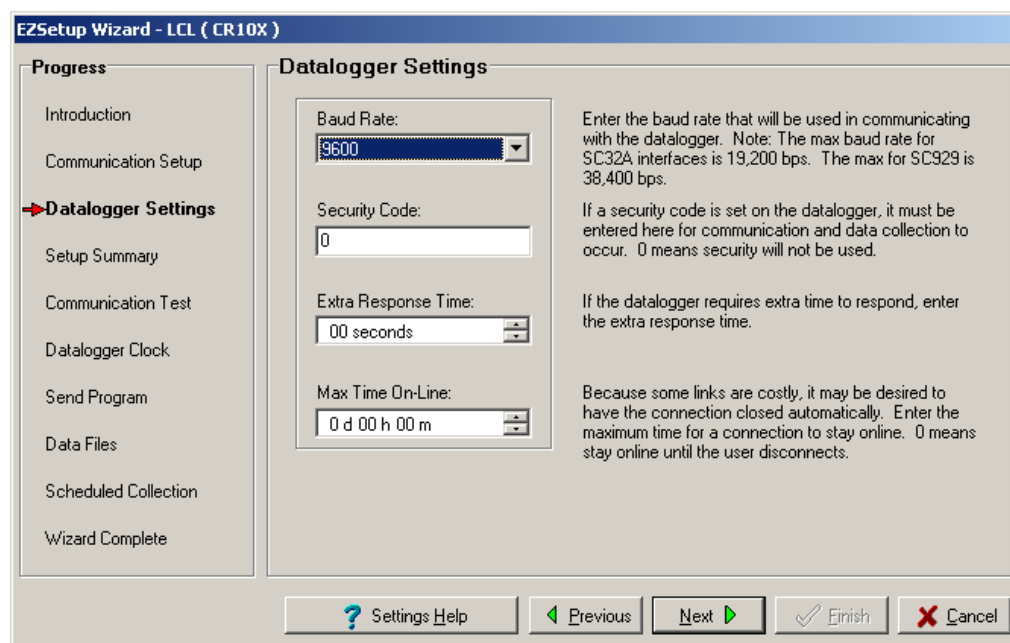


Choose the communication port you will be using on the computer. Click NEXT.

Appendix C. Configuring a Campbell Scientific Datalogger Using LoggerNet

Datalogger Settings

This step is provided for fine tuning the connection to the datalogger. Use the default settings shown above, Baud rate of 9600, No security code, extra response time or Max Time On-Line (see below).



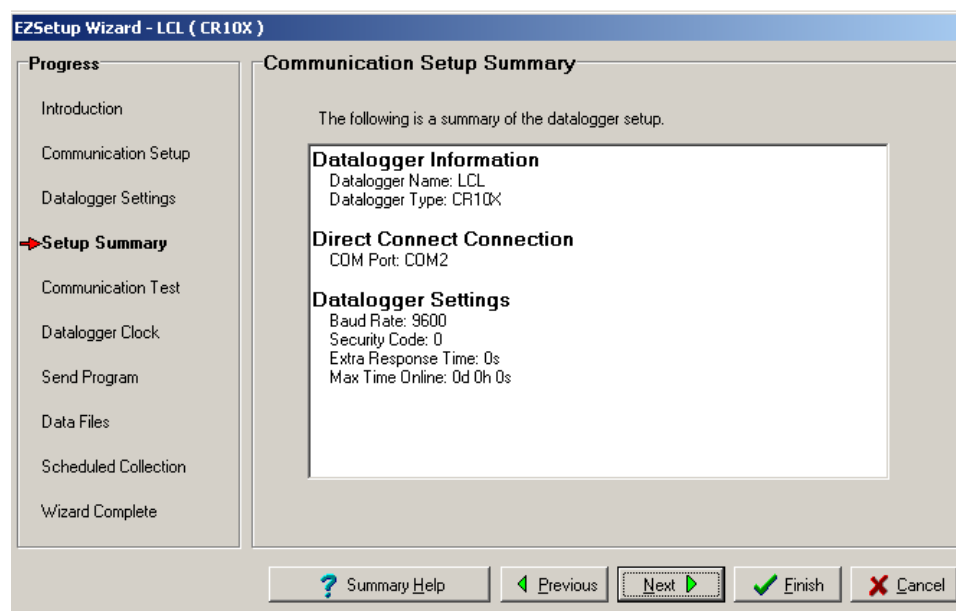
The screenshot shows the 'EZSetup Wizard - LCL (CR10X)' window. On the left is a 'Progress' sidebar with the following steps: Introduction, Communication Setup, **Datalogger Settings** (highlighted with a red arrow), Setup Summary, Communication Test, Datalogger Clock, Send Program, Data Files, Scheduled Collection, and Wizard Complete. The main area is titled 'Datalogger Settings' and contains four input fields with explanatory text to their right:

- Baud Rate:** A dropdown menu showing '9600'. Text to the right: 'Enter the baud rate that will be used in communicating with the datalogger. Note: The max baud rate for SC32A interfaces is 19,200 bps. The max for SC929 is 38,400 bps.'
- Security Code:** A text box containing '0'. Text to the right: 'If a security code is set on the datalogger, it must be entered here for communication and data collection to occur. 0 means security will not be used.'
- Extra Response Time:** A text box containing '00 seconds'. Text to the right: 'If the datalogger requires extra time to respond, enter the extra response time.'
- Max Time On-Line:** A text box containing '0 d 00 h 00 m'. Text to the right: 'Because some links are costly, it may be desired to have the connection closed automatically. Enter the maximum time for a connection to stay online. 0 means stay online until the user disconnects.'

At the bottom of the window are five buttons: '? Settings Help', '< Previous', 'Next >', '✓ Finish', and '✗ Cancel'.

Setup Summary

The Setup Summary provides a list of the settings entered. Review the information.



The screenshot shows the 'EZSetup Wizard - LCL (CR10X)' window at the 'Setup Summary' step. The 'Progress' sidebar on the left now highlights 'Setup Summary' with a red arrow. The main area is titled 'Communication Setup Summary' and contains the following text:

The following is a summary of the datalogger setup.

Datalogger Information
Datalogger Name: LCL
Datalogger Type: CR10X

Direct Connect Connection
COM Port: COM2

Datalogger Settings
Baud Rate: 9600
Security Code: 0
Extra Response Time: 0s
Max Time Online: 0d 0h 0s

At the bottom of the window are five buttons: '? Summary Help', '< Previous', 'Next >', '✓ Finish', and '✗ Cancel'.

From this screen, you can use the PREVIOUS button to return to a page and change these settings if necessary, or hit NEXT to test communication.

Communication Test

This step allows you to test the communication link with the datalogger and ensure that the datalogger has been set up correctly. Click Yes and then NEXT to continue. A screen should open indicating that communication is successful. If it is unsuccessful check to make sure 1) the serial cable and RS232 interface are attached to the serial ports on the computer and datalogger, 2) the datalogger is currently running and has a power source (you may need to check power supply with a volt meter, 3) review the set up to ensure the appropriate set up was used. Once communication is successful, click NEXT.

Datalogger Clock

On this screen, compare the Datalogger Clock to the PC Date/Time. Date and time should match within 2 minutes. If not, click on the Set Datalogger Clock button. [Note: All NPS climate stations run on standard time and should not be adjusted to daylight savings time. If you set the datalogger clock from a PC adjusted to daylight savings time, you will need to set the Time Zone Offset to -1 hours. Hit NEXT.

EZSetup Wizard - CR10XTest (CR10X)

Progress

- Introduction
- Communication Setup
- Datalogger Settings
- Setup Summary
- Communication Test
- Datalogger Clock**
- Send Program
- Data Files
- Scheduled Collection
- Wizard Complete

Datalogger Clock

Datalogger Date/Time
2/1/2007 1:25:00 PM

PC Date/Time
2/1/2007 1:25:01 PM

Check Datalogger Clock

If the Datalogger Date/Time does not match the PC Date/Time you may wish to set the datalogger's clock.

To check the datalogger clock, click the "Check Datalogger Clock" button.

Time Zone Offset
-1 hours

Set Datalogger Clock

The Time Zone Offset will be used in setting the datalogger clock.

To set the datalogger clock, click the "Set Datalogger Clock" button. Otherwise, click Next to continue.

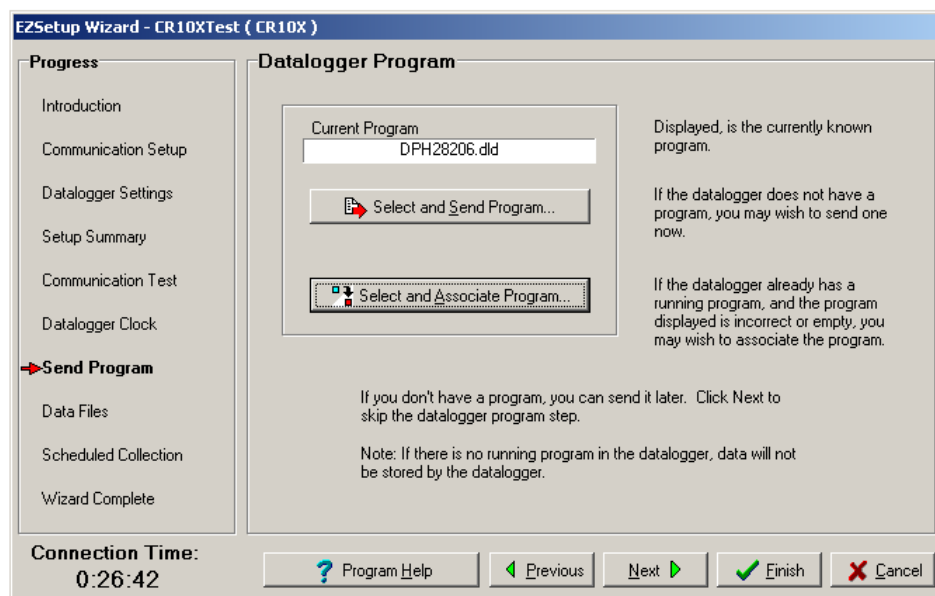
Note: Because there are delays in the communication link, when the clock is set there may be some difference between the datalogger and PC clock.

Connection Time:
0:21:53

Clock Help Previous Next Finish Cancel

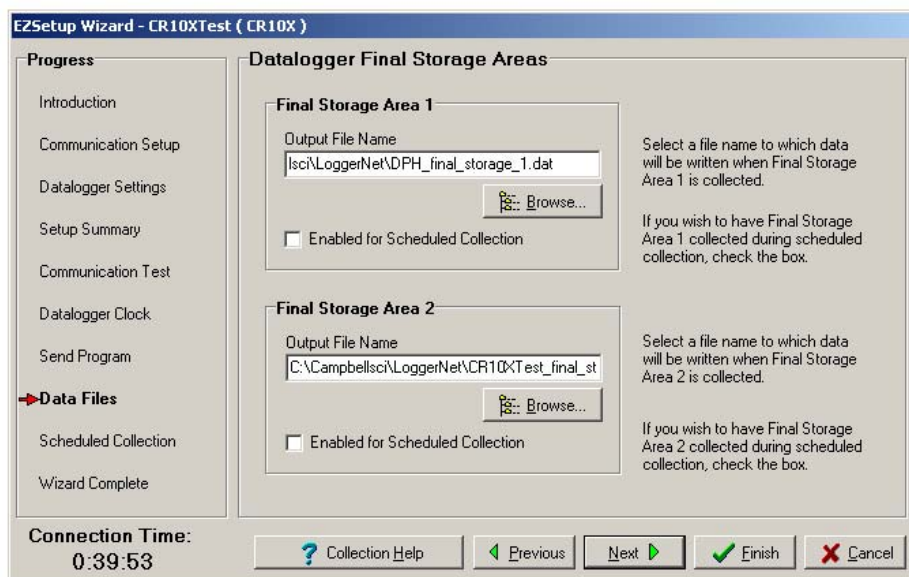
Send Program

The Send Program step allows you to send or associate a program to the datalogger. If the datalogger is already running a program, you should Select and Associate the .DLD file so that LoggerNet will use the labels for input and final storage. If you don't have a program currently on the datalogger you can choose the appropriate program using the Select and Send Program button.



Data Files

This step is used to define what data tables, or final storage areas, should be collected by LoggerNet and saved to disk. A datalogger program may send final output data to either Final Storage Area 1 or both Area 1 and 2. (e.g. a program may compile hourly data in Area 1 and daily summaries in Area 2). Type in the appropriate drive, path and filename or use the Browse button to identify the correct path and directory. Click Scheduled Collection only if your datalogger uses a remote modem connection (see Scheduled Collection).



Scheduled Collection

This is only used for dataloggers using modem connection, and allows you to define a schedule on which LoggerNet will automatically call the datalogger and collect data. Within the NCCN/NWAC Network, data is collected on an hourly basis. If data is usually collected with a direct connection, leave the Enabled for Schedule Collection boxes unchecked. Click the FINISH button. The Wizard Complete page will open.

Wizard Complete

Once a datalogger has been configured, it can be edited directly in the Setup window, or you can edit it using the EZSetup Wizard. When editing in the EZSetup Wizard, click the step on the left side of the Introduction page to go directly to that step, or walk through each wizard page using the Next button.

Appendix D. Datalogger Programming

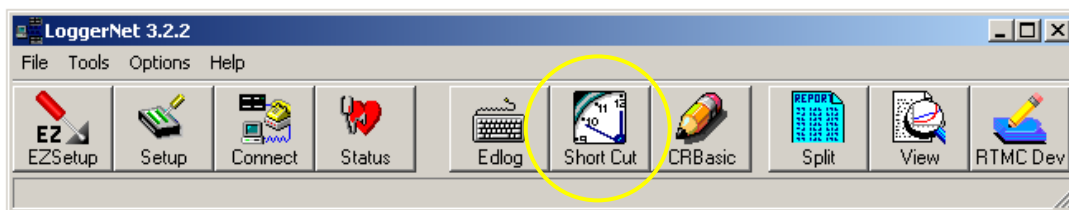
This SOP describes the steps usually taken to creating or edit a datalogger program. Two common programs can be used for programming Campbell Scientific 21x, CR10 and CR10x dataloggers. These are ShortCut and EdLog. ShortCut is a user friendly program which allows the user a menu based method for creating simple datalogger programs. EdLog is the standard method for programming these dataloggers and allows the maximum programming flexibility. EdLog requires an understanding of programming and the programming language. Most meteorological instruments purchased directly from Campbell Scientific will provide examples of programming code in each instrument manual. With limited programming knowledge, these can be used to create a program in EdLog. EdLog can also be used to edit a program or add more complex programming to a program initially created in ShortCut.

Create a New Program Using ShortCut

Open ShortCut by double clicking on the LoggerNet tool bar will appear.



Icon. The following LoggerNet

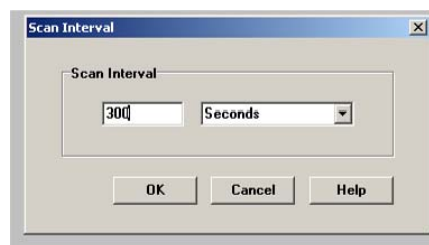


Click on the Short Cut button to open the program.

Step 1: Create a New Program

Click on the New Program button to create a new program.

A window with displaying datalogger icons will open. Use the arrow on the right and scroll to the appropriate datalogger type, and click to choose it.



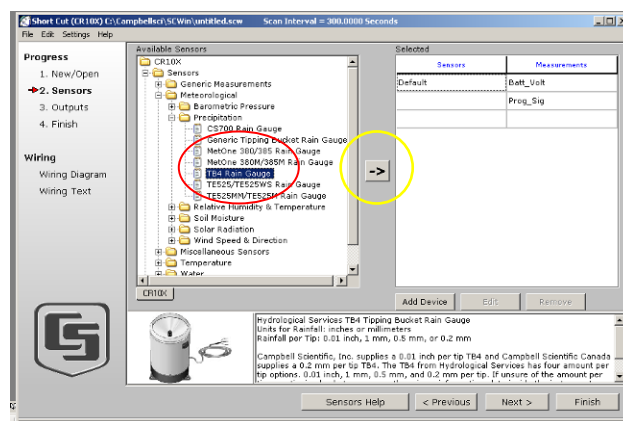
The Scan Interval window will now be displayed. All NCCN park operated climate stations are standardized, taking measurements on a 5 minute interval. Since interval is input in seconds, enter 300 seconds (5 minutes) and press Okay.

Step 2: Sensors

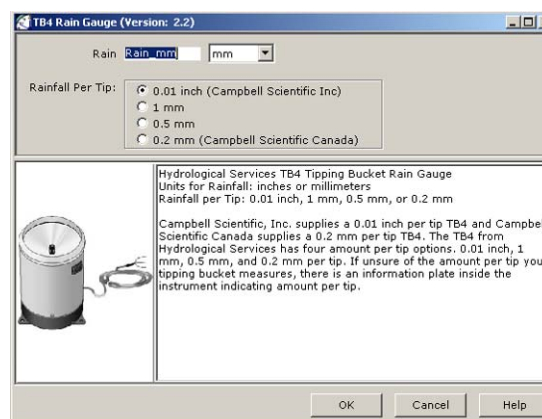
The Sensor window will now be displayed. This step allows the user to choose specific sensors or measurements from a pick list. The order you choose the sensors and measurements can dictate the location of data so care should be taken to choose these in a standardized order (for instance, for consistency one might always start with precipitation, followed air temperature and Rh sensors). Notice in the example below that Battery Voltage and a Program Signature are placed in the measurements as a default.

Appendix D. Datalogger Programming

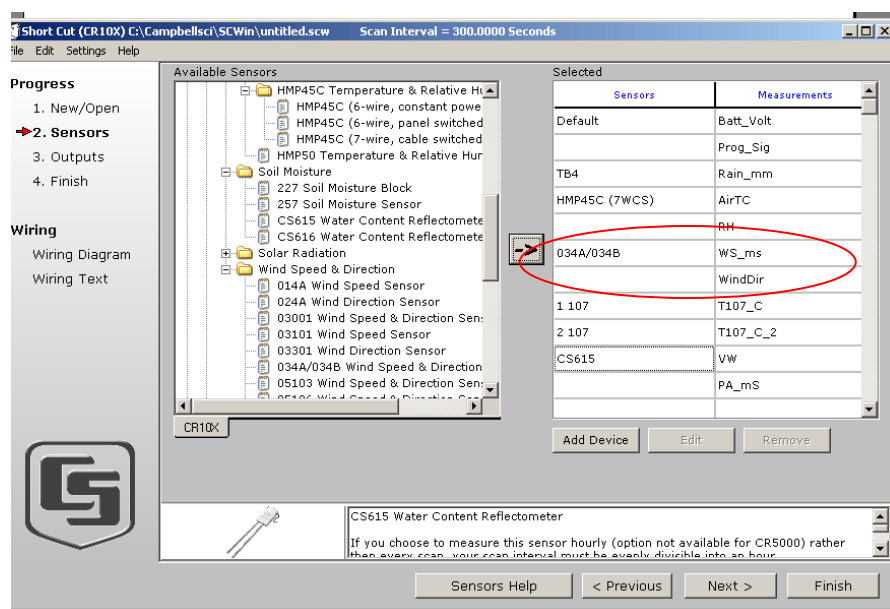
To begin adding sensors, look at the available sensors window on the left. Click to open the Sensors File, then the Meteorological File. A list of standard Campbell Scientific met sensors will be displayed. Highlight the first sensor, for example a TB4 Rain Gauge (see right). A picture of the instrument and a brief description is then displayed in the lower window. This allows the programmer to make sure they have the appropriate instrument. With the instrument highlighted, click on the Arrow Button (circled in yellow) to the right of the menu.



A window will open displaying any parameters requiring input (e.g. The TB 4 tipping bucket has 4 different models, each with a different recorded amount of rainfall per tip. The programmer also has the choice of how to record the rainfall, in millimeters or inches. Choose the appropriate measurements (e.g. 0.01 inch, millimeters) and click the OK button. Repeat this process for each instrument you will add to the datalogger.



As you add each sensor, it will be displayed in the right hand window of the page (see below). Notice that there are two columns. The left column displays the sensor name (e.g. 034A/034B – a wind sensor), and the right column displays the measurements taken recorded by that instrument. (e.g. “WS_ms” – Windspeed in meters per second, “WindDir” – Wind Direction). When you have added all the instruments you will connect to the datalogger, click on the NEXT > button.

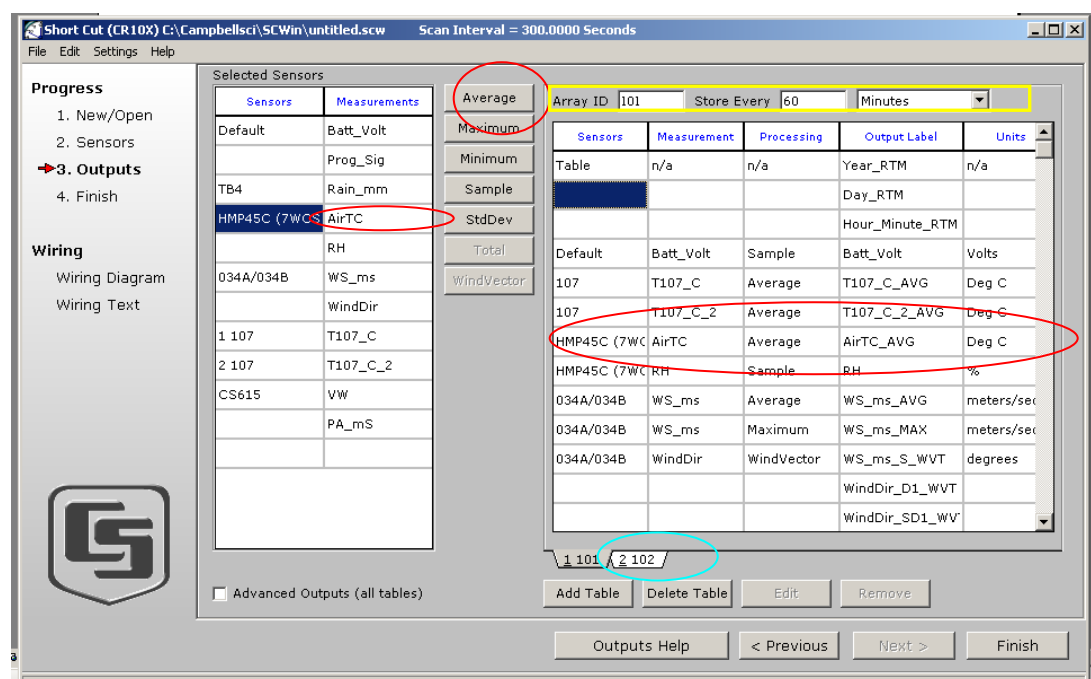


Step 3: Outputs

Step 3 allows you to configure the output of your datalogger. This is an important step and care should be taken to ensure that output order is as consistent as possible in your network of dataloggers.

In the top right corner of the Output page (see yellow box below), you may input an Array ID. The Array ID field is for the identification number that will be used by the datalogger to identify the output array. You can accept the default ID number, or type a new number in the field (1 to 511 are valid options). A unique array ID must be used for each output table. ShortCut© will automatically create two output tables, one for hourly measurements and one for daily measurements.

The “Store Every” field and the adjacent list box are used to set the interval at which data will be stored to memory. The default output intervals are 60 minutes for Table 1 (hourly data) and 1440 minutes for Table 2 (daily data). NCCN park operated climate stations generally use a single output table containing hourly data, however some telemetered sites may require a daily output table for ease of posting daily weather on websites. The output intervals for these tables can be



changed by entering a new value in the Store Every field and using the list box to the right of the field to select the unit.

Next, look at the Selected Sensors Table which is provided on the left side of the Output worksheet. To add a sensor measurement to the active output table, highlight a measurement from the selected sensors table and press one of the output buttons (In the example above, an air temp/RH sensor is highlighted and one can choose average, maximum, minimum, sample or standard deviation). The instrument and the output information will now be displayed in the Output table on the right side of the worksheet.

Appendix D. Datalogger Programming

Once added to the list, an output can be edited or deleted by pressing the Edit or Remove button. Values will be saved to the datalogger's memory in the order they appear in the output table screen. In an effort at standardization, all dataloggers in the climate station network should provide outputs in the same order. Outputs can be reordered by dragging and dropping them into a new position.

Once all desired outputs are entered into the first table, click on the tab to bring up the next table (shown in previous example as “2 102” – circled in blue). If you will not output daily data, then press the Delete Table button to delete this table. If you will output daily data, repeat the process of adding sensor outputs.

Once all desired outputs are entered into the output tables, press the Finish button to complete the program.

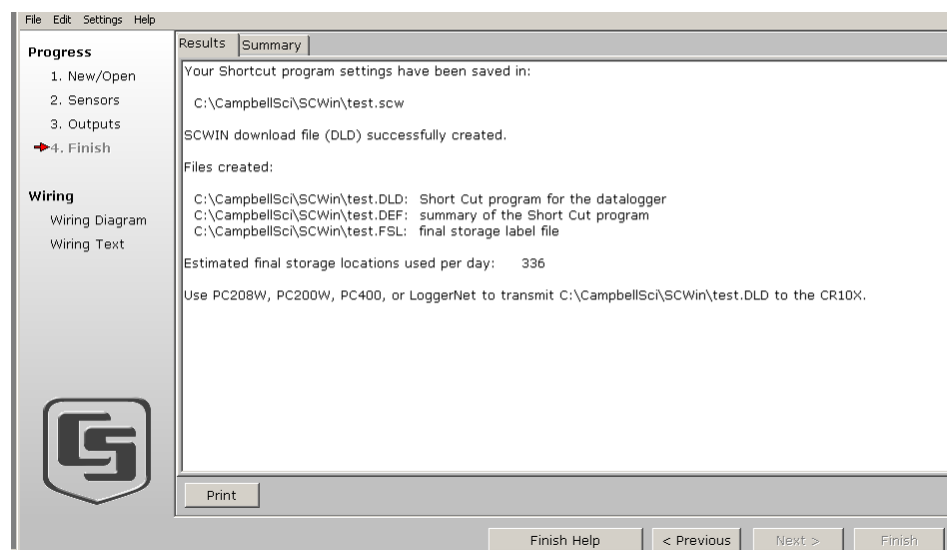
Step 4. Finish Program

A “Save As” window will pop up. Choose the appropriate network file location for the program and name it using the following standardized convention:

- The first 3 letters are the acronym for the specific datalogger (e.g. DPF = **D**eer **P**ark **F**orest datalogger)
- The next 3 digits are the current Julian Day (1 to 365)
- The final 2 digits are the current Year (00 to 99).
- Example: A program made for the Deer Park Forested Site made on January 1st, 2006 would be saved as DPF00106

The file will be saved as a ShortCut for Windows© (SCWIN) file and given the extension .SCW.

After saving the program, a window will appear displaying the result of your programming efforts. There are two tabs to choose from on this display.



Appendix D. Datalogger Programming

The Results Tab provides the location and name of the program, a list of the files created by ShortCut© and the estimated final storage locations used per day by the output of the program. Four files will be created, each with a different extension, including:

- SCW: The Short Cut program which can be accessed for future editing
- DLD: The executable file used by the datalogger
- DEF: A summary of the Short Cut program you created
- FSL: The final storage label file

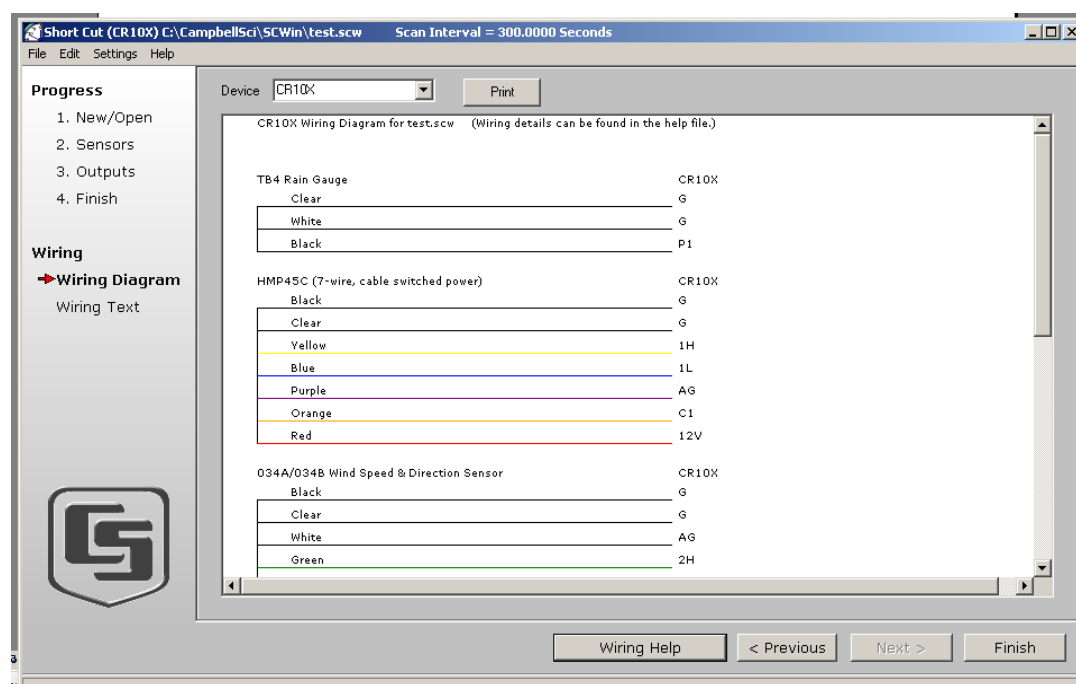
The estimated final storage locations used per day can be used to estimate how many days of data can be collected before the datalogger will begin overwriting existing data. For example, the result tab indicates that the example program will require 336 data locations per day. A standard CR10x datalogger has 62,280 memory locations. A datalogger running this program will therefore run $62,280/336 = 185$ days before overwriting memory. [Note: Most CR10x dataloggers used on NCCN climate stations have extended memory with 124,560 locations.]

The Summary tab will display, in text form, the wiring of the instruments and the labels for the output of the datalogger.

Wiring Diagrams

On the left side of the screen are written Wiring Diagram and Wiring Text. Place the mouse pointer over Wiring Diagram and click. This will bring up a diagram describing the wiring for attaching each instrument to the datalogger (see example below).

On the left is labeled each sensor and the colors of the wires associated with that instrument. On the right is the location on the datalogger wiring panel (in the below example a CR10X) where the wires are attached. Codes corresponding to the wiring panel are described in Table 1 (next page).



Appendix D. Datalogger Programming

Table D1. Wiring Diagram Notation: CR10x Datalogger.

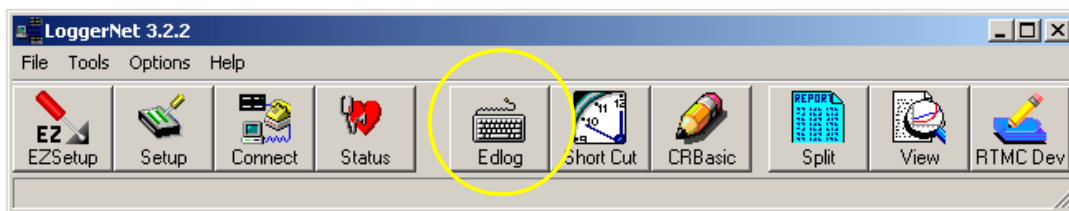
Wiring Code	Explanation
#H,#L	Analog Channels. The analog channels for the CR10X are labeled as DIFF 1 through 6, H (high) and L (low), with a different colored text labeling the channels as SE 1 through 12. This provides connection for 6 differential sensors (DIFF 1 through 6, H and L) or 12 single ended sensors (SE 1 through 12). If a sensor is measured differentially it is important that the correct signal wire be connected to the correct side (H or L) of the differential channel. A wire marked 2H should be connected to the high side of channel 2.
AG	Analog Ground Terminals. The AG, or analog ground, channels provide a reference ground for single-ended measurements. A wire marked AG can be connected to any analog ground terminal .
G	Ground Terminals. The ground terminals, marked G on the wiring panel, are used for sensor power and shield connections where current may be flowing. These terminals are connected directly to earth ground. A wire marked G can be connected to any ground terminal on the datalogger.
E#	Voltage Excitation Channels. An E depicts an excitation channel. The CR10X has three excitation channels which are identified as E1, E2, and E3 on the wiring panel. A wire marked E1 should be connected to the channel marked E1 on the wiring panel.
5V	5V Output. The two 5 volt channels, marked 5V on the wiring panel, are used to power external peripherals. A wire marked 5V can be connected to either of the 5 volt channels on the wiring panel.
C#	Control Ports. A C depicts a control port. The datalogger has eight digital control ports which are used to provide switched 5 volt power to external peripherals. The power is turned on and off under program control. The control ports are identified by the labels C1, C2, C3...C8. A wire marked C2 should be connected to the channel marked C2 on the wiring panel.
P#	Pulse Channels. A P depicts a pulse channel. The CR10X has two pulse channels identified by P1 and P2 on the wiring panel. A wire marked P2 should be connected to the channel marked P2 on the wiring panel.
12V	12V Output. The datalogger has two 12 volt connections which are used to provide 12 volt power from the datalogger to external peripherals. A wire marked 12V can be connected to either channel marked 12V.
SW12	Switched 12V Output. The datalogger has one 12 volt connection which is used to provide switched 12 volt power to external peripherals. A wire marked SW12V should be connected to the channel marked SW12V on the wiring panel. Additionally, a jumper should be connected from the indicated control port to the channel marked SW12V CTRL. The control port is used to turn the 12 volt power on and off.

Once you have printed the wiring panel diagram, Click on the Finish button and close ShortCut.

The program is now complete and could be immediately downloaded to a datalogger to begin operation. ShortCut, however, is a simplified program and some programming options are not available in the ShortCut format. For this reason, another step is usually taken with programs for NCCN park operated climate stations. For final documentation and programming, the .SCW file is imported into EdLog.

Opening a ShortCut program using EdLog

Return to the main LoggerNet tool bar. Click on the EdLog button to open the program.



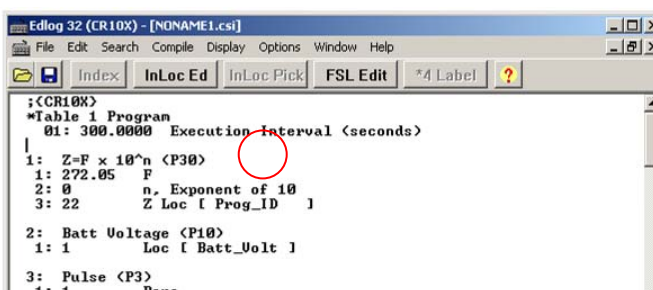
The software will open the last program you were working with in EdLog. To open your ShortCut program, click on the File pull down menu and choose Document DLD. An Import DLD window will open. Browse to the appropriate location, and click on the .DLD file associated with your ShortCut program. The program will now be opened in EdLog, ready to edit.

Edit or Add Instructions using EdLog

NCCN programs require three standard additions to .DLD files created from the ShortCut program.

The first addition is an instruction to insert a program identification code into every program. The nature of a long term project is that, overtime, climate station programs will change. Typical changes may include tipping bucket or radiation sensor calibration multipliers, offsets for snow sensors, upgrading or replacement of a certain sensor type, as well as the removal or addition of certain sensors. Because these can inherently change the output order or values of data, having a program identifier within the raw data is important for data QA/QC.

To insert a Program ID instruction, follow these steps.



1. In Edlog, scroll to the top of the program. Insert the cursor above the first instruction (it will have a 1: in the left most margin).
2. Click on the Edit pulldown menu at the top of the screen. Choose "Insert Instruction". You can also do this by pressing the shift + insert keys on your keyboard. This will open the Insert Instruction menu.

Appendix D. Datalogger Programming

3. Scroll down to Instruction 30 and press the Okay button. This will insert the Z=F instruction into position 1 (all subsequent Instructions will automatically be renumbered). Within the instruction, the F value will be highlighted. Type in a number which corresponds to the version of the program (i.e. Julian Day (001 to 365), followed by a decimal, followed by the Year (00 to 99)). For example, the program in the earlier example DPF00106 would be given an F value of 001.06. Exponent of 10 remains a value of "00" and Type in the name of the Z Location (in brackets) as "Prog_ID". See example below:

```
##### PROGRAM ID #####
;Date when program is modified; format = JulianDay.YY

1: Z=F (P30)
  1: 001.06 F
  2: 00 Exponent of 10
  3: 1 Z Loc [ Prog_ID ]
```

The other required changes will be made to the Output section of the program. Output Instructions are found after the P92, P80 and P77 instructions in a standard program:

```
##### OUTPUT #####
;Hourly output to Final Storage Area 1

51: 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)

52: Set Active Storage Area (P80)
  1: 1 Final Storage Area 1
  2: 101 Array ID

; Record Time
53: Real Time (P77)
  1: 1220 Year,Day,Hour/Minute (midnight = 2400)
```

You will first need to add an Output Instruction for the Program ID.

1. This is achieved by inserting the cursor below the P77 Real Time Instruction and inserting a Resolution or P78 code. This is required to allow decimal place values (the year of the Program ID) to be output into memory.
2. Next, insert a P70 instruction which will sample the value at the time of output.
3. Finally, insert another P78 instruction which will once again make output low resolution for the remainder of the output values. Code should look like the below example:

```
; Enable high resolution to allow decimal value of Program ID
54: Resolution (P78)
  1: 1 High Resolution

; Record Program ID
55: Sample (P70)
  1: 1 Reps
  2: 1 Loc [ Prog_ID ]

; Disable high resolution for the remainder of values
56: Resolution (P78)
```

Appendix D. Datalogger Programming

```
1: 0      Low Resolution
```

Finally, you will need to edit the output value of RH. ShortCut does not allow you to program the output as an hourly average, but rather, it forces you to sample the hourly value. This can be changed in Edlog by finding the RH output instruction inserted by ShortCut. It should look like this...

```
59: Sample (P70)
   1: 1      Reps
   2: 5      Loc [ RH      ]
```

1. Click the cursor above this code and insert a P71 Instruction to average an output value. Reps should remain as 1.
2. Click within the brackets next to Loc []. The space within the brackets should highlight.
3. Click on the InLoc Pick button at the top of the screen. This will open up the input locations the program has created.
4. Highlight RH and hit OKAY. It should insert it between the brackets and show the corresponding location.

```
59: Average (P71)
   1: 1      Reps
   2: 5      Loc [ RH ]
```

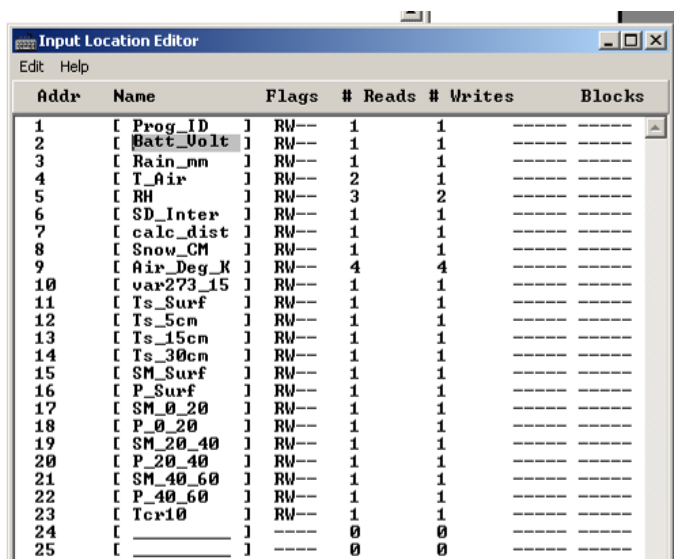
5. Now highlight the previous P70 Instruction below (for RH). Pull down the edit menu and choose Delete Instruction. This should delete the sample instruction for RH and leave you with the Average Instruction for RH.

This technique can be used to make any other changes or edits to your program.

Edit Input Location Names using EdLog

Management of a network of dataloggers is greatly simplified if all programs use common terminology for input and output locations. You may need to change the names of Input Locations to ensure standardized names for all programs, especially if some dataloggers and their associated programs are from earlier projects and naming conventions between sites did not previously exist. You may also want to do this to have more appropriate names to help you identify what a particular measurement is. For example if you have 4 soil temperature sensors, each at a different depth, it is helpful to name them Ts_Surf, Ts_5cm, Ts_15cm, Ts_30cm rather than Ts_1, Ts_2, Ts_3 and Ts_4 which would be the automatically generated names in ShortCut.

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Addr	Name	Flags	# Reads	# Writes	Blocks
1	[Prog_ID]	RW--	1	1	-----
2	[Batt_Volt]	RW--	1	1	-----
3	[Rain_mm]	RW--	1	1	-----
4	[T_Air]	RW--	2	1	-----
5	[RH]	RW--	3	2	-----
6	[SD_Inter]	RW--	1	1	-----
7	[calc_dist]	RW--	1	1	-----
8	[Snow_CM]	RW--	1	1	-----
9	[Air_Deg_K]	RW--	4	4	-----
10	[var273_15]	RW--	1	1	-----
11	[Ts_Surf]	RW--	1	1	-----
12	[Ts_5cm]	RW--	1	1	-----
13	[Ts_15cm]	RW--	1	1	-----
14	[Ts_30cm]	RW--	1	1	-----
15	[SM_Surf]	RW--	1	1	-----
16	[P_Surf]	RW--	1	1	-----
17	[SM_0_20]	RW--	1	1	-----
18	[P_0_20]	RW--	1	1	-----
19	[SM_20_40]	RW--	1	1	-----
20	[P_20_40]	RW--	1	1	-----
21	[SM_40_60]	RW--	1	1	-----
22	[P_40_60]	RW--	1	1	-----
23	[Tcr10]	RW--	1	1	-----
24	[]	----	0	0	-----
25	[]	----	0	0	-----

To do this, press the InLoc Ed button on the top of the EdLog screen. This will open the Input Location Editor window which displays all of the Input Locations. By clicking on a Location Name, it will be become gray and allow you to edit that name. When you close the Input Location Editor window, it will automatically update the program with the new names.

Adding Comments in EdLog

Standard procedure for programs in the NCCN is to carefully document the .DLD file by inserting notes into the program. Program documentation notes should describe the history of program changes, the function of lines of code and quickly identify sections of code that may require periodic updating (for instance multipliers). This allows the user to quickly browse a program in EdLog (even in the field) and understand the function of each line of code. If you are unsure of the purpose of certain lines of code, refer to the Datalogger Operator's Manual and manuals for the specific sensors. These have examples of code and provide descriptions of the purpose of each instruction.

In EdLog, all notes are “commented out” to ensure they do not interrupt the operation of a datalogger with non-executable code. To do this, proceed any notes with a semi-colon.

Following are some examples of important notes inserted into .DLD code.

Example 1: The beginning of each program describes the name, location and history of program changes within the program itself. This can be updated in the field when program changes are made.

```
;{CR10X}  
;Olympic Upper Elwha Site {Describes Name of Climate Site}  
  
{The following comments describe history of program changes}  
;ELW21704 Adapted from ELW23103 on 8/18/04 by B. Baccus  
; Added Wind Vector, Max Wind Speed and Min Snow Depth output  
;ELW23103 Adapted from ELW29802 on 8/18/03 by R. Hoffman  
; changed PAR multiplier  
;ELW29802 Created on 10/25/02 by B Baccus
```

Appendix D. Datalogger Programming

*Table 1 Program

01: 300.0000 Execution Interval (seconds)

Example 2: In the first portion of the program where input instructions occur, headers with pound signs are placed in the code to easily find and identify the purpose of each section of code for quick editing.

```
;##### BATTERY VOLTAGE ##### {Identifies purpose of code}
;Units: volts {Identifies units of measurement}

2: Batt Voltage (P10)
1: 2    Loc [ Batt_Volt ]

;##### PRECIPITATION ##### {Identifies purpose of code}
;Tipping bucket raingage {Identifies units of measurement}
;Units: 1 tip = approx. 0.24mm (depending on calibration factor)

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

Example 3: Comments are placed within the code to better describe the purpose of specific lines. This is especially useful with instruments that require processing code, such as a snow depth sensor which calculates distance, uses temperature compensation to adjust distance and requires an offset to calculate change in distance due to snow accumulation.

```
;##### SNOW DEPTH #####
;Units: centimeters
;Height of snow sensor 200 cm

; Takes measurement from Sensor to ground
{Identifies purpose of code}

14: SDI-12 Recorder (P105)
1: 0    SDI-12 Address
2: 0    Start Measurement (aM0!)
3: 8    Port
4: 6    Loc [ SD_Inter ]
5: 100.0 Mult
6: 0    Offset

; Converts Air Temperature to Degrees Kelvin for temperature
; compensation equation {Identifies purpose of code}

15: Z=X+F (P34)
1: 4    X Loc [ T_Air ]
2: 273.15 F
3: 9    Z Loc [ Air_Deg_K ]

; The next 4 instructions apply temp compensation to distance
16: Z=F (P30)
1: 273.15 F
2: 0    Exponent of 10
3: 10   Z Loc [ var273_15 ]
```

Appendix D. Datalogger Programming

```
17: Z=X/Y (P38)
1: 9    X Loc [ Air_Deg_K ]
2: 10   Y Loc [ var273_15 ]
3: 9    Z Loc [ Air_Deg_K ]

18: Z=SQRT(X) (P39)
1: 9    X Loc [ Air_Deg_K ]
2: 9    Z Loc [ Air_Deg_K ]

19: Z=X*Y (P36)
1: 6    X Loc [ SD_Inter ]
2: 9    Y Loc [ Air_Deg_K ]
3: 7    Z Loc [ calc_dist ]

; Makes calculated distance negative for subtraction from total height.
20: Z=X*F (P37)
1: 7    X Loc [ calc_dist ]
2: -1    F
3: 9    Z Loc [ calc_dist ]

; F is height of instrument in centimeters
; F can be adjusted for field calibration {Identifies purpose of code and where
to adjust offset}
21: Z=X+F (P34)
1: 9    X Loc [ Air_Deg_K ]
2: 200    F
3: 8    Z Loc [ Snow_CM ]
```

Appendix E: Example of a Datalogger Program

Following is a typical example of a datalogger program used on an NCCN NPS Operated Climate Station. Bracketed items in red text are only part of this document for the purposes of explaining the comments or code lines in the program. Lines proceeded by semi-colons are standard examples of comments which help the programmer or field technician reference and understand the purpose of specific lines of code (see Appendix D: Datalogger Programming).

```
;{CR10X}
```

{This is not a comment but is created by EdLog when datalogger type is specified – it is required and can effect datalogger if it is incorrect – for instance if a CR10 program is changed for to a CR10X but this is not changed at beginning of program}

```
;Program: ELW27705.CSI           {Note name of program}  
;ELW27705 created from: ELW23905 by BBaccus {Describe history of  
changes}  
;ELW27705 created from: DPH28402 by RHoffman
```

```
;Olympic Upper Elwha Site       {Describe Location of datalogger}
```

```
*Table 1 Program                {Establish sampling interval every 5  
minutes}
```

```
01: 300.0000 Execution Interval (seconds)
```

```
;##### PROGRAM ID #####  
;Date when program is modified; format = JulianDay.YY  
;Update value of F when program is changed
```

```
1: Z=F (P30)  
1: 273.05 F  
2: 00 Exponent of 10  
3: 1 Z Loc [ Prog_ID ]
```

```
;##### BATTERY VOLTAGE #####  
;Units: volts
```

```
2: Batt Voltage (P10)           {Record Battery Voltage}  
1: 2 Loc [ Batt_Volt ]
```

```
;##### PRECIPITATION #####  
;Tipping bucket raingage  
;Units: 1 tip = approx. 0.24mm (depending on calibration factor)
```

```

3: Pulse (P3) {Counts Tipping Bucket Tips}
1: 1      Reps
2: 1      Pulse Channel 1
3: 2      Switch Closure, All Counts
4: 3      Loc [ Rain_mm ]
5: 0.254  Mult
6: 0      Offset

;##### AIR TEMP(C) & RH(%) #####
;Units: degrees Celsius {Notes that temp is in degress C}

;Turn on AirTemp/RH Sensor
4: Do (P86) {
1: 41      Set Port 1 High

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

;Take AirTemp measurement
6: Volt (SE) (P1)
1: 1      Reps
2: 25     2500 mV 60 Hz Rejection Range
3: 2      SE Channel
4: 4      Loc [ T_Air ]
5: 0.1     Mult
6: -40.0  Offset
;Take RH Measurement
7: Volt (SE) (P1)
1: 1      Reps
2: 25     2500 mV 60 Hz Rejection Range
3: 1      SE Channel
4: 5      Loc [ RH ]
5: 0.1     Mult
6: 0      Offset

;Turn off sensor
8: Do (P86)
1: 51     Set Port 1 Low

; if an RH reading is between 100 and 108, a common range at
100% humidity
; change the value to 100
9: If (X<=>F) (P89)
1: 5      X Loc [ RH ]

```

```

2: 3    >=
3: 100   F
4: 30    Then Do

10: If (X<=>F) (P89)
1: 5     X Loc [ RH      ]
2: 4     <
3: 108   F
4: 30    Then Do

11: Z=F (P30)
1: 100   F
2: 0     Exponent of 10
3: 5     Z Loc [ RH      ]

12: End (P95)

13: End (P95)

;##### SNOW DEPTH #####
;Units: centimeters
;Height of snow sensor 200 cm

; Measures the distance to the ground
14: SDI-12 Recorder (P105)
1: 0     SDI-12 Address
2: 0     Start Measurement (aM0!)
3: 8     Port
4: 6     Loc [ SD_Inter ]
5: 100.0 Mult
6: 0     Offset

; Converts Air temp from celcius to degrees Kelvin
15: Z=X+F (P34)
1: 4     X Loc [ T_Air   ]
2: 273.15 F
3: 9     Z Loc [ Air_Deg_K ]

; Next four instructions apply temp compensation to distance
16: Z=F (P30)
1: 273.15 F
2: 0     Exponent of 10
3: 10    Z Loc [ var273_15 ]

17: Z=X/Y (P38)
1: 9     X Loc [ Air_Deg_K ]
2: 10    Y Loc [ var273_15 ]

```

```

3: 9      Z Loc [ Air_Deg_K ]

18: Z=SQRT(X) (P39)
1: 9      X Loc [ Air_Deg_K ]
2: 9      Z Loc [ Air_Deg_K ]

19: Z=X*Y (P36)
1: 6      X Loc [ SD_Inter ]
2: 9      Y Loc [ Air_Deg_K ]
3: 7      Z Loc [ calc_dist ]

; Converts distance to ground into a negative value to subtract
from total ht.
20: Z=X*F (P37)
1: 7      X Loc [calc_dist]
2: -1      F
3: 9      Z Loc [calc_dist]

; Subtracts measured distance from total distance to give Snow
Depth value
21: Z=X+F (P34)
1: 9      X Loc [calc_dist]
2: 200      F
3: 8      Z Loc [ Snow_CM ]

;##### SOIL TEMPERATURE #####
;Units: degrees Celsius      {Notes that temp is in degress C}
;surface      {Describes location of instrument}

22: Temp (107) (P11)
1: 1      Reps
2: 3      SE Channel
3: 1      Excite all reps w/E1
4: 11      Loc [ Ts_Surf ]
5: 1.0      Mult
6: 0.0      Offset

;##### SOIL TEMPERATURE #####
;Units: degrees Celsius
;5cm depth

23: Temp (107) (P11)
1: 1      Reps
2: 4      SE Channel
3: 1      Excite all reps w/E1
4: 12      Loc [ Ts_5cm ]
5: 1.0      Mult

```

```

6: 0.0    Offset

;##### SOIL TEMPERATURE #####
;Units: degrees Celsius
;15cm depth

24: Temp (107) (P11)
1: 1      Reps
2: 5      SE Channel
3: 1      Excite all reps w/E1
4: 13     Loc [ Ts_15cm ]
5: 1.0    Mult
6: 0.0    Offset

;##### SOIL TEMPERATURE #####
;Units: degrees Celsius
;30cm depth

25: Temp (107) (P11)
1: 1      Reps
2: 6      SE Channel
3: 1      Excite all reps w/E1
4: 14     Loc [ Ts_30cm ]
5: 1.0    Mult
6: 0.0    Offset

;#### SOIL MOISTURE Surface ####

; Once an hour, turn on and read soil moisture, to save power
usage
26: If time is (P92)
1: 0      Minutes (Seconds --) into a
2: 60     Interval (same units as above)
3: 30     Then Do

; Turns on soil reflectometer
27: Do (P86)
1: 42     Set Port 2 High

; The next two instruction read the reflectometer
28: Period Average (SE) (P27)
1: 1      Reps
2: 4      200 kHz Max Freq @ 2 V Peak to Peak, Period Output
3: 7      SE Channel
4: 100    No. of Cycles
5: 1      Timeout (units = 0.01 seconds)
6: 16     Loc [ P_Surf ]

```

```

7: 1.0    Mult
8: 0.0    Offset

29: Polynomial (P55)
1: 1      Repts
2: 16     X Loc [ P_Surf ]
3: 15     F(X) Loc [ SM_Surf ]
4: -0.0663 C0
5: -0.0063 C1
6: 0.0007 C2
7: 0      C3
8: 0      C4
9: 0      C5

; Turn off reflectometer
30: Do (P86)
1: 52     Set Port 2 Low

; End time is loop
31: End (P95)

;#### SOIL MOISTURE 0-20 cm depth ####

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

33: Do (P86)
1: 43     Set Port 3 High

34: Period Average (SE) (P27)
1: 1      Repts
2: 4      200 kHz Max Freq @ 2 V Peak to Peak, Period Output
3: 8      SE Channel
4: 100    No. of Cycles
5: 1      Timeout (units = 0.01 seconds)
6: 18     Loc [ P_0_20 ]
7: 1.0    Mult
8: 0.0    Offset

35: Polynomial (P55)
1: 1      Repts
2: 18     X Loc [ P_0_20 ]
3: 17     F(X) Loc [ SM_0_20 ]
4: -0.0663 C0
5: -0.0063 C1

```

```

6: 0.0007 C2
7: 0 C3
8: 0 C4
9: 0 C5

36: Do (P86)
1: 53 Set Port 3 Low

37: End (P95)

;#### SOIL MOISTURE 20-40 cm depth ####

38: If time is (P92)
1: 0 Minutes (Seconds --) into a
2: 60 Interval (same units as above)
3: 30 Then Do
39: Do (P86)
1: 44 Set Port 4 High

40: Period Average (SE) (P27)
1: 1 Reps
2: 4 200 kHz Max Freq @ 2 V Peak to Peak, Period Output
3: 9 SE Channel
4: 100 No. of Cycles
5: 1 Timeout (units = 0.01 seconds)
6: 20 Loc [ P_20_40 ]
7: 1.0 Mult
8: 0.0 Offset

41: Polynomial (P55)
1: 1 Reps
2: 20 X Loc [ P_20_40 ]
3: 19 F(X) Loc [ SM_20_40 ]
4: -0.0663 C0
5: -0.0063 C1
6: 0.0007 C2
7: 0 C3
8: 0 C4
9: 0 C5

42: Do (P86)
1: 54 Set Port 4 Low

43: End (P95)

;##### SOIL MOISTURE #####
; 40-60 cm depth

```

```

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

45: Do (P86)
  1: 45    Set Port 5 High

46: Period Average (SE) (P27)
  1: 1     Reps
  2: 4     200 kHz Max Freq @ 2 V Peak to Peak, Period Output
  3: 10    SE Channel
  4: 100   No. of Cycles
  5: 1     Timeout (units = 0.01 seconds)
  6: 22    Loc [ P_40_60 ]
  7: 1.0   Mult
  8: 0.0   Offset

47: Polynomial (P55)
  1: 1     Reps
  2: 22    X Loc [ P_40_60 ]
  3: 21    F(X) Loc [ SM_40_60 ]
  4: -0.0663 C0
  5: -0.0063 C1
  6: 0.0007 C2
  7: 0     C3
  8: 0     C4
  9: 0     C5

48: Do (P86)
  1: 55    Set Port 5 Low

49: End (P95)

;##### INTERNAL TEMPERATURE #####
;Temperature in CR10x enclosure (C)

50: Internal Temperature (P17)
  1: 23    Loc [ Tcr10 ]

;##### OUTPUT #####
;Next instructions provide hourly output to Final Storage Area 1

; Every hour send data to final storage
51: 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)

; Indicates which storage area to use, default is Storage Area 1
52: Set Active Storage Area (P80)
  1: 1    Final Storage Area 1
  2: 101  Array ID
; Record Time

; Record year, day and hour (in minutes, where midnight is 2400)
53: Real Time (P77)
  1: 1220  Year,Day,Hour/Minute (midnight = 2400)

; Enable high resolution to allow decimal value (Year) of
Program ID
54: Resolution (P78)
  1: 1    High Resolution

; Record Program ID
55: Sample (P70)
  1: 1    Reps
  2: 1    Loc [ Prog_ID ]

; Disable high resolution for the remainder of values to save
memory
56: Resolution (P78)
  1: 0    Low Resolution

; Record Battery Voltage
57: Minimum (P74)
  1: 1    Reps
  2: 0    Value Only
  3: 2    Loc [ Batt_Volt ]

; Record hourly average air temperature
58: Average (P71)
  1: 1    Reps
  2: 4    Loc [ T_Air ]

; Record hourly average relative humidity
59: Average (P71)
  1: 1    Reps
  2: 5    Loc [ RH ]

; Sum value of all tipping bucket tips last hour
60: Totalize (P72)
  1: 1    Reps

```

```

2: 3      Loc [ Rain_mm  ]

; Record hourly minimum value of snow depth
61: Minimum (P74)
1: 1      Reps
2: 0      Value Only
3: 8      Loc [ Snow_CM  ]

; Record hourly average soil temp at surface
62: Average (P71)
1: 1      Reps
2: 11     Loc [ Ts_Surf  ]

; Record hourly average soil temp at 5cm
63: Average (P71)
1: 1      Reps
2: 12     Loc [ Ts_5cm  ]

; Record hourly average soil temp at 15cm
64: Average (P71)
1: 1      Reps
2: 13     Loc [ Ts_15cm ]

; Record hourly average soil temp at 30cm
65: Average (P71)
1: 1      Reps
2: 14     Loc [ Ts_30cm ]

; Record hourly average soil moisture at surface
66: Average (P71)
1: 1      Reps
2: 15     Loc [ SM_Surf  ]

; Record hourly average soil moisture at 0-20cm
67: Average (P71)
1: 1      Reps
2: 17     Loc [ SM_0_20  ]

; Record hourly average soil moisture at 20-40cm
68: Average (P71)
1: 1      Reps
2: 19     Loc [ SM_20_40 ]

; Record hourly average soil moisture at 40-60cm
69: Average (P71)

```

```

1: 1      Repts
2: 21     Loc [ SM_40_60 ]

```

; Record hourly average temperature of datalogger

```
70: Average (P71)
```

```

1: 1      Repts
2: 23     Loc [ Tcr10   ]

```

*Table 2 Program

```
01: 0.0    Execution Interval (seconds)
```

*Table 3 Subroutines

End Program

{At the end of the program, a table is displayed which shows Input Locations. The two columns to the right of the RW- indicate the number of times a location is read or written to. For instance, Prog_ID is placed in memory once and read once. RH is read three times, once to storage, once to see if it is greater than 100, once to see if it is less than 108. It is written twice, once with the original value, once with an adjusted value if the number is greater than 100 and less than 108.}

```

1  [ Prog_ID  ] RW--  1    1  -----
2  [ Batt_Volt ] RW--  1    1  -----
3  [ Rain_mm   ] RW--  1    1  -----
4  [ T_Air    ] RW--  2    1  -----
5  [ RH       ] RW--  3    2  -----
6  [ SD_Inter ] RW--  1    1  -----
7  [ calc_dist ] RW--  1    1  -----
8  [ Snow_CM  ] RW--  1    1  -----
9  [ Air_Deg_K ] RW--  4    4  -----
10 [ var273_15 ] RW--  1    1  -----
11 [ Ts_Surf  ] RW--  1    1  -----
12 [ Ts_5cm   ] RW--  1    1  -----
13 [ Ts_15cm  ] RW--  1    1  -----
14 [ Ts_30cm  ] RW--  1    1  -----
15 [ SM_Surf  ] RW--  1    1  -----
16 [ P_Surf   ] RW--  1    1  -----
17 [ SM_0_20  ] RW--  1    1  -----
18 [ P_0_20   ] RW--  1    1  -----
19 [ SM_20_40 ] RW--  1    1  -----
20 [ P_20_40  ] RW--  1    1  -----

```

21	[SM_40_60]	RW--	1	1	-----	-----	---
22	[P_40_60]	RW--	1	1	-----	-----	---
23	[Tcr10]	RW--	1	1	-----	-----	---
24	[_____]	----	0	0	-----	-----	---
25	[_____]	----	0	0	-----	-----	---
26	[_____]	----	0	0	-----	-----	---
27	[_____]	----	0	0	-----	-----	---
28	[_____]	----	0	0	-----	-----	---

Appendix F. NPS-Operated Climate Stations, Maintenance Log: Example

Today's Date = 7/9/2009

Site Name	Code	Date of Last Visit	Date of Next Visit	Days until Next Visit	Battery Start Date	Battery End Date	Last TB Calibration Date	Last HMP Sensor Swap	HMP Swap Due	Last Windset Swap	Windset Swap Due	Last PAR Sensor Swap	PAR Swap Due	Snow Sensor Dessicant
Deer Park Open	DPO	12/19/2006	3/19/2007	-843	solar	solar	5/17/2006	8/19/2006	8/19/2007	8/16/2006	8/16/2007	8/22/2005	8/22/2007	10/11/2001
Deer Park High	DPH	1/29/2007	4/29/2007	-802	solar	solar	10/12/2006	10/12/2006	10/12/2007	N/A		N/A		
Hayes Ranger Station	ELW	10/4/2006	2/1/2007	-889	solar	solar	10/4/2006	10/6/2006	10/6/2007	N/A		N/A		10/4/2006
Hoh Forest	HOF	10/13/2006	1/11/2007	-910	3/22/2005	11/17/2005	6/16/2006	8/21/2006	8/21/2007	Removed		Removed		N/A
Hoh Open	HOO	10/13/2006	1/11/2007	-910	11/30/2004	7/28/2005	8/18/2005	8/21/2006	8/21/2007	9/18/2006	9/18/2007	8/18/2005	8/18/2007	N/A
Lake Crescent Lab	LCL	1/26/2007	4/26/2007	-805				7/1/2003	6/30/2004					
Ozette	OZ	1/25/2007	4/25/2007	-806	10/31/2003		6/20/2005	10/1/2004		6/20/2005	6/20/2006			
Quinault Forest	QUF	11/18/2006	2/16/2007	-874	solar	solar	5/8/2006	8/9/2006	8/9/2007	Removed	Removed			N/A
Quinault Open N.F.Skokomish	QUO SKO	11/18/2006	2/16/2007	-874	solar	solar	5/8/2006	8/9/2006	8/9/2007	11/18/2006	11/18/2007	11/12/2003	11/11/2005	N/A
Waterhole Forest	WHF	9/25/2006	12/24/2006	-928	9/21/2005		6/23/2005	9/25/2006	9/25/2007	Removed	Removed	Removed		
Waterhole Open	WHO	9/25/2006	12/24/2006	-928	12/19/2004		9/8/2006	9/8/2006	9/8/2007	9/8/2006	9/8/2007	9/8/2006	9/7/2008	

Days until Next Visit will indicate red 90 days after Date of Last Visit.

Battery End Date is calculated as Battery Installed plus 240 days.

Last TB (Tipping Bucket) Calibration date will indicate red when more than 360 days have past since TB calibration date.

HMP (Air/RH sensor) Swap Due is calculated as date of last HMP sensor swap plus 360 days. Date will indicate red when more than 360 days have past.

Windset Swap Due is calculated as date of last Windset swap plus 360 days. Date will indicate red when more than 360 days have past.

PAR Swap Due is calculated as date of last PAR sensor swap plus 720 days. Date will indicate red when more than 720 days have past.

Appendix G. North Coast and Cascades Network Climate Station Site Visit Form

SITE OBSERVATIONS

TOPIC	DESCRIPTION
Site Name	DPO
Date of Site Visit?	
Time of Visit?	
Data File Name?	Start Record: End Record:
Datalogger Time Changed (Y/N)?	Datalogger Time = PC Time (Set to NIST on) =
Observers Name?	
Battery Swapped?	
Program Name on Arrival/Departure	Arrival: Departure:
Change(s) to Program	1) 2) 3)
Overall Site Condition?	
Wind speed sensor?	
Dessicant changed??	
Rain Gage cleaned?	
Empty Ethanol Glycol mixture	
Telemetry equipment?	
Access to the Site?	
Photo Documentation?	
Current Weather Conditions?	

Appendix G. North Coast and Cascades Network Climate Station Site Visit Form (continued).

DATA FIELD EXAMPLE

DEFINITION	UNITS	MONITORED DATA	EXCEPTABLE SENSOR RANGES	COMMENTS
Program ID	None		Julian Day.YY	
CR10 Battery Voltage	Volts		10.5 to 13.0v	
Tsoil Litter Surface	°C		-33°C to +48°C	
Tsoil 5 cm	°C		-33°C to +48°C	
Tsoil 15 cm	°C		-33°C to +48°C	
Tsoil 30 cm	°C		-33°C to +48°C	
Tair	°C		-20°C to +60°C	
Relative Humidity	%		0% to 100%	
PAR Up	μmol m-2 s-1		-5 to 2500	
Totalized Rain Fall	mm hr-1		0.01" @ 1 tip to 2"/hr	
Wind Speed	m s-1		0.447 m/s to 53 m/s	
Soil Moisture, Surface	v/v		0.0 to 1.0	
Soil Moisture, 0-20 cm	v/v		0.0 to 1.0	
Soil Moisture, 20-40 cm	v/v		0.0 to 1.0	
Soil Moisture, 40-60 cm	v/v		0.0 to 1.0	
Wind Direction	° True North		0-360°	
Snow Depth	Cm		0-250cm	
CR10 Panel Temp	°C		-25 ° C to 50 ° C	

CALIBRATIONS, VERIFICATIONS, SENSOR SWAPPING

SENSOR	IN OR OUT	PRODUCT/ MODEL #	SERIAL NUMBER	COMMENTS

Additional Comments:

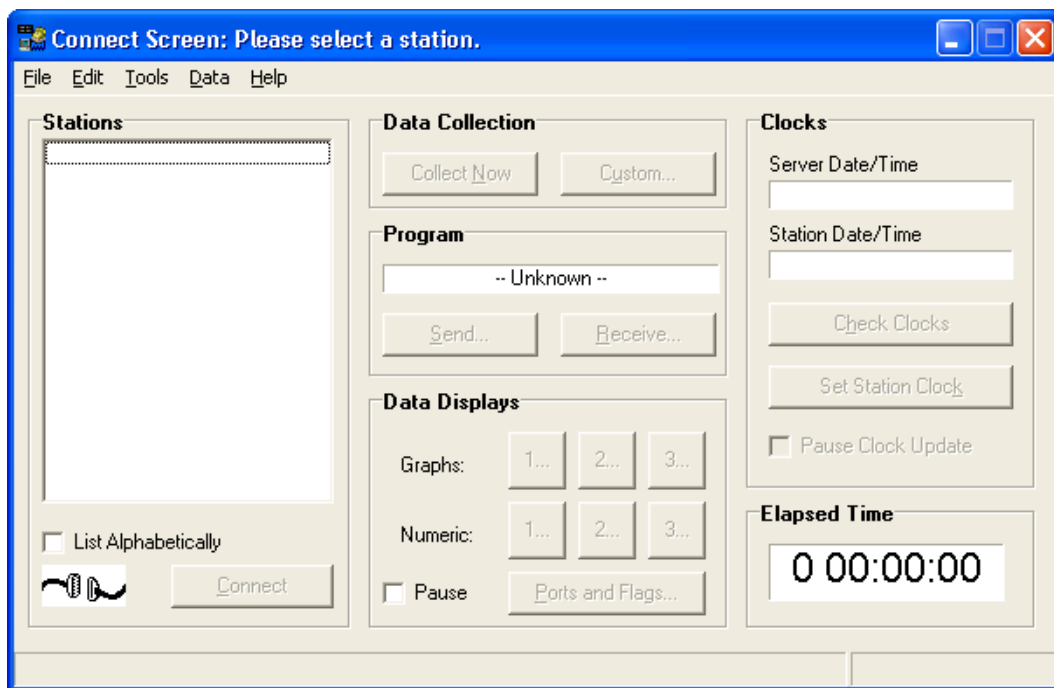
Appendix H. Climate Station Field Data Collection: Laptop

Downloading weather data from a CR10X datalogger in the field is accomplished with either a laptop or a Palm PDA. To collect data in the field via a laptop, Campbell Scientific, Inc. LoggerNet software is required. The following is a summary of the steps followed to download climate data in the field with a laptop.

LoggerNet Software must be installed on the laptop used in the field to download data. Detailed descriptions can be found in the Campbell Scientific, Inc. **Instruction Manual for LoggerNet, Version 3.3**, available with the purchase of LoggerNet or available online at <ftp://ftp.campbellsci.com/pub/outgoing/manuals/loggernet3-3.pdf>

Collecting Data in the Field

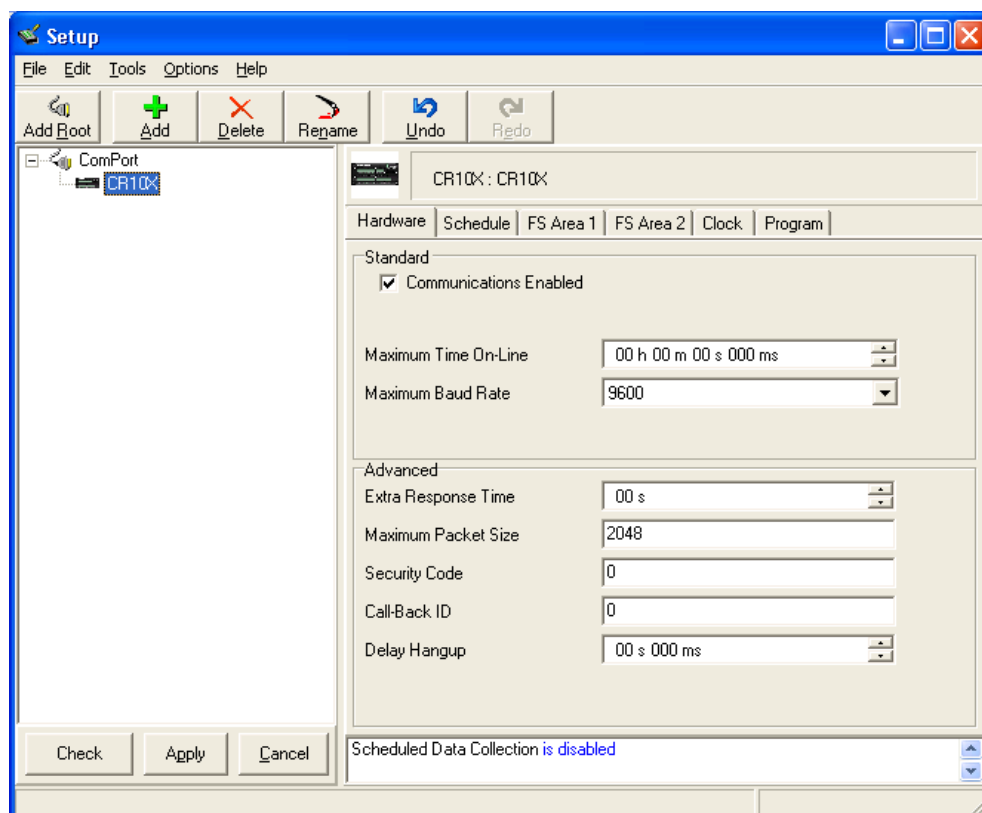
1. Connect the datalogger to the laptop using the 9-pin CSI serial cable for battery powered laptops.
2. Open LoggerNet and click **Connect** on the LoggerNet toolbar. The station name should appear in the box on the left. If it doesn't go back to **Setup** and add the station (see step 6). Click on the station and then click **Connect** at the bottom of the screen.



3. After you hit the connect tab, the icon at the lower left should show that you are connected and the elapsed time indicator will start.
4. Click on **Collect Now** under **Data Collection**. The data manually from the datalogger will be collected and stored in a file named *stationname.dat* in the LoggerNet file under the Campbell Scientific default directory folder: C:\Campbellsci\LoggerNet.
5. Once you have started data collection with **Collect Now**, you can stop it by clicking the **Cancel** button on the animated screen.

Appendix H. Climate Station Field Data Collection: Laptop

6. If the station does not appear in the station list, you may need to add the station. In LoggerNet hit the **Setup** button and add the name of the station you are visiting under ComPort.. The default will say CR10X. Click the **Rename** button up top and then **Apply**. It is important to name the station at this point. After this step is completed, proceed to Step 2.



Appendix I. Climate Station Field Data Collection: PDA

Downloading weather data from a CR10X datalogger in the field is accomplished with either a laptop or a Palm PDA. To collect data in the field with a PDA, Campbell Scientific, PC Connect software is required. The following is a summary of the steps followed to download data in the field using a Palm PDA.

Detailed descriptions can be found in the manual provided by 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 is 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.

Appendix I. Climate Station Field Data Collection: PDA



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**. 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. 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.

Appendix J. Conducting a Standard Remote Climate Station Field Visit (HP200 Version)

Equipment Check List

- HP200LX – Charged
- 9 Pin Serial Cables with SC232 Cable Interface
- Gray Clipboard with latest complete Site Visit Form
- Blank Site Visit Forms (for the specific site)
- Dessicants (in Rubbermaid)
- Tool Bag
 - o Voltage Meter
 - o Extra Small Slot Screwdriver (Campbell Scientific)
 - o Small Crescent Wrench
 - o Hexagonal Wrench Set
 - o Leatherman Knife
 - o Wire Cutters
- Spare 12 Volt Battery
- Frame Pack

Communicating with Datalogger

1. **Unlock the white enclosure to access the datalogger. All locks use the Combination 3716.**
2. **Plug the 9 pin serial cable leading from the “datalogger” side of the SC232 Cable Interface to the female plug in the right hand corner of the datalogger marked CS I/O. [NOTE: At Telemetered Sites, you will need to unplug the 9 pin connector leading to the Radio]**
3. **Plug the 9 pin serial cable leading from the “terminal/printer” side of the SC232 Cable Interface to the male plug on the back of the HP200.**
4. **Turn on the HP200 (Button marked “ON”, upper right hand corner).**
5. **Read the HP200 display to ensure that the DOS prompt is in the PC208 subdirectory (i.e. display should read “A:\PC208”).**
 - **If the display reads “A:\>” (without the subdirectory) you must get to the subdirectory by typing “cd” <SPACE> “pc208”, then hit < ENTER >.**
 - **If the display reads “Kermit-MS>”, then the HP200 is currently running Kermit, a program used to transfer files between the HP200 and a computer. Escape the program by typing “exit” and hitting the <ENTER> key.**

- **If the display cannot be read To lighten or darken, adjust contrast by holding down the <+> or <-> keys while pushing the “ON” button.**
6. **On the HP200, Type “gt” <SPACE> <StationName>. This will open a program, Graph Term, which allows communication between the datalogger and the HP200.** [NOTE: When you type in the station name following the gt command, the program accesses a stored station (.stn) file on the HP200. The station file tells Graph Term the location in the datalogger’s memory where the last data was collected. If you were to type “gt” with the wrong station name, “gt” without a station name or if there was no previous station file on the HP200, then GraphTerm will collect the entire contents of the memory]. Following is a list of the currently operating NPS Operated Climate Stations and their associated Station Names.
- Quinault Open = QUO2
 - Quinault Forest = QUF2
 - Hoh Open = HOO
 - Hoh Forested = HOF
 - Hoh Ranger Station = HRS
 - Hoh West Twin = HWT
 - Ozette = OZET
 - Barnes Creek = BCK
 - Lake Crescent Lab = LCL
 - Elwha Hayes River = ELW
 - Waterhole Open = WHO
 - Waterhole Forested = WHF
 - Deer Park Open = DPO
 - Deer Park Forested = DPF
 - Deer Park High = DPH
 - Staircase Ranger Station = SRS
 - Carbon River = CAR

7. The display will now read the following:

```
GraphTerm Options
C - Call Station
T - Terminal Emulator
D - Download program to datalogger
S - Save program from datalogger
K - PC time to datalogger clock
M - Monitor Input Locations
U - Collect uncollected data
E - Edit station parameters
V - View graphics file
Q - Quit
Option:
```

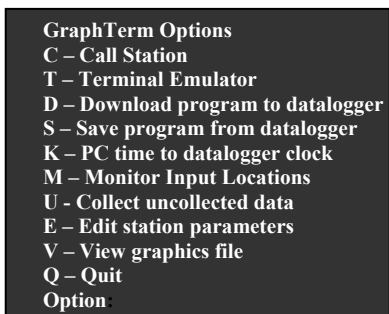
Complete Site Observation on Climate Site Visit Form

1. Check Site Name **to ensure that you are using the appropriate form**
2. Record Date of Site Visit

3. Record Time of Site Visit in **Military Time (i.e. 0-2400 hours)**
4. Compare Time of Datalogger to HP200 time or your watch (if accurate to atomic time). [Note: Dataloggers and the HP200 are always set to Standard Time (i.e. during summer months they will be 1 hour behind your watch or a computer which is set to Daylight Savings Time).]
 - a. Type "gt" <Space> <StationName> to reopen a GraphTerm options window
 - b. Choose "K" to compare PC time to the datalogger clock
 - c. GraphTerm will now display the datalogger clock and the HP200 clock. If you are confident the HP200 clock has recently been adjusted to atomic time, and the differences in time are greater than 2 minutes, Type "Y" to transfer HP200 time to datalogger. Record the time difference and record "YES" if time was changed.
 - d. Press <Esc> to return to the main GraphTerm menu
5. Record name(s) of observers
6. Note Yes or No if you intend to swap the battery at this site. You may not know until after you have monitored the current voltage at the site.
7. Note the Program Name on Arrival (from the previous site visit form) and the new Program Name on Departure if a new program is being downloaded to the datalogger.
8. If a new program was created, briefly describe changes (e.g. new tipping bucket multiplier)
9. Describe Overall Site Condition. This would include descriptive items that might help with interpretation of data. For example: "6 cm of snow on ground and rime ice covering windset" or "unusual amount of forest debris on ground, several fallen trees in vicinity" or "2 cm of standing water in field".
10. Describe Wind Sensor conditions. Is the sensor turning, were there webs or debris found and removed from the sensor.
11. Describe PAR or Radiation sensor condition. Check bubble to see if it is level. Ensure that it is clear of fallen debris. Clean with a soft cloth and water if necessary.
12. Check to ensure that the tipping bucket is clean and free of clogging debris. Describe if standing water is found. If debris is found, quantify depth of debris removed.
13. Describe access to site. Note unusual circumstances such as road washouts, blocking trees or snow.
14. Describe current weather conditions include precipitation, cloudiness and temperature

Collecting Uncollected Data Viles with the HP200

1. The display on the HP200 should still read the following:



```
GraphTerm Options
C - Call Station
T - Terminal Emulator
D - Download program to datalogger
S - Save program from datalogger
K - PC time to datalogger clock
M - Monitor Input Locations
U - Collect uncollected data
E - Edit station parameters
V - View graphics file
Q - Quit
Option:
```

2. Choose “U” for Collect uncollected data. **The screen will now show a starting location and you will see an advancing number showing the memory location currently being downloaded. [Note: if no station file is specified, the wrong station file is used or if the station file is missing from the HP200, a message will be displayed that this is the first collection and it will automatically begin collecting from location 1. This will result in all data in the datalogger being downloaded. You will also get this message if the datalogger program was changed during the last visit, as downloading new programs automatically removes old data and memory markers.**
3. **Under Data File Name on the Site Visit Form, record the Start and End memory Locations indicated.**
4. When the file has been fully collected the graph term options will once again be displayed.

Display, Examine and Record Current Data with the HP200

1. Choose “M” for Monitor Input Locations. **GraphTerm will now prompt you for the name of the current datalogger program.... “File containing labels: ”**
2. **Referencing the Site Visit Form from the previous trip to this climate site, find the “program name on departure” which was recorded on Line 7.**
3. Type in the name of this program (e.g. HOF23005) and hit <Enter> Note: **The extension .dld is not required.**
4. Type “L” for locations displayed
5. Type “1.. 33” and hit <Enter>. **This will expand display to 33 locations on the screen.**
6. Read the data displayed and record it **on the appropriate line in the “Monitored Data” boxes on the Site Visit Form. Compare these values to the acceptable ranges listed and the current conditions observed and note any peculiarities in the data.**
7. **When finished recording, press “ESC” (top left corner of HP200) to leave the Monitor Input Locations window and return to the GraphTerm options window.**
8. Type “Q” to quit the GraphTerm program.

Note any Additional Activities on the Climate Site Visit Form

1. If sensors are swapped, treat each transaction individually. Record details of each instrument, type whether or not it was.
2. Note if Tipping Bucket is calibrated. Record “As Found” multiplier and “New” multiplier if tipping bucket requires adjustment. (see *Calibrating Tipping Buckets*).
3. Note if Snow Sensor is calibrated. “As Found” measurement and actual distance between snow sensor and ground. Note new offset required in the program.

Downloading Programs from the HP200 to the Datalogger

If Tipping Bucket or Snow Sensors are field calibrated, or if factory calibrated instruments with new multipliers are added to a site, it may be necessary to change multipliers or offsets in the datalogger program. This can be done on the HP200 using EdLog. (For editing a datalogger program using EdLog, see Appendix D.) Once a new program has been created, you will need to download it to the Datalogger.

Note: Any uncollected data files must be collected from the datalogger prior to downloading a new program. You should also review this data to make sure it is complete. Downloading a new program will erase all data from the datalogger!

To download a program to a datalogger:

1. Return to the GraphTerm main menu, by Typing “gt” <SPACE> <StationName>
2. Choose “D” for Download program to datalogger.
3. You will be prompted for the Name of file to download. Type the name of the appropriate file. E.g. Type “HOO13806” [Note: No extension is required]
4. You will now see the readout describe the number of bytes being sent to the datalogger. When complete, the HP200 will beep and the message “Downloading Completed” will display on the screen.

Transferring Data Files and Programs between the HP200 and PC

After returning from the field, you will need to transfer data files from the HP200 to a network drive. Plug your 9 pin connector between the HP200 and the Com Port on your computer

On the HP200....

1. Go to A:\PC208
2. Type “kermit” (You will see Kermit-MS>)

On the desktop PC...

1. Click on the start icon (bottom left corner of screen).
2. Choose “programs”, then “accessories”, then “communication”.
3. Click on “hyperterminal”. This will open up the hyperterminal folder.
4. Click on the icon labelled HP200.ht. This will start Hyperterminal.
5. From the Transfer pull down menu, choose send or receive.

Appendix J. Appendix J: Conducting a Standard Remote Climate Station Field Visit (HP200 Version)

6. Browse for the correct file location.
Data files should be sent to I:\NRM\GEM\DATA\
7. Click Receive button

On the HP200....

1. Type “s” or “send” to send the data file.

Once the file has transferred, type “exit” to return to the DOS prompt on the HP200
Close the Hyperterminal window on the PC.

Snow Depth Sensors

After calibration, replace snow sensor by screwing it in to the socket.

Check the value of snow depth by monitoring the datalogger. Assuming no snow is on the ground, the value should read 0-{range?} centimeters.

If the value is off, change the offset (F) in the current program (show example) to 0.

Download this new program to the datalogger.

Again check the value of snow depth by monitoring the datalogger.

The value given should be the new offset constant (F).

Again change the offset (F) in the current program to reflect this value. Download this new program to the datalogger.

Monitor the value to ensure it is “0 cm”.

Appendix K. Data Import and Verification

Figures and Tables

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Appendix K. Data Import and Verification

This Standard Operating Procedure document describes the general procedures for import and verification of automated climate data from NPS operated climate stations into the working project database. Refer also to the NCCN Climate Protocol, Section 4.4 and 4.5 – Overview of Database Design, and Data Import and Processing for related guidance and clarification of the distinction between the working database and the master database.

Working Database Description and Functions

- Entry of data into the working database begins when the user transfers output from the HP200/Laptop or PDA to a network-connected drive. This transferred file is a comma-separated text file. The file is stored by the datalogger as <filename>.dat.
- If the .dat file was collected on an HP200, the file will have a terminating character hex (1A) found at the end of the last row of data. The user pre-processes this file using a text editor to delete the termination character, and saves the file, renaming it as <filename>.txt. This is necessary prior to importing, because MS Access doesn't recognize *.dat as a text file.
- Files collected from laptops or PDA's do not require editing, however they must be changed from a .dat to a .txt file in Windows Explorer.
- The working front-end application has the following functional components:
 1. Data Entry: Imports the comma-separated file into a temporary MS Access table.
 2. Data Review: Displays the temporary access table to the researcher for review and correction.
 3. Uploads the data to a permanent repository table and empties the temporary table.
 4. Quality Assurance Tools:
 - a. Allows the researcher to select for display from the permanent repository, specific parameters(s) for a given date range.
 - b. A selected parameter(s) can be exported to MS Excel for further data display and manipulation.
 - c. The MS excel data can be re-imported into Access and used to update the permanent repository.
 5. The application provides the user with functions to choose the back-end database to view, and to create time-stamped backups of the backend data store. The back-end data store consists of six separate databases, as follows:

Table K1. NPS weather station databases.

Database Name4	Weather Station Location Information Contained
DeerPark_b1Climate	DPF (deer park forested); DPO (deer park open)
Quinault_b1Climate	QUF(Quinault Forested); QUO(Quinault Open); QUR(Quinault Forested Rainfall Transect)
Hoh_b1Climate	HOF(Hoh Forested);HOO(Hoh Open);HOR(Hoh Ranger Station);HWT(Hoh West Twin)
Waterhole_b1Climate	WHF(Waterhole Forested); WHO(Waterhole Open)
Crescent_b1Climate	LCL(Lake Crescent Lab); BCK(Barnes Creek Hydrology)
Ozette_b1Climate	OZE(Ozette Lake)

Importing Hourly Data

Figure K1 displays a view of the main switchboard of the NCCN Climate Database.

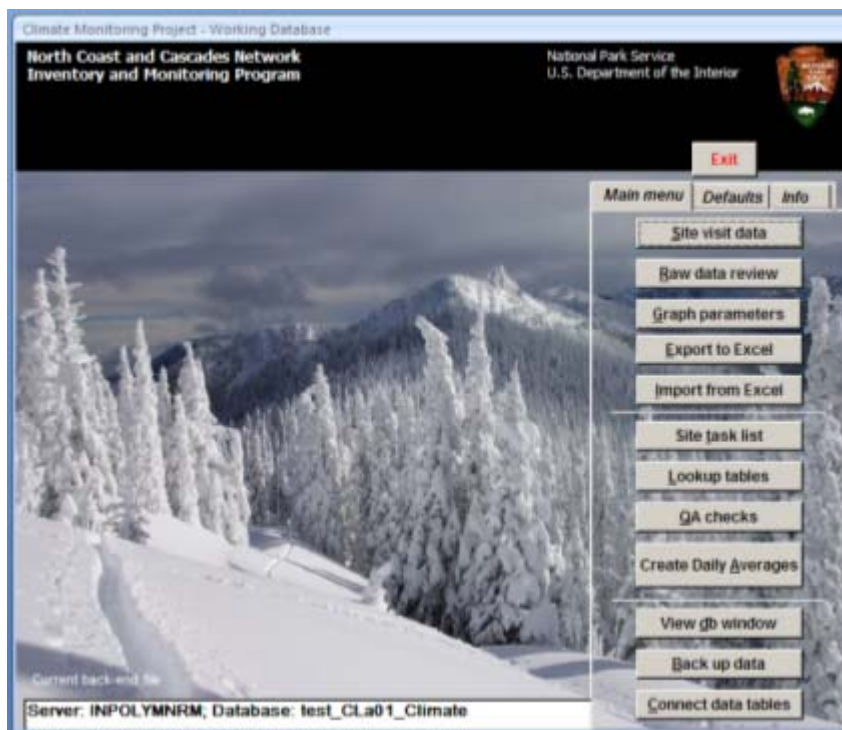


Figure K1. Climate Database Main Switchboard.

Begin the process of importing by selecting the *Site visit data* button. A box will open requesting basic information about the user, park and data timeframe (Figure K2).

The dialog box is titled 'Set application default values'. It contains several input fields: 'User' (a dropdown menu showing 'Bacous_Bill'), 'Park' (a dropdown menu showing 'OLYM'), 'Datum' (a dropdown menu showing 'NAD83'), 'Declination' (a text field with '18'), and 'Data timeframe' (a text field with '2010'). There is also a 'Project' field with 'CLa01' and an 'Activity' field with 'enter'. An 'OK' button is at the top right, and a 'New user' button is next to the 'Park' dropdown.

Figure K2. User information form.

Update the information and press OK. This will open a list of all site visits currently entered in the database (Figure K3).

Appendix K. Data Import and Verification

Data Gateway - List of data that have been entered

* Double-click on the text label to change sort order. Double-click on a specific location to change data about that location.

Add a new sampling

Close

Filter by park:

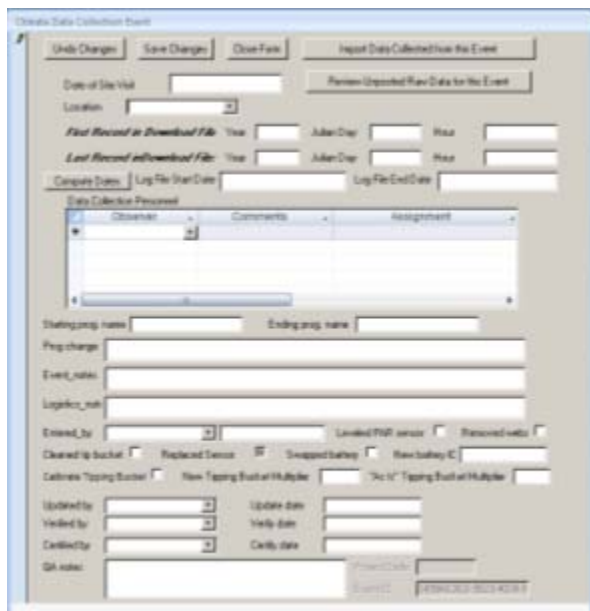
OLYM

Filter by Location:

Park*	Stake or other loc	Location type*	Event details	Year*	Visit date*	Entered/updated*	By*	Rec status*	
OLYM	DPF	FOREST	Event details	2010	27 Jan 2010	Delete	2010 Jan 28 10:57	Saccus_B8	unverified
OLYM	DPH	HIGH	Event details	2010	01 Mar 2010	Delete	2010 Apr 27 11:53	Saccus_B8	unverified
OLYM	DPH	HIGH	Event details	2010	27 Jan 2010	Delete	2010 Jan 28 16:58	Saccus_B8	unverified
OLYM	DPH	HIGH	Event details	2010	28 Apr 2010	Delete	2010 Apr 27 13:07	Saccus_B8	unverified
OLYM	DPH	HIGH	Event details	2010	05 Mar 2010	Delete	2010 Apr 27 12:12	Saccus_B8	unverified
OLYM	DPO	OPEN	Event details	2010	27 Jan 2010	Delete	2010 Jan 28 9:31	Saccus_B8	unverified
OLYM	HOF	FOREST	Event details	2010	28 Feb 2010	Delete	2010 Mar 09 16:17	Saccus_B8	unverified

Figure K3. Site visit listing panel.

Filter by park and climate station location by using the pull down menu and clicking the filter buttons to the right of the menus. If you are choosing a site visit already in the database click the event details button. If you are adding a new site visit and the data associated with it, click the *Add a new sampling* button. The data collection event form will open (Figure K4). Fill out the information, most of which can be found on the site visit forms.



Create Data Collection Event

Undo Changes Save Changes Close Form Import Data Collected from the Event

Date of Site Visit [dropdown] Reopen Unopened Raw Data for the Event

Location [dropdown]

First Record in Download File: Year [dropdown] Month [dropdown] Day [dropdown] Hour [dropdown]

Last Record in Download File: Year [dropdown] Month [dropdown] Day [dropdown] Hour [dropdown]

Compute Dates Log File Start Date [dropdown] Log File End Date [dropdown]

Data Collection Received

Shading group name [dropdown] Ending group name [dropdown]

Ping change [dropdown]

Event notes [text area]

Logfile path [text area]

Entered by [dropdown] Limited TMR sensor [checkbox] Removed water [checkbox]

Cleared up bucket [checkbox] Replaced sensor [checkbox] Swapped battery [checkbox] New battery ID [text area]

Cellnew Tipping Bucket [checkbox] New Tipping Bucket Multiple [text area] No 12 Tipping Bucket Multiple [checkbox]

Updated by [dropdown] Update date [dropdown]

Verified by [dropdown] Verify date [dropdown]

Certified by [dropdown] Certify date [dropdown]

GH value [text area]

Import Data Collected from the Event

Figure K4. Data collection event form.

When the form is completed, click the *Import Data Collected from the Event* button. The Import Data panel (Figure K5) will open.

1. On this panel, browse to the drive and file name of the comma-separated (*.txt) file to be imported.
2. Select a Data Logger Location (DPF in the below example) that correctly describes the location from which the file was taken.
3. Click *Import Data*.

Appendix K. Data Import and Verification

4. Click *Done* to exit the panel and return to the Main Switchboard Menu.

Import Datalogger Data

Import Data

Prior to using this screen, rename the raw data file to have a .txt extension and delete any trailing unprintable characters from the file.

Pick the location of the climate station from which the data to be imported were downloaded. Then browse to the path and file name of the data file to be imported. Click on the Import Data command button to import the data.

Import Data

Filename: Dpf_081100_121300.txt

This link file includes comma-delimited data to be imported

Link File: C:\Climate\Dpf_081100_121300.txt **Browse**

Datalogger Location DPF

Import Data **Done**

Figure K5. Import data panel.

Review and Post Data

1. From the Main Menu, click the *Raw Data Review* button.
2. To view data imported into a temporary file but not yet stored permanently, select the data logger location whose data is of interest (DPO in this example).

Appendix K. Data Import and Verification

Microsoft Access

File Edit View Insert Format Records Tools Window Help

Type a question for help

Review Raw Data

Select Datalogger of Raw Data to Review: DFO [Display Raw Data] [Post Data] [Close Form]

Raw Data from Import Table: For raw DFO

Instrum	Date_year	Date_day	Date_hrs	Program	Voltage	Soil_0	Soil_5	Soil_15	Soil_30	Air Temp	RH	PAR	Rainfall	Wind_Spd	Wind_Dir
130	2006	30	1600	233.05	13.34	3.011	1.838	3.019	2.937	1.982	85.9	118.9	0	1.254	
130	2006	30	1700	233.05	13.23	2.754	1.299	3.226	2.96	1.648	87.1	43.23	0	1.289	
130	2006	30	1800	233.05	13.09	2.478	0.74	3.245	3.011	1.186	88.8	1.919	0	1.066	
130	2006	30	1900	233.05	12.99	2.272	0.281	3.145	3.064	1.401	87.6	0	0	1.269	
130	2006	30	2000	233.05	12.91	2.15	0.001	3.029	3.114	1.344	86.7	0	0	0.871	
130	2006	30	2100	233.05	12.84	2.073	-0.168	2.908	3.146	1.378	86.3	0	0	0.615	
130	2006	30	2200	233.05	12.78	1.978	-0.352	2.817	3.186	1.333	86.7	0	0.506	1.708	
130	2006	30	2300	233.05	12.72	1.842	-0.598	2.703	3.176	1.824	83.7	0	0	1.365	
130	2006	30	2400	233.05	12.66	1.814	-0.672	2.597	3.177	1.389	88.1	0	0	1.006	
130	2006	30	100	233.05	12.62	1.812	-0.671	2.517	3.173	1.394	89.2	0	0	0.893	
130	2006	30	200	233.05	12.57	1.738	-0.799	2.45	3.161	1.261	99	0	0.506	1.307	
130	2006	30	300	233.05	12.53	1.665	-0.914	2.389	3.149	1.506	95.7	0	0	1.445	
130	2006	30	400	233.05	12.49	1.648	-0.937	2.323	3.128	1.167	97.9	0	0	0.667	
130	2006	30	600	233.05	12.46	1.592	-1.028	2.253	3.11	1.139	98.9	0	0.253	0.571	
130	2006	30	600	233.05	12.43	1.561	-1.066	2.208	3.09	0.888	100.4	0	0	0.682	
130	2006	30	700	233.05	12.4	1.535	-1.103	2.162	3.067	0.966	100.4	0	0	0.842	
130	2006	30	800	233.05	12.37	1.494	-1.153	2.124	3.046	0.771	100	5.182	0	0.753	
130	2006	30	900	233.05	12.38	1.418	-1.238	2.075	3.024	1.183	92.6	64.62	0	1.02	
130	2006	30	1000	233.05	12.51	1.514	-1.163	2.03	3.008	1.724	88.3	152.3	0	0.867	
130	2006	30	1100	233.05	12.81	1.843	-0.742	2.053	2.996	3.651	79.9	486.1	0	0.921	
130	2006	30	1200	233.05	13.67	2.392	-0.375	2.154	2.963	4.88	74.4	646.2	0	0.842	
130	2006	30	1300	233.05	13.54	2.795	0.464	2.327	2.957	4.216	88.2	332.6	0	0.563	
130	2006	30	1400	233.05	13.43	3.183	1.409	2.659	2.946	3.662	93.1	199.5	0	0.481	
130	2006	30	1500	233.05	13.3	3.736	1.606	3.073	2.949	2.887	96.6	107.7	0	0.397	

Record 11 of 2515

Form View

Figure K6. Raw data review panel.

3. Click on *Display Raw Data*
4. All records that have not yet been appended to the permanent data table will be displayed (see Figure K6).
5. Remove data that is obviously invalid (e.g., the value -6999 that appears when a data-collection instrument transmits an out of range reading).
6. If necessary add a missing year/day/time row, leaving the parameters blank, so that in a future step, missing parameters for this time can be interpolated.
7. When you are satisfied with the data, click on *Post Data*. This command posts a record to the permanent hourly-data table. When the raw data file is large, the processing takes a significant amount of time (10 minutes for 2000 raw records ... large files may take 30 to 40 minutes).

NOTE: When the raw data is from locations with hydra-probe soil sensors a data transformation step is required prior to posting to the permanent table (see Steps 8–10 below):

Appendix K. Data Import and Verification

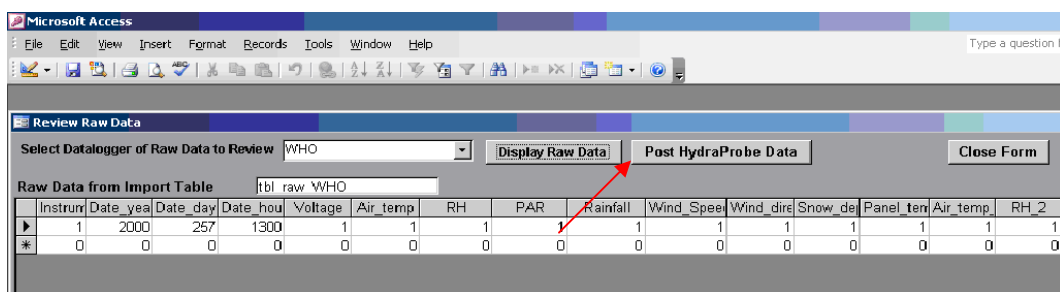


Figure K7. Review Raw Data Panel showing HydraProbe transformation button location.

8. Prior to posting from the Review Raw Data panel, click “Post HydraProbe Data” (Figure K7). The application will transform each set of four hydra-probe voltages into 11 parameter values, then posts these 11 values to the permanent data table for each hour that the data was taken.
9. After all the HydraProbe Data is posted, the “Post HydraProbeData” command button disappears and the “Post Data” command button appears.
10. Click the “Post Data” button to post the remaining parameters to the permanent data table. When posting is completed, the application will delete the records from the temporary table. [NOTE: If the user Posts the HydraProbe data, closes the form and comes back later to post the remaining data, he/she will be unable to do so, because the “Post Data” command button isn’t visible. In this case, the user can click “Post HydraProbeData” a second time. The application will not post duplicate records; instead it will report that it encountered “duplicate keys” when attempting to post the records a second time. However, because the posting operation takes a long time (10 minutes or more), it is recommended that the user perform the two posting operations in sequence, without closing the form between postings].

Review of Posted Data

After data has been posted, it is ready for you to review the data, performing quality assurance checks and making necessary modifications to the posted records. It is often advantageous graph the data and to compare similar data (such as soil moisture at different depths at the same location during the same time period) or for the same data during the same season during successive years. These comparisons are more easily done graphically using MS Excel. The Climate Database application allows you to select blocks of data from the working data store for export to MS Excel for review.

The data can be manipulated in MS Excel in order to correct obviously erroneous data, or to estimate missing data. The data can then be re-imported into the working data store to update the original records.

Export Data to Excel

1. Select *Export to Excel* button from the Main Switchboard Menu (Figure K1). This will open the Export Data panel (Figure K8). The program allows the user to export data to an Excel file for more complex graphical display, modification or review.

Appendix K. Data Import and Verification

Export to Excel Spreadsheet

Export Data

Pick the location of the climate station and the date range of data to be downloaded to an excel spreadsheet. Then browse to the path and file name of the excel file to be exported to. Then click on the Export Data command button.

Datalogger Location **Select up to Four Parameters to Export:**

Date Range of Interest

Begin: **End:**

Export Data

Filename: This file contains test data from HOF for spring 2006

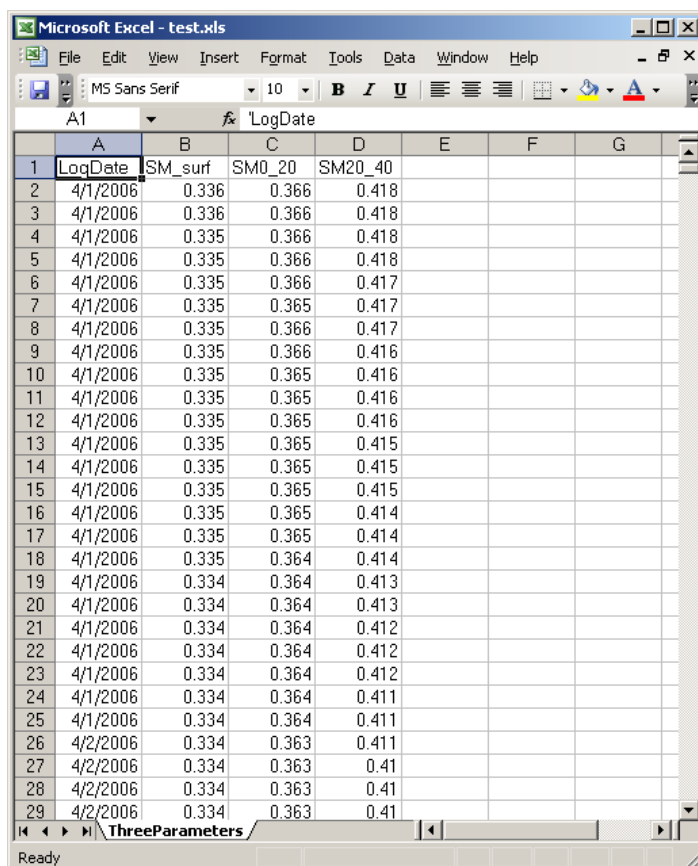
Link File:

*This function will create up to four worksheets in the workbook <filename>.xls that you specify. Worksheet named "OneParameter" is created or overwritten when you specify one parameter to export, "TwoParameters" is created or overwritten when you specify two, etc.

Figure K8. Export data panel.

2. The data chosen for export in a single operation can be up to four parameters' worth, all from the same location, and for the same time period. (NOTE: If you need to compare data from separate time periods or different locations, export them to separate spreadsheets and then consolidate the spreadsheets for analysis).
3. Select the location of interest.
4. Enter the time period of interest.
5. Enter (or browse to) an excel file name that you would like to contain these data. If the file does not exist, the application will create it.
6. Press *Export Data*.
7. Press *Done* when the Export-complete message box appears. Data appears in an MS Excel spreadsheet (Figure K9).

Appendix K. Data Import and Verification



The screenshot shows a Microsoft Excel window titled 'Microsoft Excel - test.xls'. The worksheet is named 'LogDate'. The data is organized into columns: A (LogDate), B (SM_surf), C (SM0_20), and D (SM20_40). The data rows range from 1 to 29. The first 26 rows are for 4/1/2006, and the last 3 rows are for 4/2/2006. The values for SM_surf range from 0.334 to 0.336, SM0_20 from 0.363 to 0.366, and SM20_40 from 0.41 to 0.418.

	A	B	C	D	E	F	G
1	LogDate	SM_surf	SM0_20	SM20_40			
2	4/1/2006	0.336	0.366	0.418			
3	4/1/2006	0.336	0.366	0.418			
4	4/1/2006	0.335	0.366	0.418			
5	4/1/2006	0.335	0.366	0.418			
6	4/1/2006	0.335	0.366	0.417			
7	4/1/2006	0.335	0.365	0.417			
8	4/1/2006	0.335	0.366	0.417			
9	4/1/2006	0.335	0.366	0.416			
10	4/1/2006	0.335	0.365	0.416			
11	4/1/2006	0.335	0.365	0.416			
12	4/1/2006	0.335	0.365	0.416			
13	4/1/2006	0.335	0.365	0.415			
14	4/1/2006	0.335	0.365	0.415			
15	4/1/2006	0.335	0.365	0.415			
16	4/1/2006	0.335	0.365	0.414			
17	4/1/2006	0.335	0.365	0.414			
18	4/1/2006	0.335	0.364	0.414			
19	4/1/2006	0.334	0.364	0.413			
20	4/1/2006	0.334	0.364	0.413			
21	4/1/2006	0.334	0.364	0.412			
22	4/1/2006	0.334	0.364	0.412			
23	4/1/2006	0.334	0.364	0.412			
24	4/1/2006	0.334	0.364	0.411			
25	4/1/2006	0.334	0.364	0.411			
26	4/2/2006	0.334	0.363	0.411			
27	4/2/2006	0.334	0.363	0.41			
28	4/2/2006	0.334	0.363	0.41			
29	4/2/2006	0.334	0.363	0.41			

Figure K9. Example of data exported to MS Excel.

8. Note that the parameter names appear as column headings, while the worksheet name, in this case is “ThreeParameters”. Had the user selected one parameter for export, the name of the spreadsheet would have been “OneParameters”, similar names are used for two and four parameters.
9. The same Excel workbook will contain exports of one-, two-, three-, or four- parameters. However, if you export, for instance, two parameters, to a workbook that already has a “Two Parameters” worksheet, that sheet will be overwritten. Consequently, if you want to compare several parameters whose time-frames are different or whose locations are different, within the same workbook, export one parameter, rename the “OneParameters” worksheet into which it has been exported, then export the second parameter, and so on. NOTE: One limitation of this function is as follows: If you are exporting several parameters to the same worksheet at the same time and any one of the parameters does not have a record for a particular date/time, then none of the parameters for that particular date/time will be exported. Thus, if you want to compare parameters in order to fill in missing data, you must export the parameters separately, as described above.

Reimport Excel Data

1. Once data has been reviewed and edited in Excel, you will need to reimport it into the database. From the main switchboard menu, select the *Export from Excel* button. This displays the panel below (Figure K10).

Import Datalogger Data

Transfer Data from Excel Spreadsheet

Enter the filename and path of the Excel file that contains data you want to use to update existing records.

Transfer Data

Filename: test.xls
This file contains data to be used to update the permanent hourly data.

Link File: C:\Climate\test.xls **Browse**

Choose the appropriate QA/QC flag for these data: Estimated

Datalogger Location to which these data apply: HOF

Enter the name of the upper-left cell and the lower-right cell of the block of data to be imported from the spreadsheet, separated by a colon (e.g., A1:H19)

If you want to upload data from a worksheet other than the first one in the workbook, enter the name of the worksheet here:

Does the spreadsheet have field names in the first row of the block you are importing?
☒ Yes ☐ No

Transfer Data **Review Data**
Done

Figure K10. Import from Excel panel.

2. On this panel, select the file from which data is to be re-imported into Access
3. Supply a QA/QC flag to indicate the quality of the modified data. (Refer to the NPS Operated Climate Stations SOP1, Data Retrieval & Management for descriptions of these fields).
4. Supply the location to which these data belong.
5. If your data has column headings, and if you want to import the entire worksheet, you are not required to define the upper-left and lower-right corners of the block to be imported.
6. Select whether you have column headings and click *Transfer Data*
7. Your data will be transferred in to temporary tables, one table for each parameter.
8. Press the *Review Data* button on this panel to view this temporary table (Figure K11), and if necessary make further modifications to the data prior to updating the permanent data record.

Appendix K. Data Import and Verification

ReviewExcel Data

Close Form

Raw Data Transferred from Excel File:

C:\ClimateTest.xls

Into Temporary Table Name:

Imp_Param1

Post Data

Description of correction applied in Excel:

Location	LogDate	ParameterID	ParameterValue	DataQualityFlag
HOF	04/01/2006 0:00	SM_surf	0.336	Estimated
HOF	04/01/2006 1:00	SM_surf	0.336	Estimated
HOF	04/01/2006 2:00	SM_surf	0.336	Estimated
HOF	04/01/2006 3:00	SM_surf	0.336	Estimated
HOF	04/01/2006 4:00	SM_surf	0.336	Estimated
HOF	04/01/2006 5:00	SM_surf	0.336	Estimated
HOF	04/01/2006 6:00	SM_surf	0.336	Estimated
HOF	04/01/2006 7:00	SM_surf	0.336	Estimated
HOF	04/01/2006 8:00	SM_surf	0.336	Estimated
HOF	04/01/2006 9:00	SM_surf	0.336	Estimated
HOF	04/01/2006 10:00	SM_surf	0.336	Estimated
HOF	04/01/2006 11:00	SM_surf	0.336	Estimated

Record: 11 of 12

Figure K11. Temporary table derived from MS Excel import.

9. When you are satisfied with the result, click *Post Data* to update the permanent record.
10. When the data has successfully posted, you see the following screen (Figure K12). Notice that the screen (Figure K18), shows **three** temporary tables (see red arrow). There will be one temporary table for each of the parameters in the spreadsheet you imported (three in this case). Data in each of the temporary tables must be reviewed and imported.

ReviewExcel Data

Close Form

Raw Data Transferred from Excel File:

C:\ClimateTest.xls

Into Temporary Table Name:

Imp_Param1

Post Data

Description of correction applied in Excel:

Location	LogDate	ParameterID	ParameterValue	DataQualityFlag
#Var	#Name?	#Name?	#Name?	

Record: 11 of 12

Figure K12. Data posting panel.

11. To review and post each succeeding table, select the next temporary table, by clicking on the record selector (green arrow), and repeat the posting operation.
12. After having reviewed and posted all data, click *Close Form*.

Creating Daily Averages

Annual climate reports and data inquiries usually require daily and monthly summaries of the hourly data. When the hourly data has been reviewed and appropriate modifications made, the data should be summarized to produce a database of certifiable daily values.

1. From the main switchboard menu, click on the *Create Daily Averages* button. This will open up the Compute Daily Summaries panel (Figure K13).

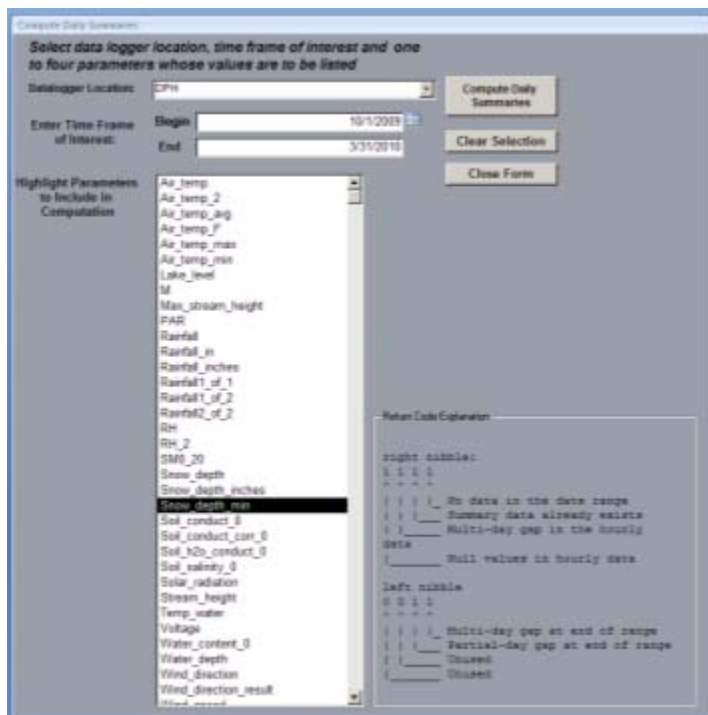


Figure K13. Compute daily summaries panel.

2. From the pull down menu, choose the datalogger location.
3. Choose the beginning and end dates of the hourly data you want to summarize. The program will not allow you to overwrite values that have already been summarized, so it is important to determine which data has already been summarized before beginning this process.
4. Highlight the parameter you wish to summarize into daily values. (e.g. Snow_depth_min, Figure K13).
5. Click on the *Compute Daily Summaries* button.
6. The program will warn you if there is any missing data but will continue to summarize.
7. A message will appear when all data has been summarized.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 2: High Elevation Climate Stations

Version 5/26/2010

Revision History Log

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Introduction

The Northwest Weather and Avalanche Center (NWAC) plans, develops, installs and maintains a high elevation weather monitoring data network in the Pacific Northwest. This mountain weather network is currently comprised of 24 remote automated weather stations (most consisting of at least two or more sub-stations producing a total of 44 separate data sites) which provide real-time hourly or instantaneous weather data including temperature, wind speed and direction, precipitation, snow depth, and relative humidity. Most sites and sensor locations were developed to view both a vertical and horizontal cross-section of the atmosphere and to provide critical information where it is most representative. As a result, base stations commonly link multiple substations that span a range of elevations. In some areas, substations may be separated by a considerable distance (1-2 km or more). Base station information is gathered on a real-time basis by phone modem, radio-to-phone modem link, or satellite transmission.

The NWAC utilizes the mountain weather data to support more accurate avalanche and mesoscale mountain weather forecasts, and disseminates the information to cooperators for planning, maintenance and avalanche control purposes (<http://www.nwac.us>).

The NWAC is administered by the U. S. Department of Agriculture (USDA), Forest Service and has mountain weather and avalanche forecast responsibility for the Washington Cascades, Olympic Mountains, northern Oregon Cascades (in earlier years it also had forecast responsibility for the southern British Columbia Cascades and for Crater Lake NP). Primary cooperator support for the program currently comes from:

- USDA-Forest Service
- Washington State Department of Transportation
- National Weather Service
- National Park Service
- Pacific Northwest Ski Area Association
- Washington State Parks and Recreation Commission
- Snowpark and Snowmobile Programs
- County Title II/RAC program grants
- Friends of the Avalanche Center (FOAC)
- Ski schools and other private organizations

The NWAC began building a network of automated weather stations shortly after they began forecasting in 1976. The network of stations spans the Cascade and Olympic Mountains in Washington and northern Oregon. Since then the network has grown to be a valuable source of mountain weather data in the northwestern United States. Instrumentation at each site has been tested and modified to withstand the harsh winter environment. The data are used to help determine snow layering and avalanche potential, the depth and extent of freezing rain that impairs driving conditions, and overall mountain weather conditions in the Olympic and Cascade mountains of Washington and northern Oregon. The location of sensors has proved invaluable

for observing and defining unique phenomenon associated with easterly pass flows, arctic inversions, and topographically forced convergence. Some of the data generated from these high-elevation stations has been parsed, analyzed and archived (Peterson, 1996). Although NWAC currently archives all of its own data on a regular basis, historical data is not readily available. As a result, NWAC is also actively pursuing alternative sources for data storage, analysis and dissemination.

Northwest Weather and Avalanche Center (NWAC) and National Park Service (NPS) Partnership

High-elevation weather stations developed by NWAC are being used at four high-elevation sites identified at the NCCN weather workshop. High weather monitoring is limited due to the inherently difficult conditions found at high elevations, especially remote higher elevation sites that lack electricity for sensor heating and may receive bad riming accumulations many times each winter. The remote locations (lack of regular or emergency maintenance options), limited power and data transmission options (lack of AC), and harsh weather conditions lead to many challenges in reliable and accurate data collection (Moore, 2007). Despite the many challenges, the NWAC stations have proven generally reliable at high elevations and several have been in operation since the mid-1980s (Appendix A, Station Information).

The NWAC's original network of high-elevation weather stations in and around the park was intended to provide real-time data to avalanche forecasters, meteorologists, and outdoor recreationists. Because of the relative reliability and success of the NWAC high elevation stations, the NCCN utilized the expertise of the NWAC staff, through cooperative agreements, and funded two high elevation stations: Camp Muir and Sunrise. Future sites may be installed as funding allows. The Park Service is responsible for funding these stations, installing and maintaining the stations with the assistance of NWAC and other contractors as needed, and is ultimately responsible for data management.

Table SOP 2.1. High elevation sites identified at the NCCN Weather Workshop.

Location	Elevation (ft)	Installed	Type
Sunrise, Mount Rainier National Park (two locations)	6,420 & 6,900	2003	NWAC
Camp Muir, Mount Rainier National Park	10,100	2006	NWAC
Camp Schurman, Mount Rainier National Park	9,500	No	NWAC
Washington Pass	5,500 & 6,630	2005	NWAC

The NCCN also utilizes weather data from five previously existing NWAC stations (Appendix A, Station Information). The NWAC is responsible for the maintenance of these stations and provides the data to the Park as requested. Data management is the responsibility of both the NWAC and NPS.

Information in this protocol was provided by the Northwest Weather and Avalanche Center through a combination of verbal communication and written correspondence with NWAC staff, the NWAC draft Mountain Weather Instrumentation Manual (Moore, 2009) available on-line at: http://www.nwac.us/media/uploads/pdfs/NAC_Weather_Guide.pdf, and the NWAC web site located on-line at: <http://www.nwac.us>.

Station and Instrument Siting Requirements

Weather Station Specifications

Standard measured parameters include hourly precipitation, air temperature (24-hour minimum, 24-hr maximum and current), relative humidity, and 24 hour snowfall and total snow depth. 24 hour snow depth sensors are only installed if the station is accessed daily as the snowboard must be cleared every 24 hours. Wind sites include hourly wind speed/direction, and temperature (24-hour minimum, 24-hour maximum, and current), and relative humidity. Data is collected at a specified interval, stored in a datalogger, and is transmitted every hour either via a phone line modem or RF link to a phone line modem. Below is a discussion of the components of each High Elevation Climate Site within the NCCN, which includes the sensors, station hardware, and data acquisition and transmission methods.

Site Selection

Site selection is determined based on meteorological characteristics, site accessibility, data transmission, power options, and overall monitoring objectives. The following guidelines are used to determine site selection. See the Site Installation Checklist (Table 3) for additional details.

1. Sites are representative of weather conditions in the general area.
 - Avoid sites directly to the lee or in front of knobs or other terrain obstacles. Terrain barriers may result in turbulent winds and highly site specific precipitation and/or wind effects. Topographic features or distinct topographic changes, elevation, and local weather patterns are all considered when choosing a site location.
2. Sites will provide for long-term operation and a relatively unchanged landscape over time.
 - Consider future site development plans of the area prior to installation. If there is a potential the site may be developed in the future, consider an alternate location.
 - Vegetation growth will be a factor over the long run. Establish a plan to maintain vegetation growth to a height that will not affect data quality.
3. Stations are located on level terrain.
 - Due to the effects of creep and glide on instrument towers in areas of heavy snowfall, relatively flat surrounding terrain in the immediate area of the site is required. Snow creep and/or glide can and will destroy even the most robust of towers if the station location is not very carefully situated to avoid such effects.
4. Wind and precipitation stations are rarely co-located.
 - Precipitation sites require protection from high winds in order to capture falling precipitation in the rain gage.
 - Wind sites are located on ridge tops clear of obstructions to capture accurate wind speed and direction.

- Temperature and relative humidity may be measured at both wind and precipitation locations. Specific requirements for obtaining the most reliable and meaningful wind and precipitation data are described under Instrument Siting Requirements.
5. Station locations require a reliable method to transmit data.
- Determine which methods are possible at the proposed site location (phone line, VHF/UHF/ or spread spectrum radio, cell-phone, satellite, or meteor burst telemetry site)

Instrument Siting Requirements

Precipitation

Precipitation is the amount of water falling upon the earth as rain, snow, sleet, and hail. At NWAC and NPS High Elevation weather sites, precipitation is measured by way of heated precipitation gauges, unheated gauges in combination with an ethyl glycol storage tank and pressure transducer, and acoustic snow depth sensors.

- An effective precipitation measuring site will have 360 degrees of tree protection that shelters the gage from wind effects as much as possible while still not encroaching on the site at more than a 45 degree angle measured out from the gage or tower top (an inverted 45° cone centered on the gage). This site configuration increases vertical precipitation by reducing the effects of turbulence and eddy currents (which tend to carry away the precipitation). The 45 degree angle limits snow accumulations on nearby conifer branches from falling into the gage during windy but non-precipitating events (and thereby producing misleading water amounts).
- Precipitation gauges must be located high enough on a tower to avoid winter snow accumulation from building up and obstructing the gage orifice.

Wind

Wind sensors measure the wind speed, the rate at which air passes a given point and wind direction, the direction from which the air is moving.

- Wind sensors are typically installed on ridge tops or in highly exposed areas to allow free air to impinge upon the sensor and free the sensor from the effects of any nearby obstruction.
- If practical, the wind speed/direction sensor should be at least 10 feet higher than any obstruction between 500 and 1,000 feet of the sensor. Exceptions exist within the NPS high-elevation weather network due to limitations at site locations. These are noted in Appendix 1, Site Information.
- An object will be considered an obstruction if the object is greater than 10 degrees in horizontal width as measured from the sensor.

Temperature/Relative Humidity

Air temperature refers to the air surrounding the weather station instrumentation. Relative humidity (RH) is the percentage ratio of the actual amount of water vapor in the air to the amount of water vapor required for saturation at the existing temperature.

- Direct solar radiation strongly affects sensor temperature. Temperature sensors are mounted within a natural or fan aspirated radiation shield, which provide some solar shielding.
- Locate sensors away from areas where rough terrain or air drainage is likely to result in non-representative temperature data.
- Whenever possible, sensors will be located no closer to an obstruction than four times the height of the obstruction (an object will be considered an obstruction if the object is greater than ten degrees in horizontal width as measured from the sensor and within 200 feet of the sensor).

Tower Specifications

All high-elevation weather stations detailed in this protocol use a Rohn 45 or 45G tower or equivalent as a base for mounting sensors and enclosures with dataloggers and modems. USDA-Forest Service/OSHA tower safety guidelines currently specify a Rohn 45G tower (18-inch equilateral) or its equivalent as the minimum acceptable tower standard for safety. Fold-down sensor towers also meet the USDA-Forest Service OSHA safety guidelines and are used in fire weather programs, but these towers are not recommended for high elevation/heavy snowfall locations due to their overall lighter weight and weaker construction, and the fact that wintertime maintenance requires them to be folded over—a very impractical or impossible requirement for deep snowpack environments.

- Follow Rohn installation guidelines when installing a Rohn tower. Rohn provides guidelines for constructing a base for many scenarios including guyed towers, towers attached to a structure, and towers exposed to rime events. See Appendix B-1 and B-2 for specifications.
- A deep snowpack will exert large vertical and horizontal forces on guy wires and other tower components and can bend or snap attached towers. It is often better at high elevation sites to construct a larger concrete base and consider a shorter tower in order to avoid the use of guy lines.
- When installing a tower consider that the tower must survive 125 MPH winds, withstand snow loads of typical high mountain locations within the Western US, and support technical personnel on the tower while servicing all sensors.

Power

High-elevation automated stations can operate on DC or AC power depending on what is available at the site. However, at sites without AC, heated sensors will not operate as their power requirements far exceed power typically available from even the most robust of solar panel/deep cell battery combinations. Most data loggers, sensors, and data transmission methods can run reliably off a 12V DC supply system if sensor heating is not required. Almost all types of sensor heating (heated precipitation gage, wind sensors, ceilometer, visibility, etc) require a reliable source of electricity (generally 120-240 VAC, but 24-36V DC in some cases) to be available at the site, as wattage requirements of 1000 watts or more are common.

- DC systems typically include several deep-cycle RV or marine batteries wired in parallel along with a 10-20 watt or larger solar panel.
- When AC is available, batteries are trickle/float charged from the AC. When AC power is interrupted, heating of sensors will cease and previously heated sensors will gradually

freeze, fill with snow, or rime if adverse weather conditions are occurring. However, if sufficient DC is still available, parameters like temperature, snow depth, and other low power consumption measurements will still provide automated measurement and be available via remote access of the weather system data logger. Therefore backup DC power sources are used at sites with AC power

Station Locations

Four High-elevation weather stations are located within the boundaries of the North Coast and Cascades Network: Hurricane Ridge, Camp Muir, Sunrise, and Paradise (Table 2.2). In addition, Washington Pass is located just outside the boundary of North Cascades National Park and Chinook Pass is located just outside the eastern boundary of Mount Rainier National Park. These sites are operated in cooperation between the NWAC and Washington State Department of Transportation. Crystal Mountain is located outside the northeast boundary of the park and is operated in cooperation between the NWAC and Crystal Mountain Ski Area. Data generated from all these three sites are utilized by the parks. Due to siting criteria (see Instrument Siting Requirements), wind sites and precipitation sites are often located in separate locations. See Appendix A, Site Locations and Instrument for information on each site and a site map of each park.

Table SOP 2.2. Location of NWAC and NPS/NWAC sites located within and in close proximity to NCCN parks. Note that data may be intermittent for some years.

Site Location	Park	Period of Record	Data	Agency	In Park?
Paradise	MORA	1991–Present	wind speed/direction	NWAC	Y
Paradise	MORA	1991–Present	temperature, relative humidity precipitation, total snow, 24-hour snow	NWAC	Y
Hurricane Ridge	OLYM	1985–Present	temperature, relative humidity, precipitation, relative humidity, total snow, wind speed/direction	NWAC/RAWS	Y
Sunrise	MORA	2003–Present	temperature, relative humidity, precipitation, total snow depth	NPS/NWAC	Y
Sunrise	MORA	2004–Present	wind speed/direction, temperature, relative humidity	NPS/NWAC	Y
Camp Muir	MORA	2006–Present	temperature, relative humidity, wind speed/direction	NPS/NWAC	Y
Washington Pass	NOCA	1980–Present	temperature, relative humidity, precipitation, total snow	NWAC/WADOT	N
Washington Pass	NOCA	1980–Present	temperature, relative humidity, wind speed/direction	NWAC/WADOT	N
Crystal Mountain	MORA	1988–Present	24 hour snow, total snow, temperature, relative humidity, precipitation	NWAC/Crystal Mountain Ski Area	N
Crystal Mountain	MORA	1988–Present	temperature, 24 hr snow, total snow	NWAC/Crystal Mountain Ski Area	N
Crystal Mountain	MORA	1988–Present	temperature, wind speed/direction	NWAC/Crystal Mountain Ski Area	N
Chinook Pass	MORA	1984–Present	precipitation, total snow, temperature, relative humidity	NWAC/WADOT	N
Chinook Pass	MORA	1984–Present	Temperature, relative humidity, wind seed/direction	NWAC/WADOT	N

Installation

To help ensure that the best possible site location is chosen and ensure successful installation of the station, a weather site checklist is provided in Table 2.3.

Table SOP 2.3. Basic checklist for installation of weather station

Factor	Discussion
Site Planning	▪ Choose the best site meteorologically for the parameters to be measured. This will likely result in separate locations for wind and precipitation stations. ▪ Consider all environmental issues, including both cultural and biological. In sensitive areas, installation may require services of a botanist, plant ecologist, cultural technician and/or archaeologist. ▪ Plan for site inspection/analysis in June and construction to begin in July or August, depending on environmental sensitivity of site.
Location	▪ Site locations must be meteorologically representative of surrounding terrain. ▪ Sites locations must be adjacent to AC power or be in a location to support solar panels ▪ To transmit data, site locations require either a phone line or an RF connection to a base station with a phone line. ▪ Choose a flat or wind-scoured area to minimize creep and glide caused by deep snowpacks. ▪ In deep winter snowpack locations, eliminate use of guy wires to ground and be sure to meet or exceed manufacture guidelines for size of concrete tower base. ▪ Consider the use of horizontal guys to surrounding trees above expected maximum snow depth, or use near vertical guys, I-beams or other structural members for tower support. ▪ Ensure that selected locations and immediately surrounding terrain will remain relatively undisturbed for the foreseeable future.
Power	▪ Ensure that power, if required, is available and can be laid/buried to site as appropriate ▪ Determine if weather sensors require 120 or 240 VAC and ensure appropriate circuit breakers are used. ▪ Use direct burial 600 volt rated power cable (normally 12AWG or larger), & place in flex or rigid conduit as necessary. ▪ If solar power is used, ensure that all components and connections meet code and panels mounted vertically with a southerly exposure to maximize solar input and minimize accumulated snow or rime.

Table SOP 2.3. Basic checklist for installation of weather station (continued).

Factor	Discussion
Telemetry cable or other data transmission methods	▪ If extensive land lines from sensor site to inside data logger are necessary, install telemetry cables outside of conduit-enclosed power line to minimize induced AC or DC in telemetry cables. ▪ Use high quality direct burial, shielded telemetry cable and be sure to include many extra pairs to accommodate problems and/or future expansion. ▪ If site is to be VHF/UHF/Spread Spectrum radio, cell-phone, satellite, or meteor burst telemetered site, be sure to check for proper signal reception before acquiring equipment and beginning installation.
Tower	▪ Ensure that tower base installation or tower brackets (if next to building) are adequate for planned tower height. ▪ Provide proper training for all maintenance personnel—utilize climbing harnesses and proper protection. ▪ Make sure that the tower can be safely climbed during all weather conditions. Check and tighten all bolts and nuts at tower section interfaces (inspect all tower components at least annually). ▪ Properly ground tower, all AC connections and data logger. Install lightning rod and proper grounding cable and ground rod if appropriate at exposed sites.
Sensors and junction box	▪ Provide for proper placement and secure attachment of all sensors to tower. ▪ Use properly galvanized nuts and bolts for attachment. ▪ Use cable ties or high quality electrical tape to fasten cables to tower legs. ▪ Install proper lightning or power surge protection for sensors (e.g., fuse and tranzorb for each sensor wire in water-tight junction box), and phone modem lines.

Measured Parameters and Equipment

Sensors

Following is a description of sensors used on NWAC/NPS automated high weather stations within the NCCN. These sensors have been proven to be generally reliable in harsh mountain environments. Sensors discussed have run the gamut of winter operation from continental to maritime weather regimes, and from heavy riming and deep snow pack situations to interior and more continental mountains characterized by low humidities, limited rime episodes and shallow snow packs.

See Appendix C for a list of Campbell Scientific, Inc. (CSI) Instruction Manuals and hyperlinks to the on-line manuals used in the NWAC/NPS High Elevation Climate Sites. 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.

Table 2.4 lists the contact information for sensors used at these high elevation mountain sites. Instruction manuals are located in appendices C-G.

Table SOP 2.4. Equipment suppliers for high-elevation weather stations.

Equipment	Contact
Wind Speed/ Direction Sensors	Taylor Scientific , 4658 NE 178th St, Seattle, WA 98155 (206)-362-1074; phil@taylorse.com
Radio Communications Various Weather Sensors	NoHow Inc , P.O. Box 936, Polson, MT 59860-0936 406-883-5881; www.nohowinc.com; howie@nohowinc.com
Campbell Scientific Sensors	Campbell Scientific , 815 W. 1800 N, Logan, UT 84321-1784 (435)-753-2342; www.campbellsci.com
Wind Speed/Direction Sensors	Electric Speed Indicator Co , 12234 Triskett Rd, Cleveland, OH 44111; (216) 251-2540, (216) 251-2641 (Fax); rileyesi@aol.com. http://www.etisensors.com/
Snow Depth Sensors	Judd Communications , 2248 E. Lauri Kay Drive, Salt Lake City, UT 84124 (801)-424-2889; www.juddcom.com; dan@juddcom.com
Precipitation Sensors	ETI Instrument Systems, Inc , 1317 Webster Ave, Ft Collins, CO 80524 (970)-484-9393
Radio Equipment	Antenex , 2000-205 Bloomingdale Rd, Glendale Heights, IL 60139 (639)-351-9007; www.antenex.com
Tower Equipment	Talley Communications , 12976 Sandoval Street, Santa Fe Springs, CA 90670, (800)-949-7079; www.talleycom.com; sales@talleycom.com

Wind Speed

The most robust sensors currently are the mechanical rotor type. Although some off-axis errors are known to exist, the sensor's solid construction allows for continuous operation in almost all weather conditions, especially if AC power is available for de-riming. If no AC power is available to the site, sensors will rime.

The Taylor Scientific wind speed (mechanical rotor type) sensor has proven successful in a variety of harsh mountain conditions with and without AC power. This sensor is available with either analog DC voltage or pulse output (Appendix D)

Wind Direction

When AC power is not available, a split tail vane construction offers good response and the high aspect ratio design allows the vane to break free of most rime episodes during changing wind direction, even when unheated. If AC power is available, a heated sensor offers more reliable operation.

The Electric Speed Indicator (ESI) Wind Direction Transmitter and split tail vane is used at high-elevation weather sites in the NCCN with no AC power. The sensor uses a circular potentiometer and brush for analog voltage output.

The more robust Taylor Scientific wind direction sensor has proven reliable at high elevation sites with AC power, and the manufacturer is planning to offer an integrated propeller type vane/speed unit by 2008.

Table SOP 2.5. Wind sensors: Performance standards.

Parameter	Units	Accuracy	Range	Resolution
Wind Direction	Degrees (from True North)	+/-5 degrees	0–360 degrees	0.5 degrees
Wind Speed	Meters/second	+/-12 m/s ⁻¹ (for speeds <10.1 m/s ⁻¹) +/-1.1% of reading (for speeds >10.1 m/s ⁻¹)	0–49 m/s	NA

Temperature/ Relative Humidity

As temperatures rise and fall, metal's ability to conduct electricity varies in a known way. This temperature-induced change in resistance to current flow forms the basis of measurement for most current air temperature sensors, or thermistors.

Air temperature (AT) sensors are often combined with relative humidity (RH) chips to serve as integrated ATRH sensors, since RH sensors require temperature to make their measurements. ATRH sensors require the use of a radiation shield if used in the field. This shield may or may not be aspirated depending on location and access to AC power.

- The Campbell Scientific (CS) 500 Temperature and Relativity Humidity Probe and CSI/RM Young 6-plate Gill Radiation Shield/cross arm mount are currently used on NWAC stations in the NCCN.

Table SOP 2.6. Campbell Scientific temperature and relative humidity probes: Performance standards.

Parameter	Units	Accuracy	Range	Resolution
Temperature	Degrees	±2.0°C	-40°C to ±30°C	0.1°C
	Celsius	±1.0°C	-30°C to +30°C	0.1°C
		±2.0°C	+30°C to +40°C	0.1°C
Relative Humidity	%	At 20°C Unspecified (0–10% RH) ±3.0°C (10–90% RH) ±6.0°C (90–100% RH)	0–100°C	

Snow Depth

Acoustic snow depth gages are the primary method to measure snow depth at remote sites. Problems typically involve inaccurate readings due to blowing snow, lack of proper power or grounding, or some human obstruction such as fences or ropes that marks off the study plot that may at times obstruct the measuring sound wave.

- The Judd Communications Depth Sensor is an inexpensive solution for remotely measuring snow depth. The sensor measures the distance from the sensor to a target. The sensor works by measuring the time required for an ultrasonic pulse to travel to and from a target surface. An integrated temperature probe with solar radiation shield provides an air temperature measurement for properly compensating the distance measured. An embedded microcontroller calculates a temperature compensated distance and performs error checking (See Appendix E for instruction manual). The operation of the sensor is quite simple: once the distance from sensor to snow surface has been measured, this distance is subtracted from the previously measured and stored height of the sensor above the ground, thus providing the total snow depth.

Table SOP 2.7. Judd Snow Depth Sensor performance standards.

Parameter	Accuracy	Range	Resolution
Snow Depth	±1 cm or 0.4 % distance to target	5–10 meters (1.6 to 32.8 feet)	3 mm (12 inches)

Precipitation

Electrically heated tipping bucket type gages offer the most reliability in areas receiving high volumes of frozen precipitation. Power fluctuations (brown outs, surges, etc) produce the most problems. In areas where AC power is not an options, a cumulative or storage precipitation gauge that uses propylene glycol/ethanol is an option to capture frozen precipitation, with a high resolution pressure transducer providing output in hundredths of inches or mm of water.

- The Qualimetrics (now All-Weather) 12” heated tipping bucket gauge is used to measure both rainfall and snowfall. The rain gauge involves a balanced pair of buckets (tipping bucket) which tip alternately as each becomes filled with water. Each tip of the bucket represents an exact volume of water collected. See Appendix F for Instruction Manual.

Table SOP 2.8. Qualimetrics heated tipping bucket gauges: Performance standards.

Parameter	Accuracy	Range	Resolution
Precipitation	0.5% typical at 0.5 inches per hour	0.00 inches to unlimited capacity	0.01 inches

- If AC is not available at the site, the ETI NOAH II Total Precipitation Gauge is an option for high elevation sites. The ETI NOAH II Total Precipitation Gauge provides accurate, unattended measurement of precipitation in the form of either rain or snow over the full range of temperatures and environmental conditions. See Appendix G for Instruction Manual.

The NOAH II features:

High Capacity: An automatic drain-and-fill process permits collection of large amounts of precipitation. When the gauge's electronics sense that the collection chamber is full, it quickly drains the waste solution, recharges with antifreeze and automatically continues measuring and reporting additional precipitation.

Low Maintenance: The NOAH II can operate unattended for long periods of time. Antifreeze, which is used to melt snow and keep the solution from freezing, is automatically recharged into the collection chamber after a drain occurs. The antifreeze reservoir is sized to provide many months of unattended, maintenance-free operation.

Low power: The average power drain of the gauge is 15 milliamps. The NOAH II electrical components require a 12-volt DC power source. Because there can be different methods of supplying the power depending on the site and application, the configuring, acquisition, and installation of the power source is the responsibility of the customer. ETI recommends an 18 ampere-hour battery maintained by a solar panel and regulator for remote operational sites.

Table SOP 2.9. ETI NOAH II precipitations gauges: Performance standards.

Parameter	Accuracy	Range	Resolution	Power Requirements
Precipitation	±0.01 inches (in calm or light wind conditions)	0.01 inches to 55 gallon	0.01 inches	12 VDC, 15 ma average current

Soil Temperature

Soil Temperature refers to the temperature of soil. The two factors that greatly affect soil temperature are ambient air temperature and depth from the soil surface, however surface insulation (e.g. duff/snow), solar radiation, soil density and texture, soil moisture, and microbial processes can also contribute to differences in soil temperature. All soil temperature data will have an associated measurement of depth.

To ensure comparability between sites, soil temperature measurements are taken at standardized depths associated with forest and understory growth unless otherwise noted. These are:

- Surface Soil.
- 5 cm depth
- 15 cm depth
- 30 cm depth

The surface probe is installed horizontally at the mineral soil/organic layer interface. The 5-, 15-, and 30-cm probes are then placed at the given depths below this point.

Table SOP 2.10. Soil temperature probe performance standards.

	Units	Accuracy	Range	Resolution
Temperature	Celsius	+/- 0.4°	-35° to +50° C	0.1

Soil Moisture

Soil moisture refers to the water content of the soil. Soil moisture is measured with water content reflectometers which measure the volumetric water content of the soil. All soil moisture data will have an associated measurement of depth.

To ensure comparability between sites, soil moisture measurements are taken at standardized depths associated with forest and understory growth unless otherwise noted. Soil moisture measurements are paired with soil temperature measurements. These are:

- Surface Soil*
- 5 cm depth
- 15 cm depth
- 30 cm depth

The surface probe is installed horizontally at the mineral soil/organic layer interface. The 5-, 15-, and 30-cm probes are then placed at the given depths below this point.

Table SOP 2.11. Soil moisture probes: Performance standards.

Parameter	Units	Accuracy	Range	Resolution
Soil Moisture	% volumetric water content	+/-2.5%	0-50%	0.1%

Datalogger

The Campbell Scientific CR10X Datalogger is a multi-channel data logger designed for remote monitoring. The CR10X is capable of monitoring all types of weather sensors and will read a total of 12 single ended analog sensors or 6 differential analog sensors, along with two pulse counters, three switched excitation channels and eight digital I/O ports. This capacity is expandable to hundreds of channels using optional multiplexers.

Table SOP 2.12. Campbell Scientific CRX10 dataloggers: Performance standards.

Model	Specifications	Power Requirements	Data Storage
CR10X	12 single-ended/six differential channels, two pulse counters, three switched excitation channels, eight digital I/O ports. Operating system can be by mixed array, table data, PakBus, Modbus or ALERT.	12V DC	128K memory module standard (expandable to 2 Mb)

Configuring a CR10X Datalogger

CR10X dataloggers can be programmed with a laptop with Campbell Scientific Loggernet software or a Palm PDA with Campbell Scientific PConnect software installed. Campbell Scientific Loggernet and PConnect Software enables users to set up, configure, and retrieve data from a network of Campbell Scientific dataloggers with a computer or Palm PDA and share this data over an Ethernet communications network (Campbell Sci., 2002, 2006).

Programming the datalogger is done in the office or in the field. It is recommended that the programming be done in the office, and only done in the field if necessary. Loggernet software should be loaded onto all PCs and portable laptop computers or PConnect onto all PDA's that are used for programming and downloading data from 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 and PConnect Instruction Manuals are included in any purchase of Loggernet PConnect software respectively and are available on-line. (See Appendix 4, Campbell Scientific Instruction Manuals).

Appendix H, Configuring the Datalogger outlines the basic steps to configure the datalogger and send programs to the datalogger. There are a number of other tools within the software that are not described in the appendix, but are available in the manual.

Creating the Datalogger Program

A program may be created by the user or obtained from an outside source. Campbell Scientific, LoggerNet Software can be used to create a program for various dataloggers. The basic steps to create and edit datalogger programs using LoggerNet are found in the LoggerNet Instruction Manual. Programs for High Elevation Climate Stations are provided by staff from the NWAC.

Station Maintenance

Although these systems are automated they need human oversight and continued attention to provide the quality of data that will be useful for creating a long term climate record. Due to the harsh climate that sensors and all station infrastructure (tower, cables, antenna, junction boxes, etc) are exposed to, all parts of the station need to be regularly maintained and inspected. For high quality output, a maintenance visitation schedule of at least twice/year (fall and spring) is recommended, with other repair or maintenance trips scheduled as needed (weather and avalanche conditions permitting).

The most effective method for determining problems is to monitor station data on a regular basis and compare such data with other nearby stations or with NWS radiosonde sounding, ACARS information (Aircraft Communications Addressing and Reporting System - weather reports from commercial aircrafts), or forecast model data. This is most efficiently accomplished by utilizing trained meteorologists to analyze the data for potential problems.

There are two types of maintenance performed on high elevation sites:

- Preventive maintenance: Instrument cleaning, emptying/clearing the precipitation gauge, scheduled component replacement, calibration.
- Corrective maintenance: Equipment repair or replacement

A maintenance log will be maintained by all NPS high-elevation weather stations. The log will track annual maintenance records, sensor replacement and calibrations, and any other records pertinent to data quality (Appendix I).

Preventive Maintenance Requirements

The preliminary requirements for preventive or periodic maintenance are based on manufacturer recommendations and experience with similar automated surface measurement systems. Table 13 documents the general schedule for preventative maintenance. See Appendix J for the annual maintenance check-list, which includes an on-site visit for routine and preventive maintenance, field calibrations, and major component swap-out, etc. Appendix K describes the steps for changing out the ethanol/glycol used to operate the ETI NOAH II Total Precipitation Gauge.

Table SOP 2.13. General maintenance schedule for weather stations.

Time Frame	Instructions
Weekly	Monitor station data on a regular basis and compare such data with other nearby stations, with National Weather Service balloon sounding or forecast model data. Utilize NWAC to analyze the data for potential problems.
6 months	Download data from datalogger if telemetry failed during 6 months. Clean debris from precipitation gage. Clean the radiation shield. Check wind speed/direction sensor. Clean the enclosure. Replace desiccant in enclosure.
Annual	Calibrate temperature/relative humidity sensor. Calibrate snowdepth sensors. Replace glycol ethanol (see Appendix K for instructions).
2–5 Years	Replace temperature/relative humidity sensor. Replace batteries. Calibrate precipitation gauge. Calibrate Datalogger. Calibrate the datalogger. Check with Campbell Scientific.
5–10 Years	Replace soil temperature probes. Replace wind speed/direction sensors. Replace sensors and sensor cables as necessary.
General Maintenance	Inspect station. Check sensor leads for damage. Ensure tower is straight and stable. Check alignment of antenna. Clean glass on solar panel.

Corrective Maintenance

Once a problem is detected, it is the responsibility of the station Principal Investigator to determine the response time for repair. If the manager is relatively confident that the problem is with the telemetry, he/she may choose to wait for a logistically opportune time to visit the site knowing that the data logger is most likely recording the hourly data on-site. Due to the remote nature of some of the site locations, a problem occurring in the winter may not be resolved until the spring when access is possible. Unheated wind sensors will rime. Sites not accessible in the winter will eventually de-rime as temperatures rise.

Fuses or breakers controlling power distribution to remote weather sites may be tripped and need resetting. This will require manual intervention and time. To get through such intermittent loss of power at AC-required locations and still have data loggers and unheated sensors providing automated measurements, DC power sources are installed as back-up. Power and phone line issues are resolved as soon as logistically possible.

Photo Documentation

Annual photo documentation is intended to track any changes which occur at the site over the history of the weather station. Growth of surrounding vegetation, tilting of towers, and damage of sensors can all be tracked with photo documentation.

The steps to photographically document the climate site during the annual maintenance trip are as follows:

1. Take at least four general site views that represents the most informative overall perspective.
2. From a position 4 meters west of the station and starting at due south, nine still photos taken every 22.5 degrees clockwise to due north. Stitch photos into a single 180-degree image. **To be retaken at each annual site visit and archived.**
Start with **S, SSW, SW, WSW, W, WNW, NW, NNW**. End with **N**
3. From a position four meters east of the station and starting at due north, nine still photos taken every 22.5 degrees clockwise to due south. Stitch photos into a single 180-degree image. **To be retaken at each annual site visit and photos placed in the archive.**
Start with **N, NNE, NE, ENE, E, ESE, SE, SSE**. End with **S**

For information on photographic management and storage, refer to SOP 4 (Managing Photographic Images).

Data Management

Management and stewardship are some of the most important activities to be undertaken in climate monitoring to ensure that high-quality climate data records are collected, retained and are accessible for analysis and/or re-analysis by current and future generations of scientists, park staff/management, and the general public. The preservation of the data for future use requires facilities and infrastructure to ensure the long-term storage of the data. Another key component of data management includes adequate monitoring of the data stream. This includes timely quality control of the observations as data is collected and corrective action can be taken when problems arise. Data management of climate data generated from High Elevation stations will follow procedures defined in the NCCN protocol narrative, Chapter 4. Procedures are described in the following sections.

Data Retrieval

Data from High Elevation Mountain Weather sites can be downloaded in the field via lap top computer or Palm PDA, accessed remotely (automated) via phone telemetry using a phone modem, or accessed remotely through a combination of RF (radio frequency) communication to a phone modem. Automated data transmission allows the user to view the data real-time and display data on-line for multiple users (Campbell Sci., 2006). The three types of data transmission are defined as Direct Connection, Phone Modem, and Phone to Radio Frequency (RF).

Direct Connection

A direct connection consists of a datalogger with an RS-232 port or interface device connected to the serial port on the computer. An SC32B Interface or an SC-USB Interface is used to provide an optically isolated connection between the CR10X and a laptop or desktop computer. The SC32B connects to a computer RS-232 port and the SC-USB connects to a USB port.

Phone Modem

A phone modem connection consists of a phone modem connected to the datalogger at the field site and a phone modem connected to the home server computer on the receiving end of data transmission. A voice-synthesized modem allows a CR10X to transmit data via digitized voice.

Phone to Radio Frequency

Phone to RF is used to transfer data from the datalogger in the field in situations where phone access is available to the RF base station. Data from the datalogger is transferred via radio frequency or spread spectrum to a base station datalogger which is connected to a phone line. The data is then transferred via phone line to the home server computer.

LoggerNet allows the user to program the datalogger for the appropriate mode of communication. The user is able to set the scheduled collection intervals. Within the NCCN/NWAC Network, data is collected on an hourly basis.

Data Collection via Phone Line

In order to download climate data remotely from the datalogger, Campbell Scientific software Loggernet or PC208 is required. See appendix L for a description of the steps to remotely download climate data from the datalogger via a phone line using Loggernet.

Field Data Collection

Manual downloading of data can be accomplished in two ways, with a laptop or with a Palm PDA. See Appendix M and N for a summary of the procedures involved in collecting data via a laptop with Campbell Scientific, Inc. LoggerNet software installed, and with a Palm PDA with Campbell Scientific, PConnect.

Data Archiving

In order to minimize data loss, data should be downloaded to properly and routinely backed up computer storage on a daily basis. If automated transfer of data fails during a period of time, data should be downloaded from datalogger within six months. Downloaded data will be properly time stamped (year-month-day) and identified (by station number) and stored sequentially in a comma delimited ASCII array. Such data is then easily imported into spreadsheets or data bases for modeling, display or research applications. Following is the file naming convention for High Elevation climate data.

File Naming Convention

Filenames for data and metadata information = xxx[n][yy].zz[z], where:

- xxx = 3-letter, National Weather Service, National Handbook-5 identifier for each station, e.g. sun for Sunrise, WA, and hur for Hurricane Ridge, WA.
- n = elevation identifier for substations (generally substations are numbered from lowest to highest elevation)
- yy = year beginning season (e.g., for 1994-95 winter season, yy = 94)
- zz[z]
 - o zz[z] = .stn for general station metadata files (one per station which describe the data file format particular to that station.
 - o zz[z] = .yy for metadata file specific to given year (yy) for a given station or substation which describes the sensors, locations and data format for a particular station or substation.
 - o zz[z] = .dat for flagged data files (see quality control section)
 - o zz[z] = .txt for textual information files where n and yy are used only in naming sub-station data files.

If substations of a particular station exist they are numbered sequentially from lowest to highest elevations. For example, the Hurricane Ridge, WA (hur) site has no substations; annual raw station data file(s) for this site for the 1994/95 winter season would be hur94.dat. For Stevens Pass, WA (st9), which has 4 substations, annual raw data files for the 1989/90 winter season would be st9189.dat for the lowest elevation site through st9489.dat for the highest elevation site.

Data Quality Assurance

To assure data quality for NCCN high elevation climate stations the system will be monitored at all levels of data acquisition and storage. The Climate Program Managers, with assistance from field staff, contractors and partners, are responsible for the first level of quality assurance including:

1. Ensuring that maintenance is performed and individual maintenance logs are kept up to date.

2. Checking telemetry data on a weekly basis to ensure measured data values are reasonable by comparing data with actual weather conditions, nearby stations, and modeled forecasts.

Quality Review

During this step, downloaded data receives careful review.

Data Quality Flags

As data is downloaded and stored in and stored, quality control codes are applied to the data which describe any issues associated with the data. The quality control methodology and associated quality control flag descriptions are given in Appendix O, Northwest Avalanche Center Data Flag System

Automated queries will be run to search for out of range values. These values would be identified and eventually replaced with null values, automatically generated values or interpolated values.

Data will also be exported into Excel formats for efficient display and graphing of each parameter in order to visually review values. The date range displayed will span more than one raw data set to allow for comparison and watch for sudden shifts, or sloping trends of instruments. Data values will also be displayed and compared against similar or associated instruments. Examples of typical comparisons are as follows:

- Air Temperature and Datalogger Panel Reference Temperature
- Precipitation and Surface Soil Moisture
- Solar Radiation over multiple years
- Soil Temperature, comparing values at multiple depths
- Soil Surface Temperature and Air Temperature
- Soil Moisture, comparing values at multiple depths
- Battery voltage trends

Data with unusual values would be identified and replaced with null or interpolated values.

Data recorded during maintenance visits (identified from Site Observation Forms) will be scrutinized for false values from equipment calibration or replacement activities.

Data Modification

As previously described, data identified as having unusual, out of range or false values (due to maintenance) would be flagged and replaced, either with null values, automatically generated values or interpolated values for final data sets. Before modification, site trip reports and data from other local weather stations are checked to confirm decision.

The following data modification guidelines will be followed:

- **Null Values:** Null values will replace all erroneous temperature, relative humidity, wind speed, wind direction and soil moisture measurements.

- **Automatically Generated Values:** Update queries will be used to automatically replace certain out of range values. Examples of this would include:
 - Relative Humidity values greater than 100% would be changed to 100%.
 - Wind Speed values of .271 m/s (the lowest threshold of the wind speed sensor) would be changed to a value of “0”.
 - Radiation values below zero would be changed to zero.
 - Malfunctioning sensors may display a standardized “null” value of “-6999” or “-9999”. These would be replaced with a true null value.
- **Interpolated Values:** In some instances, missing or false values will be manually replaced with an interpolated or estimated value. This will only be the case with parameters requiring totaled values for reporting purposes such as precipitation and radiation. The following rules for interpolation will be followed:
 - **Precipitation:** Two methods may be used to replace missing precipitation values. Relationships between existing climate stations are determined in advance of problems. Values from nearby stations are compared to each other using an R squared value derived from a linear regression. Corresponding data from the station with the highest R squared value (i.e. having the most similar pattern of rainfall) is used to replace missing data. This value is also adjusted with the equation from the best fit line. If no rain occurred at nearby stations, a value of “0” is used.

Metadata & Data Certification

Once a data set has been completely reviewed and final revisions made, the Project Lead will complete an up-to-date metadata interview form and a NCCN Project Data Certification Form. Details of this process are described in the NCCN Climate Protocol Narrative, Section IV, Data Handling, Analysis and Reporting.

Analysis and Reporting

Analysis and Reporting will be completed according to the requirements described in the NCCN Climate Protocol Narrative, Section IV, Data Handling, Analysis and Reporting.

Personnel Requirements and Training

Partnerships

The NWAC has provided the expertise for the installation and operation of these high-elevation weather stations. The continued partnership is essential for the long-term success of these stations. The NWAC constantly checks the quality of the data generated from the stations, troubleshoots station problems with park staff, and looks for new technology for use at high elevation stations. Park staff are continually being trained on the operation of the stations and will rely on the NWAC for assistance in maintaining these stations.

Roles and Responsibilities

The NCCN Atmospheric workgroup will take the lead in managing the high elevation NPS stations. Contractors and partners will be utilized on an as needed basis. The NCCN Atmospheric workgroup is comprised of the Atmospheric Program Managers and field technicians from Mount Rainier National Park, Olympic National Park, and North Cascades National Park.

The NWAC will continue to maintain and operate previously existing stations within the NCCN Parks (Paradise and Hurricane Ridge) as funding allows. The NCCN may assume responsibility of these stations in the event the NWAC is no longer able to maintain them. The NWAC, along with their partners, operate the Crystal Mountain, Washington Pass, and Chinook Pass stations. The NCCN will utilize data generated from these stations, but is not associated with the maintenance and operations of the stations. Data management will be the responsibility of the NCCN atmospheric group and NCCN data manager. They will work with the NWAC to track maintenance and QA/QC of those stations not managed by the park service. Mount Rainier National Park is responsible for the maintenance and operation of the Sunrise and Muir high-elevation weather stations, and will use contractors and partners as necessary.

The NPS program managers, with assistance from field staff are responsible for appropriate site selection and placement of future high elevation climate stations funded by the Park Service.

The field technicians are responsible for station maintenance and assurance that accurate observations are taken. This includes addressing maintenance issues with promptness, and visual checks of data on a frequent basis to assure that station readings are reflective of actual conditions. Contractors and partners will be utilized as necessary.

The data management aspect of the monitoring is the joint responsibility of the NCCN data manager, NPS program managers, field technicians, and the contractors and partners under agreements. Data QA/QC is the responsibility of the field technicians and the contractors and partners under agreements. The NCCN data manager will be the technical representatives on all contracts related to climate data archiving and dissemination and will stay up to date on technological advances in the field, ensuring that the NCCN high elevation monitoring program is consistent with other national programs.

The NCCN Data Manager, NPS program manager and field staff are also responsible for climate monitoring reporting on an annual basis.

Table SOP 2.14. Roles and responsibilities of high elevation automated weather stations.

Station	Managing Agency	Maintenance	Data Management
Camp Muir	NPS	NPS with contractor assistance	NPS
Sunrise	NPS	NPS with contractor assistance	NPS
Paradise	NWAC	NWAC	NWAC/NPS
Hurricane	NWAC	NWAC	NWAC/NPS
Washington Pass	NWAC/WADOT	NWAC/WSDOT	NWAC
Chinook Pass	NWAC/WADOT	NWAC/WSDOT	NWAC
Crystal Mountain	NWAC/Crystal Mountain	NWAC/Crystal Mountain	NWAC/Crystal Mountain
Chinook Pass	NWAC/WADOT	NWAC	NWAC

Qualifications and Training

Before engaging in CSI datalogger programming, it is highly recommended that staff attend the three day CR10X/Loggernet training course offered by CSI. There is a high level of technical skill required to install, program and operate high elevation climate stations, including an understanding of datalogger programming, electronics, 12V power systems, climate instrument operation and meteorology. Effective troubleshooting must be done in the field to eliminate redundant site visits that incur high logistical costs and data gaps. The quality of the data produced is determined by the attention to maintenance details by the program manager and field staff.

Trained meteorologist from the NWAC and National Weather Service in Seattle will be used to determine the quality of real-time data generated from the high-elevation weather stations. Real-time data will be checked by park staff on a weekly basis. Any questions about data quality will be directed towards trained meteorologists.

The set-up of the RF communications network for data transmission requires technical experience. It is recommended to utilize trained personnel and/or outside contractors to program the radios, set-up the communication network, and test the system. The NCCN parks may work to accomplish this in-house in the future as training allows.

Operational Requirements

Annual Workload and Field Schedule

Weather monitoring is ongoing and constant. Data are transmitted every hour, of every day, 365 days a year. It is necessary that annual maintenance trips be scheduled between May and September for purposes of access and to avoid working in extreme conditions. Each of the NPS and NWAC high elevation stations identified in this protocol should be visited for maintenance and calibration at least twice per year. It is preferable to visit stations once in the spring and again in the fall before the long winter. If a station is offline, that station should have priority and be visited as soon as reasonably possible. A minimum of one day per station should be allotted for maintenance.

Transmitted data should be checked on at least a weekly basis and compared against nearby stations and forecasted models to assure that station readings are reflective of actual conditions. If sensors are not operating (eg. rimed wind speed sensors) or reading incorrectly (high or low temperature), data should be flagged accordingly.

estimate about an 8-10 year maximum lifetime for high-elevation weather sensors, which means that managers must plan for replacement of 10-15% + of capital equipment each year. See Appendix P for a list of equipment costs. Cooperative agreements for installation and maintenance for the NPS high elevation stations will be initiated with the Northwest Weather and Avalanche Center on an annual basis.

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Appendix A. High Elevation Climate Stations Site Information and Location

Name/ID	Elevation m (ft)	Location UTM Northing Easting	Period of Record	Data logger/ Transmission	Precip	Temperature (max/min)/RH	Snowfall	Snow Depth	Wind Speed/ Direction	Soil Moisture/ Temperature
Paradise Precipitation Site	1,692 (5,550 ft)	E 673566 N 5377351	1991– Present	Campbell Sci. CR10X datalogger CSI Com200 modem/phone line	Qualimetrics 12" electrically heated gage	Campbell Sci CS500 temp/RH sensor and gill 6-plate radiation shield	Judd Acoustic total depth senor	Judd acoustic 24 hour depth sensor		
Paradise Wind Site	1,676 (5,500 ft)	E 596690 N 5181647	1991– Present	Campbell Sci. CR10X datalogger CSI. DC 112 modem/phone line					Taylor 120V heated Wind Speed and Direction Sensor. Located on roof of Jackson Visitor Center; 4 feet above roofline	
Camp Muir	3,078 (10,100 ft)	E 596655 N 5187760	2006– Present	CSI CR10X datalogger; Freewave 902- 928 MHz Spread Spectrum RS232 Radio		Campbell CS500 temp/RH sensor and radiation shield			Taylor Scientific Unheated Wind Speed (pulse output)/ Electric Speed Indicator- Split tail Wind Direction transmitter. Located on Gombu; 2 ½ feet above roofline	

Appendix A. High Elevation Climate Stations Site Information and Location (continued)

Name/ID	Elevation m (ft)	Location UTM Northing Easting	Period of Record	Data logger/ Transmission	Precip	Temperature (max/min)/RH	Snowfall	Snow Depth	Wind Speed/ Direction	Soil Moisture/ Temperature
Sunrise Precipitation Site	1957 (6420 ft)	E 603484 N 5196393	2003– Present	Campbell Sci. CR10X, Freewave Spread spectrum Radio,,IML 56LV phone modem, Campbell Sci. Com 210 Phone Modem, yagi onmidirectional antenna	ETI Total precipitation gage, automated, 12 inch collection, ETI Antifreeze 55 gallon drum (propylene glycol/ethanol)	Campbell CS500 temp/RH sensor and radiation shield		Judd Acoustic Total Snow depth senor		CSI 107 & CS616 Soil Temp probes Depth A=5 cm Depth B=30cm Soil Moisture: A=0–20 B=20–40
Sunrise Wind Site	2103 (6900 ft)	E 602722 N 5196863	2004- Present	Campbell Sci. CR10X, Freewqve 902- 928 spread spectrum radio RF, Campbell Sci. 310 M RF Modem, yagi directional antenna		Campbell CS500 temp/RH sensor and gill 6 plate radiation shield			Wind direction/ Speed Taylor Scientific Unheated Wind Speed (pulse output)/ Electric Speed Indicator- Split tail Wind Direction transmitter. Located on 10 foot Rohn tower	
Chinook Pass Base Station	1676 (5500 ft)	E 613040 N 5191900	1984- present (some msg)	Campbell Sci. CR10X, Freewqve 902- 928 spread spectrum radio RF, Campbell Sci. 310 M RF Modem, yagi directional antenna	Sierra Misco 2500P12 propane heated 12 inch tipping bucket precipitation gage	Campbell CS500 temp/RH sensor and radiation shield; CSI 107 AT probe		Judd Acoustic Total Snow depth senor		

Appendix A. High Elevation Climate Stations Site Information and Location (continued)

Name/ID	Elevation m (ft)	Location UTM Northing Easting	Period of Record	Data logger/ Transmission	Precip	Temperature (max/min)/RH	Snowfall	Snow Depth	Wind Speed/ Direction	Soil Moisture/ Temperature
Chinook Pass Knob site	1902 (6240 ft)	E 612959 N 5192862	1984- present (some msg)	Campbell Sci. CR10X, Freewqve 902- 928 spread spectrum radio RF, Campbell Sci. 310 M RF Modem, yagi directional antenna		Campbell CS500 temp/RH sensor and radiation shield			Wind direction/ Speed Taylor Scientific Unheated Wind Speed (DC output)/Electric Speed Indicator- Split tail Wind Direction transmitter. Located on 10 foot Rohn tower	
Hurricane Ridge	1603 (5260 ft)	E 464440 N 5315913	1985- Present	Campbell Sci. CR10X datalogger Campbell 200 modem/phone line	Qualimetrics 12" electrically heated gage [Qualimetrics is now AllWeather]	Campbell Sci. CS500 temp/RH sensor and radiation shield		Judd Acoustic Total Snow depth senor	Taylor 120V heated Wind Speed & Direction Sensors	
Washington Pass Wind Site	2020 (6630 ft)	E 673717 N 5377137	1980- Present (data intermitt ent in some years)	Campbell Sci. 310 Phone Modem, Campbell Sci. 450 Mhz UHF Transceiver RF312, Antenex 7dBd omnidirectional antenna		Campbell Sci. CS500 temp/RH sensor and radiation shield			Taylor Scientific Unheated Wind Speed (pulse output)/Electric Speed Indicator- Split tail Wind Direction transmitter. Located on 10 foot Rohn Tower	

Appendix A. High Elevation Climate Stations Site Information and Location (continued)

Name/ID	Elevation m (ft)	Location UTM Northing Easting	Period of Record	Data logger/ Transmission	Precip	Temperature (max/min)/RH	Snowfall	Snow Depth	Wind Speed/ Direction	Soil Moisture/ Temperature
Washington Pass Precipitation Site	1679 (5500 ft)	E 673566 N 5377351	2004– Present	Campbell Sci. Com 310 Phone Modem, Campbell Sci. 450 Mhz UHF Transceiver RF312, Antenex 7dBd omnidirectional antenna	Sierra Misco 2500P12 propane heated 12 inch tipping bucket precipitation gage [Plan to replace with either Taylor propane heated 12-inch precip gage or ETI Total precipitation gage, automated, 12 inch collection, ETI Antifreeze 55 gallon drum (propylene glycol/ethanol)]	Campbell Sci. CS500 temp/RH sensor and radiation shield		Judd-2 Acoustic Snow depth sensor		
Washington Pass Base Station— Flagg Mountain, Mazama, WA				Campbell Sci. 450 Mhz UHF Transceiver RF312, RF 310 Base Station, Campbell Sci. 210 Telephone Modem						

Appendix A. High Elevation Climate Stations Site Information and Location (continued)

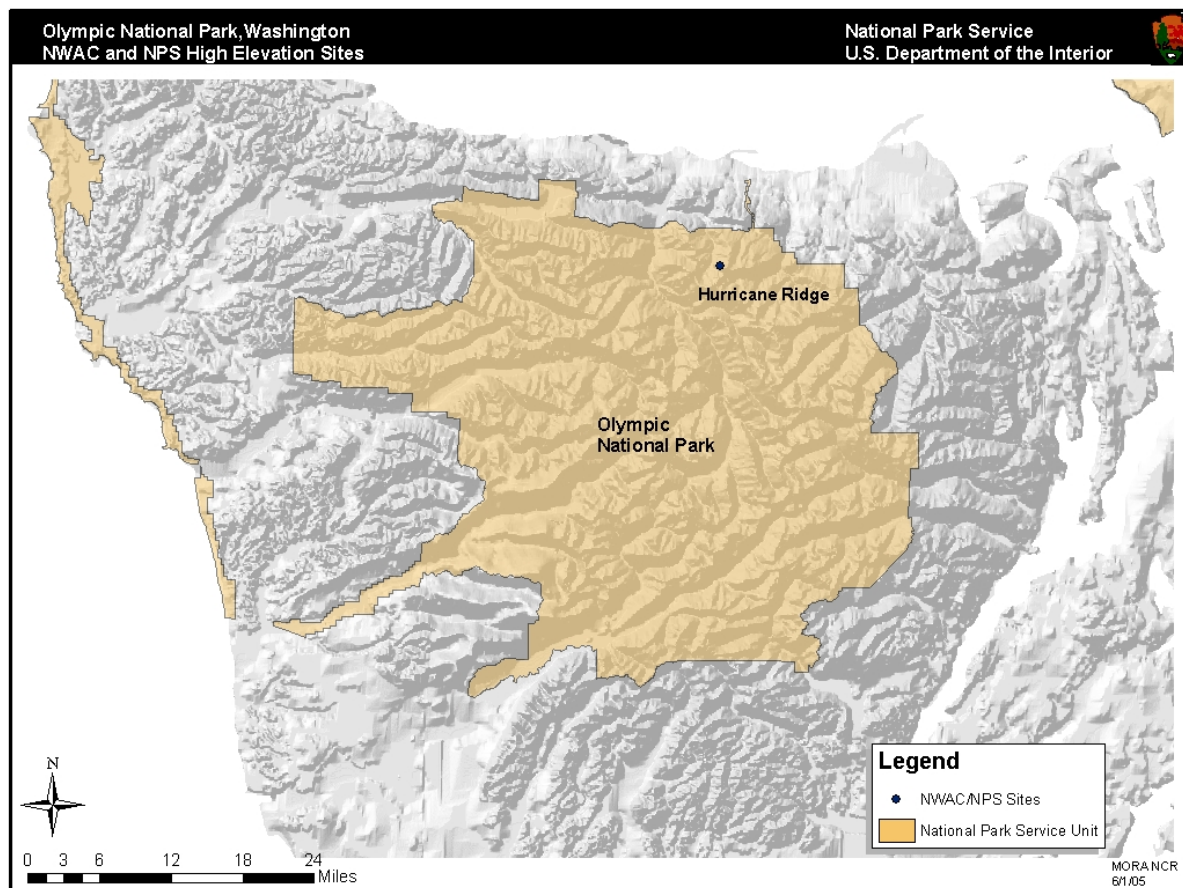


Figure A.1. Olympic National Park high-elevation weather station locations.

Appendix A. High Elevation Climate Stations Site Information and Location (continued)

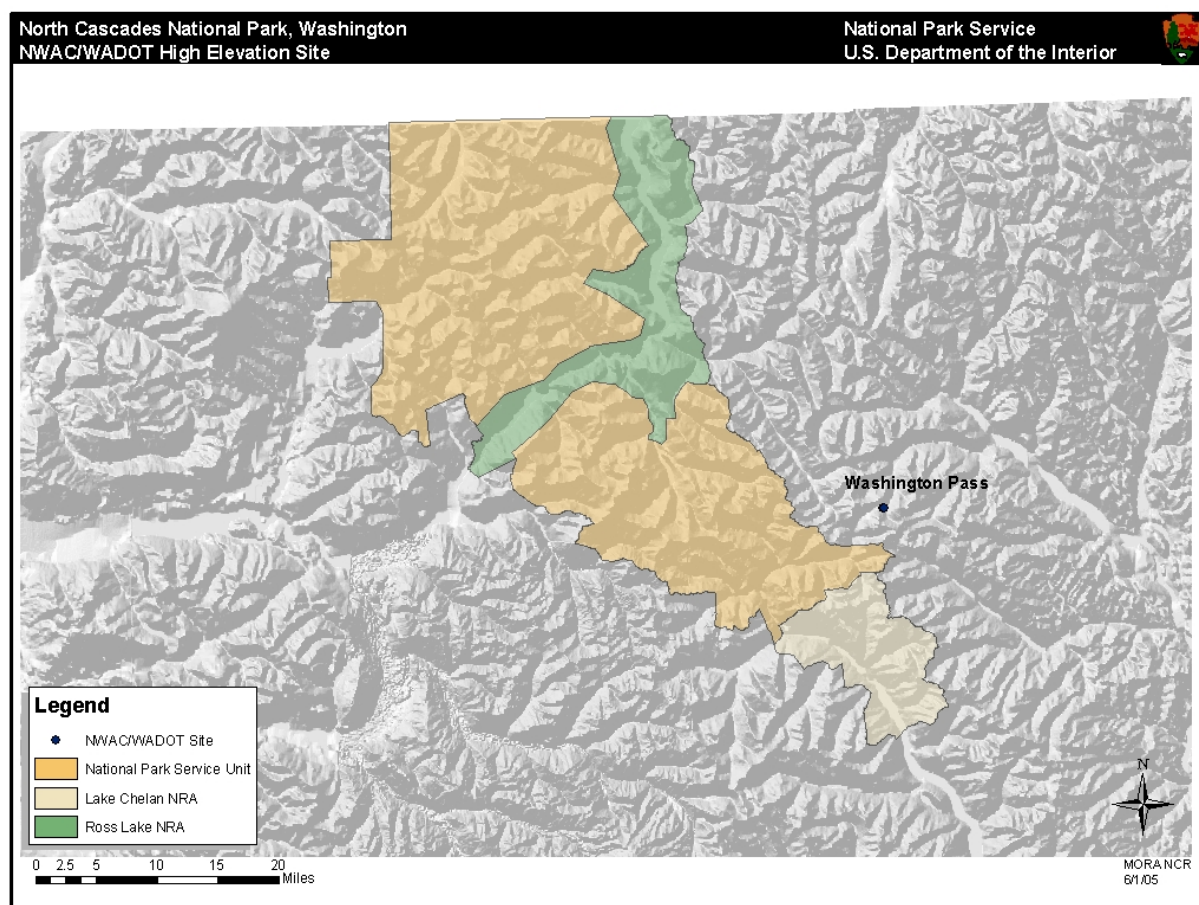


Figure A.2. North Cascades National Park high-elevation weather station locations.

Appendix A. High Elevation Climate Stations Site Information and Location (continued)

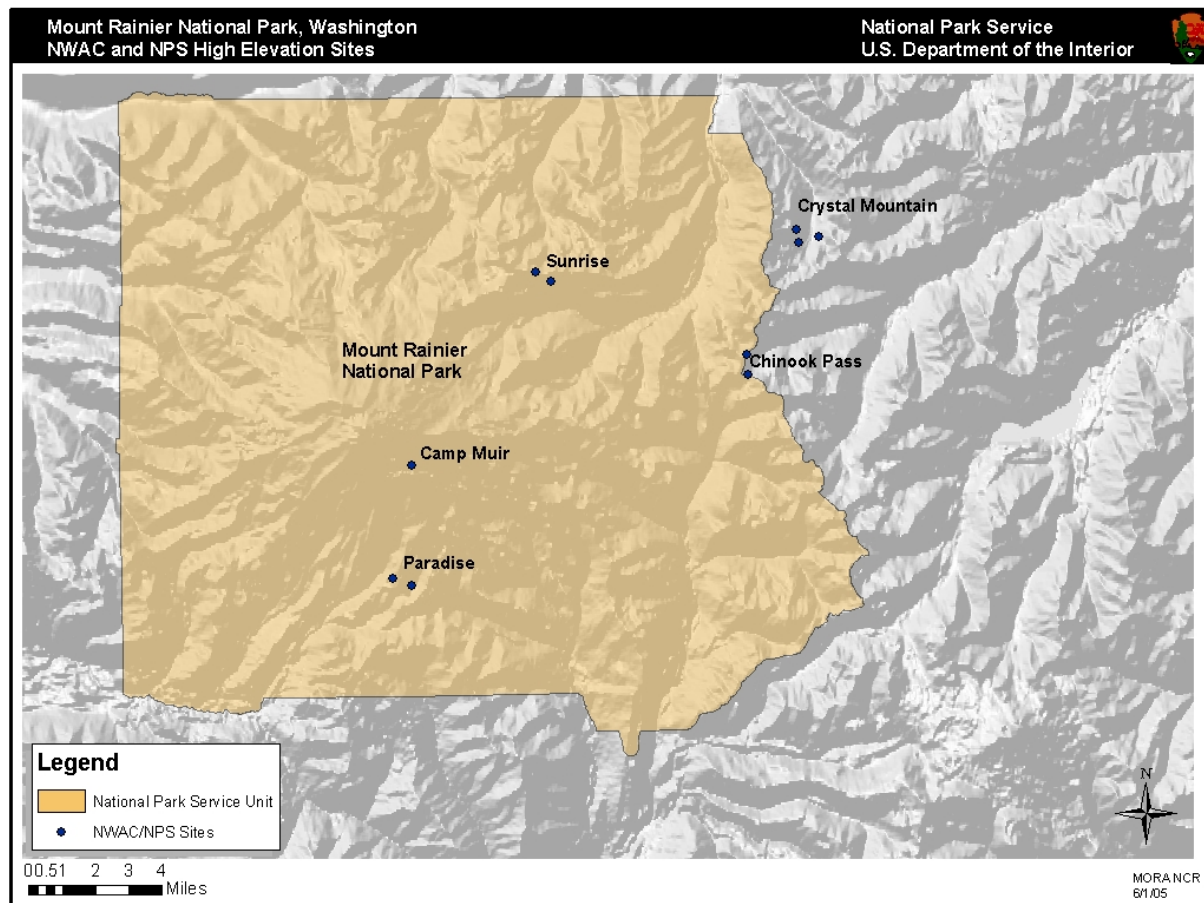
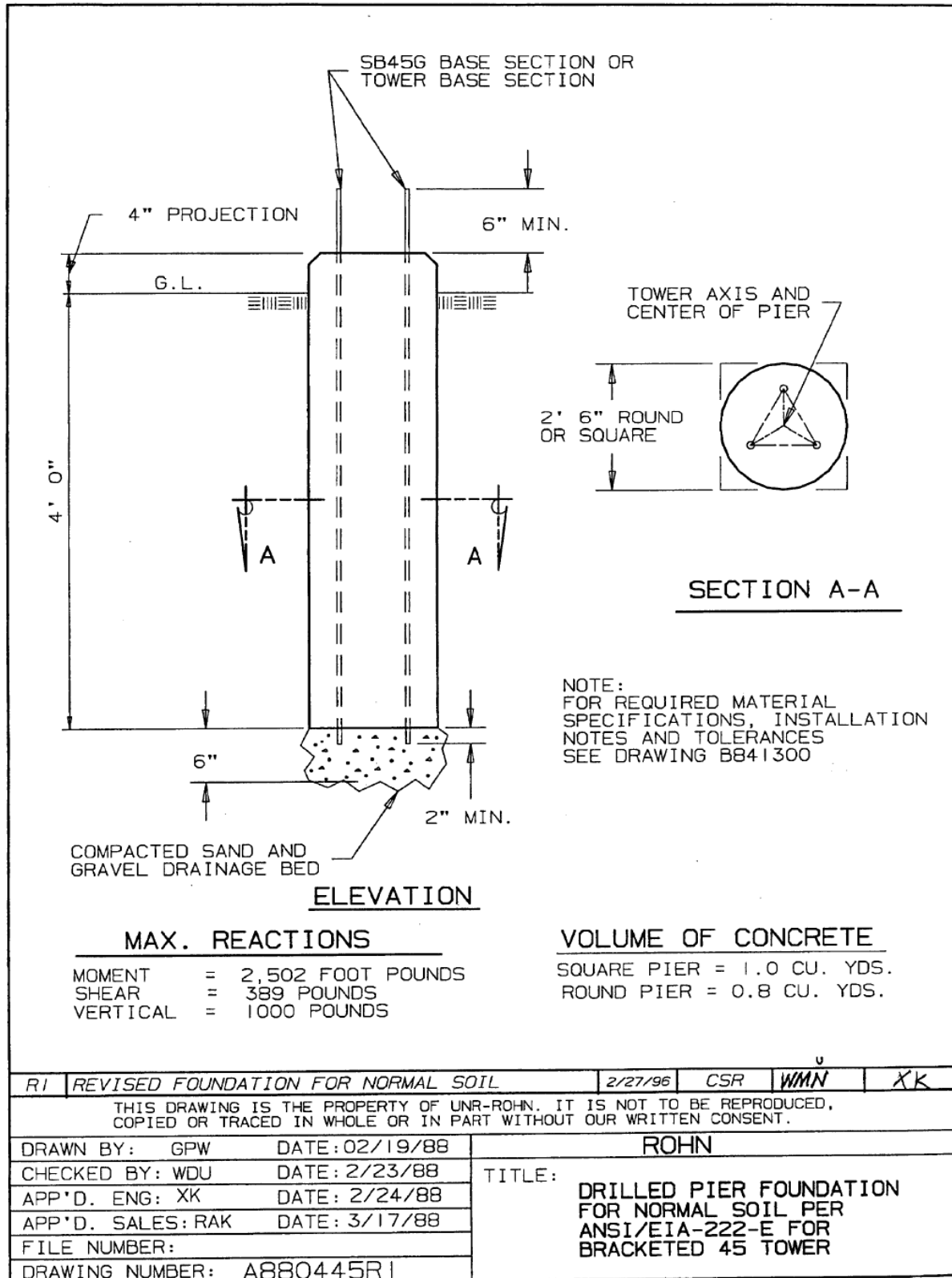


Figure A.3. Mount Rainier National Park high-elevation weather station locations.

Appendix B. Rohn 45G Bracketed Tower Specifications



ROHN®

SELF-SUPPORTING TOWERS - ALLOWABLE ANTENNA AREAS (SQ. FT.)

	70 MPH								80 MPH								90 MPH							
	NO ICE				1/2" ICE (NOTE 7)				NO ICE				1/2" ICE (NOTE 7)				NO ICE				1/2" ICE (NOTE 7)			
HT.	#25	#45	#55	#65	#25	#45	#55	#65	#25	#45	#55	#65	#25	#45	#55	#65	#25	#45	#55	#65	#25	#45	#55	#65
10'	19.7	42.5	75.0	175.9	22.8	55.0	99.0	231.4	14.3	30.0	57.0	133.0	15.5	40.0	74.0	174.3	10.5	25.0	45.0	103.6	10.5	30.0	57.0	135.0
20'	14.2	22.0	43.0	117.0	14.4	25.0	52.0	150.0	9.0	16.0	30.0	85.0	7.1	16.0	35.0	105.0	6.9	11.0	23.0	85.0	2.1	10.0	26.0	85.0
30'	6.4	12.0	26.0	76.2	2.5	9.0	27.0	95.0	3.7	7.5	17.0	55.8	0.0	2.7	16.0	65.0	1.7	4.0	12.0	40.0	0.0	0.0	9.0	49.0
35'	3.6	8.7	21.9	61.2	0.0	4.7	22.2	76.4	1.4	4.7	14.5	44.0	0.0	0.0	12.4	53.4		1.9	9.4	32.2		0.0	5.7	37.7
40'	1.5	5.1	15.0	48.8	0.0	0.0	8.0	59.1		1.4	8.0	34.1		0.0	2.5	39.0			4.0	24.1			0.0	25.0
45'		2.3	11.4	39.0			5.5	45.7			5.9	26.2			0.0	28.8			2.2	17.7			0.0	17.2
50'			6.5	29.3			0.0	33.5			1.5	19.7			0.0	19.1				14.5				8.0
55'			4.0	24.4			0.0	25.0				14.5				11.4				7.7				2.6
60'			0.8	18.4			0.0	16.0				9.4				4.1				3.3				0.0
70'				8.7				1.9				1.3				0.0								
80'				0.9				0.0																

1. TOWER DESIGNS ARE IN ACCORDANCE WITH APPROVED NATIONAL STANDARD ANSI/EIA-222-E.
2. ALL TOWERS MUST HAVE "FIXED" BASES. PINNED BASES MUST NOT BE USED.
3. DESIGNS ASSUME TRANSMISSION LINES SYMMETRICALLY PLACED AS FOLLOWS:
#25 TOWER - ONE 5/8" LINE ON EACH FACE (TOTAL = 3).
#45 TOWER - ONE 7/8" AND ONE 1/2" LINE ON EACH FACE (TOTAL = 3 @ 7/8" & 3 @ 1/2").
#55 & #65 - TWO 7/8" LINES ON EACH FACE (TOTAL = 6).
4. ANTENNAS AND MOUNTS ASSUMED SYMMETRICALLY PLACED AT TOWER APEX.
5. ALLOWABLE ANTENNA AREAS ASSUME ALL ROUND ANTENNA MEMBERS.
6. ALLOWABLE FLAT-PLATE ANTENNA AREAS, BASED ON EIA RS-222-C, MAY BE OBTAINED BY MULTIPLYING AREAS SHOWN BY 0.6.
7. FOR WIND SPEEDS WITH ICE, THE AREAS SHOWN INCLUDE 1/2" RADIAL ICE. ANTENNA AREAS WITHOUT ICE MUST NOT EXCEED THE AREAS SHOWN FOR THE NO ICE CONDITION.
8. DO NOT INSTALL OR DISMANTLE TOWERS WITHIN FALLING DISTANCE OF ELECTRICAL AND/OR TELEPHONE LINES.
9. TOWER ERECTION AND DISMANTLING MUST BE BY QUALIFIED AND EXPERIENCED PERSONNEL.
10. INSTALL WARNING PLATE (P/N ACWS) IN A HIGHLY VISIBLE LOCATION.
11. ALL ANTENNA INSTALLATIONS MUST BE GROUNDED IN ACCORDANCE WITH LOCAL AND NATIONAL CODES.
12. FOR FOUNDATION DETAILS SEE DRAWING B870725.

BY: *R.A.M.* DATE: *9/24/87* CHECKED: *Red* DATE: *9-24-87* DWG. NO. A871266R1

SOP 2.42

25G-1

25G



Appendix C. Campbell Scientific Instrument Instruction Manuals: Links

New and archived Campbell Scientific, Inc. Instruction manuals can be downloaded at:
<ftp://ftp.campbellsci.com/pub/outgoing/manuals/>

Datalogger

CR10X Overview <ftp://ftp.campbellsci.com/pub/outgoing/manuals/cr10x-ov.pdf>

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

Power Supplies

CH12R or CH100 charging regulator. Manual available via CSI request

Modems

Com 200 Telephone Modem

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/com200.pdf>

Com 210 Telephone Modem

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/com210.pdf>

Com 310 Telephone Modem

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/com310.pdf>

Sensors

Air temperature/Relative Humidity CS500

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/cs500.pdf>

Air temperature/Relative Humidity HMP45C

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/hmp45c.pdf>

Soil temperature Probe

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/107.pdf>

Soil moisture Probe

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/cs616.pdf>

LI200X Pyranometer Solar radiation

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/li200x.pdf>

Software

LoggerNet – PC to Datalogger capabilities

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/loggernet3-3.pdf>

PConnect – Palm handheld device to datalogger capabilities

<ftp://ftp.campbellsci.com/pub/outgoing/manuals/pconnect.pdf>

Appendix D. Electric Speed Indicator Wind Speed/Direction Manual: Links

The manual for operating and maintaining the wind speed and direction indicators manufactured by Electric Speed Indicator Co Inc. was available on the Reports and Publications web site for the North Coast and Cascades Network

(<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>) as of 15 April 2010.

Literature

Electric Speed Indicator Co. Inc. 1980. Wind Speed and Wind Direction Indicator Instruction, Operations and Maintenance Manual, Type FAA-277 and Type F420C. Electric Speed Indicator Co. Inc., Cleveland, Ohio. Available at North Coast and Cascades Network publications web site (<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>).

Appendix E. Judd Communications Depth Sensor Manuals: Links

The manual for operating and programming Judd Communications depth sensor was available on the Reports and Publications web site for the North Coast and Cascades Network (<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>) and on the manufacturer's web site (<http://www.juddcom.com/ds2manual.pdf>) as of 16 April 2010. Sample programming information for the sensor was also available on the company web site (<http://www.juddcom.com/>).

Literature

Judd Communications. Depth sensor manual. Judd Communications, Salt Lake City, Utah. Online. (<http://www.juddcom.com/ds2manual.pdf>). Accessed 16 April 2010. Also online, North Coast and Cascades Network web site (<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>).

Appendix F. Qualimetrics Precipitation Gauge 6028 User's Manual: Links

The manual for operating, calibrating, and maintaining the Qualimetrics precipitation gauge was available on the Reports and Publications web site for the North Coast and Cascades Network (<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>) as of 16 April 2010. Manuals for similar products were also available on the website of All Weather Inc. (<http://www.allweatherinc.com/>).

Literature

All Weather Inc. User's manual: 12" tipping bucket rain gauge Models 6018-A&B, 6028-A, B, C & D. All Weather Inc., Sacramento, California. (<http://www.allweatherinc.com/>).

Appendix G. NOAH II Rain Gauge Instrument Manual: Links

The manual for operating the NOAH II Rain Gauge was available on the Reports and Publications web site for the North Coast and Cascades Network (<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>) as of 16 April 2010.

Literature

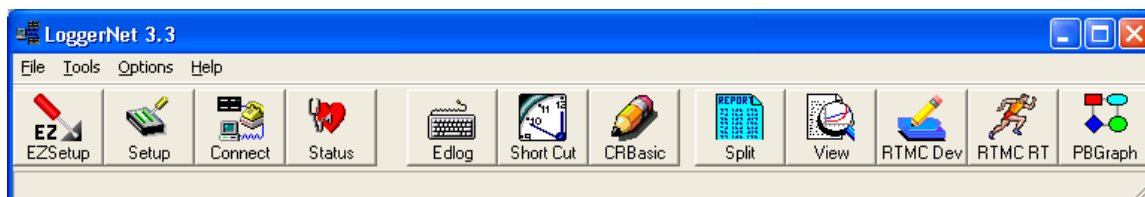
ETI Instrument Systems Inc. Instrument manual: NOAH II_(TM) Total Precipitation Gauge (Rohn Tower Model). ETI Instrument Systems Inc., Fort Collins, Colorado. Company web site: (<http://www.etisensors.com/index.htm>).

Appendix H. Configuring a Campbell Scientific Datalogger Using LoggerNet®

LoggerNet® Overview

Once LoggerNet® is loaded onto a PC or laptop, the toolbar menu shown below is used to navigate through various functions. Following is a brief description of the purpose of each tool in the toolbar. The EZSetup Wizard is a simple method of creating a connection between a PC running LoggerNet® and a Campbell Scientific datalogger. The steps to set up a communication link with a datalogger utilizing the EZSetup Wizard are described in detail in this appendix.

Open LoggerNet® by double clicking on the icon on your desktop. The following tool bar will open



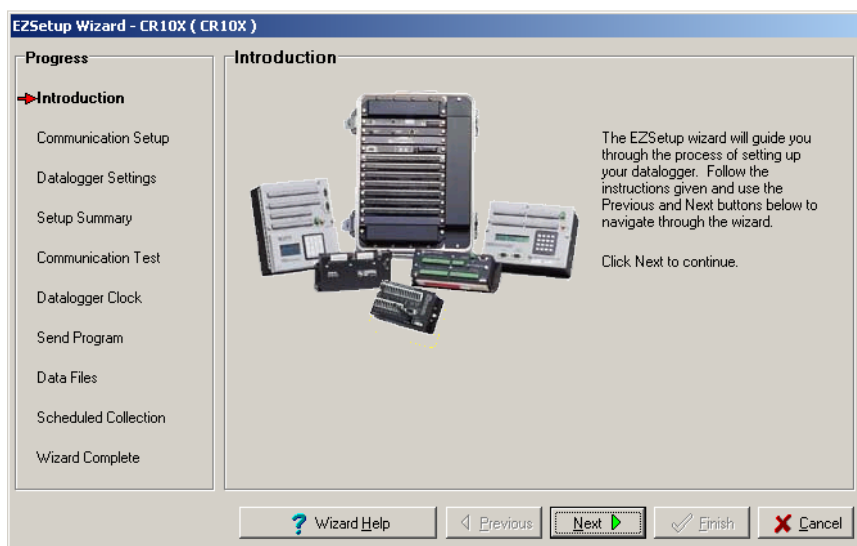
- **EZSetup:** The EZSetup wizard is designed to walk you through the setup and configuration of your datalogger network.
- **Setup:** The Setup button accomplishes the same tasks as EZSetup, but allows the user a bit more control when setting up your network, and allows for more complex network configurations.
- **Connect:** The Connect button is used primarily for initializing or checking operation of a datalogger and manually collecting data. This screen provides near real-time communication with a datalogger.
- **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:** A tool used for creating, editing, and documenting programs for Campbell Scientific 21x, CR10 and CR10X dataloggers.
- **Short Cut:** A user friendly interface for creating simple programs for Campbell Scientific 21x, CR10 and CR10X dataloggers. Designed for the beginner datalogger programmer. Datalogger programs may be created using shortcut and later adapted and edited in Edlog.
- **CR Basic:** The programming language used for CR200, CR5000 or CR9000 dataloggers.
- **Split:** A tool used to analyze data collected from Campbell Scientific dataloggers.
- **View:** Program used to look at any data file collected from dataloggers, regardless of the format (comma separated, table oriented ASCII, binary, or printable).

Appendix H. Configuring a Campbell Scientific Data Logger (continued)

- **RTMC Dev:** Real-Time Monitor and Control Development is a graphic display editor that is used for real-time data displays of the data collected by the LoggerNet server.
- **RTMC RT:** Real-Time Monitor and Control Run-time available separately from LoggerNet. It allows the user to run forms created in RTMC so that data can be displayed on a remote computer.
- **PBGraph:** Used to visually monitor and retrieve settings from devices in a PakBus network (a networking communication protocol).

EZSetup: Programming the Datalogger

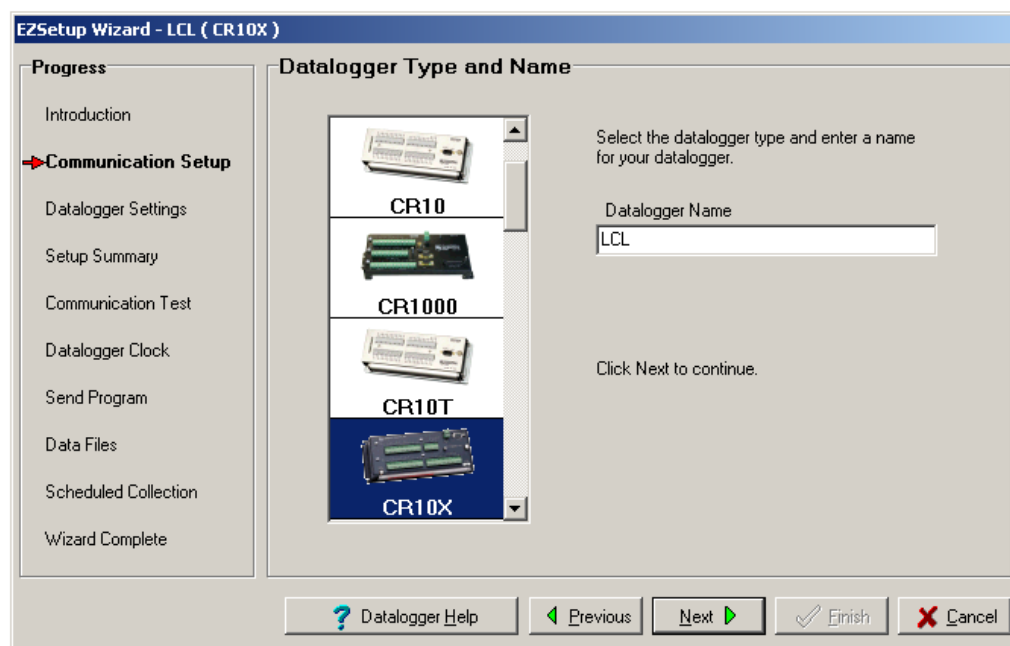
The EZSetup wizard is designed to walk you through the setup and configuration of a datalogger. As you work through the steps for the Wizard, each screen has fields that are completed with the pertinent information about your station. In addition to setting up a new station, the EZSetup Wizard can be used to edit an existing Station. EZSetup wizard is opened from the Toolbar screen.



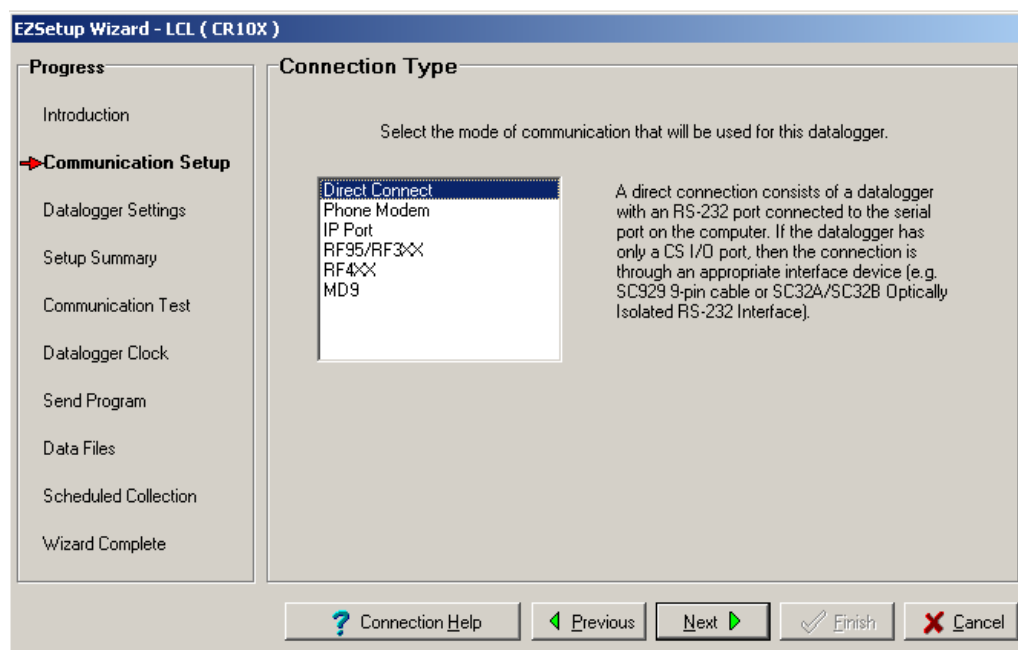
Communication Setup

This screen allows you to select the datalogger type and give it a name, define the configuration of COM ports, modems and communications settings such as phone numbers and RF radio addresses. The communications setup begins with the screen below. For setting up a telemetry based system, see Appendix H, Automated Data Transmittal.

Appendix H. Configuring a Campbell Scientific Data Logger (continued)



Click on the appropriate Datalogger Type (e.g. CR10X) and give the Datalogger a unique name appropriate for the location. Click Next. Highlight Direct Connect (see below) to connect directly to the datalogger using a serial cable and an RS-232 interface. Hit the NEXT button.

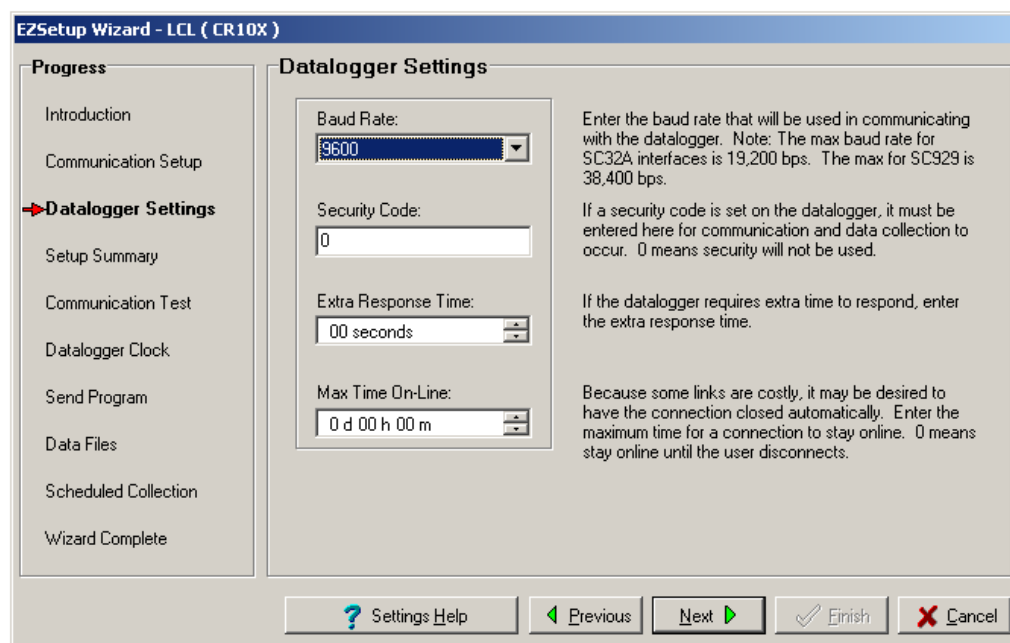


Choose the communication port you will be using on the computer. Click NEXT.

Appendix H. Configuring a Campbell Scientific Data Logger (continued)

Datalogger Settings

This step is provided for fine tuning the connection to the datalogger. Use the default settings shown above, Baud rate of 9600, No security code, extra response time or Max Time On-Line (see below).



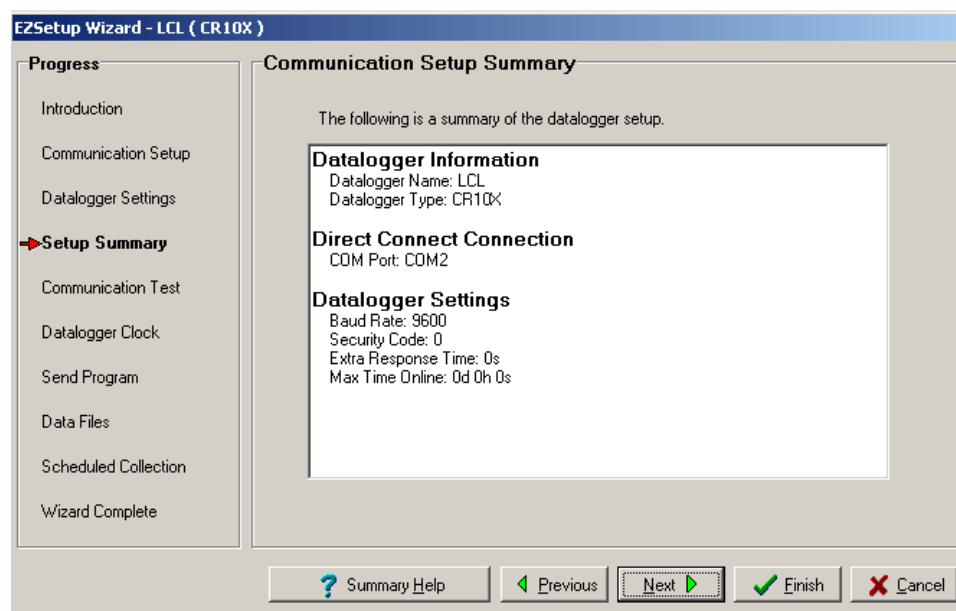
The screenshot shows the 'Datalogger Settings' window of the EZSetup Wizard. On the left, a 'Progress' sidebar lists steps: Introduction, Communication Setup, **Datalogger Settings** (highlighted with a red arrow), Setup Summary, Communication Test, Datalogger Clock, Send Program, Data Files, Scheduled Collection, and Wizard Complete. The main area is titled 'Datalogger Settings' and contains four input fields with explanatory text to their right:

- Baud Rate:** A dropdown menu showing '9600'. Text to the right: 'Enter the baud rate that will be used in communicating with the datalogger. Note: The max baud rate for SC32A interfaces is 19,200 bps. The max for SC929 is 38,400 bps.'
- Security Code:** A text box containing '0'. Text to the right: 'If a security code is set on the datalogger, it must be entered here for communication and data collection to occur. 0 means security will not be used.'
- Extra Response Time:** A text box containing '00 seconds'. Text to the right: 'If the datalogger requires extra time to respond, enter the extra response time.'
- Max Time On-Line:** A text box containing '0 d 00 h 00 m'. Text to the right: 'Because some links are costly, it may be desired to have the connection closed automatically. Enter the maximum time for a connection to stay online. 0 means stay online until the user disconnects.'

At the bottom, there are five buttons: '? Settings Help', '< Previous', 'Next >', '✓ Finish', and '✗ Cancel'.

Setup Summary

The Setup Summary provides a list of the settings entered. Review the information.



The screenshot shows the 'Setup Summary' window of the EZSetup Wizard. The 'Progress' sidebar on the left is the same as in the previous screen, but 'Setup Summary' is now highlighted with a red arrow. The main area is titled 'Communication Setup Summary' and contains the following text:

The following is a summary of the datalogger setup.

Datalogger Information
Datalogger Name: LCL
Datalogger Type: CR10X

Direct Connect Connection
COM Port: COM2

Datalogger Settings
Baud Rate: 9600
Security Code: 0
Extra Response Time: 0s
Max Time Online: 0d 0h 0s

At the bottom, there are five buttons: '? Summary Help', '< Previous', 'Next >', '✓ Finish', and '✗ Cancel'.

From this screen, you can use the PREVIOUS button to return to a page and change these settings if necessary, or hit NEXT to test communication.

Communication Test

This step allows you to test the communication link with the datalogger and ensure that the datalogger has been set up correctly. Click Yes and then NEXT to continue. A screen should open indicating that communication is successful. If it is unsuccessful check to make sure 1) the serial cable and RS232 interface are attached to the serial ports on the computer and datalogger, 2) the datalogger is currently running and has a power source (you may need to check power supply with a volt meter, 3) review the set up to ensure the appropriate set up was used. Once communication is successful, click NEXT.

Datalogger Clock

On this screen, compare the Datalogger Clock to the PC Date/Time. Date and time should match within 2 minutes. If not, click on the Set Datalogger Clock button. [Note: All NPS climate stations run on standard time and should not be adjusted to daylight savings time. If you set the datalogger clock from a PC adjusted to daylight savings time, you will need to set the Time Zone Offset to -1 hours. Hit NEXT.

EZSetup Wizard - CR10XTest (CR10X)

Progress

- Introduction
- Communication Setup
- Datalogger Settings
- Setup Summary
- Communication Test
- Datalogger Clock**
- Send Program
- Data Files
- Scheduled Collection
- Wizard Complete

Datalogger Clock

Datalogger Date/Time: 2/1/2007 1:25:00 PM

PC Date/Time: 2/1/2007 1:25:01 PM

If the Datalogger Date/Time does not match the PC Date/Time you may wish to set the datalogger's clock.

To check the datalogger clock, click the "Check Datalogger Clock" button.

Time Zone Offset: -1 hours

The Time Zone Offset will be used in setting the datalogger clock.

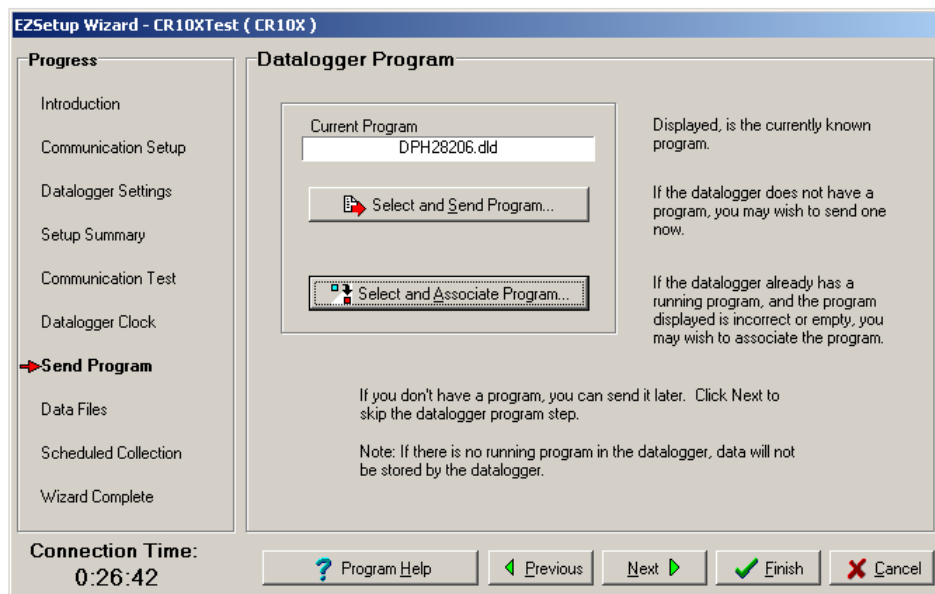
To set the datalogger clock, click the "Set Datalogger Clock" button. Otherwise, click Next to continue.

Note: Because there are delays in the communication link, when the clock is set there may be some difference between the datalogger and PC clock.

Connection Time: 0:21:53

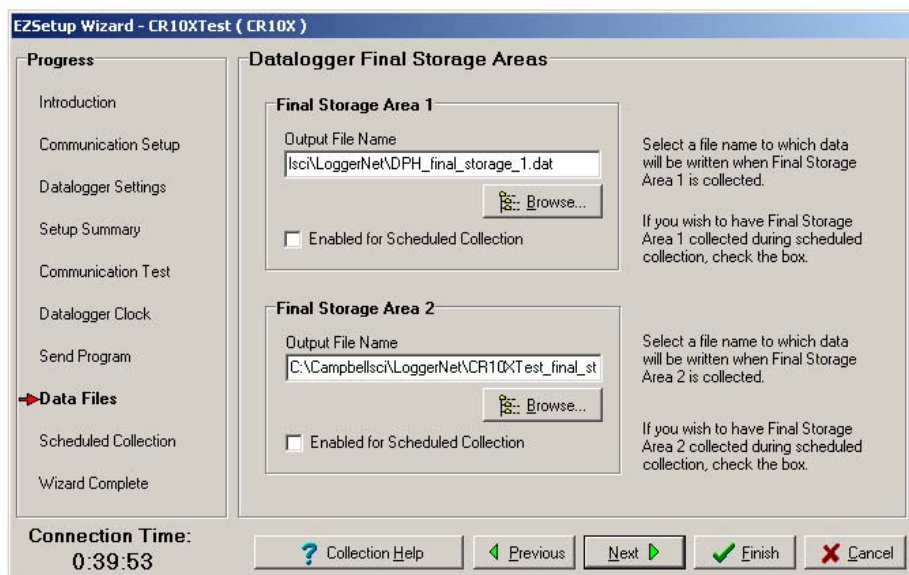
Send Program

The Send Program step allows you to send or associate a program to the datalogger. If the datalogger is already running a program, you should Select and Associate the .DLD file so that LoggerNet will use the labels for input and final storage. If you don't have a program currently on the datalogger you can choose the appropriate program using the Select and Send Program button.



Data Files

This step is used to define what data tables, or final storage areas, should be collected by LoggerNet and saved to disk. A datalogger program may send final output data to either Final Storage Area 1 or both Area 1 and 2. (e.g. a program may compile hourly data in Area 1 and daily summaries in Area 2). Type in the appropriate drive, path and filename or use the Browse button to identify the correct path and directory. Click Scheduled Collection only if your datalogger uses a remote modem connection (see Scheduled Collection).



Scheduled Collection

This is only used for dataloggers using modem connection, and allows you to define a schedule on which LoggerNet will automatically call the datalogger and collect data. Within the NCCN/NWAC Network, data is collected on an hourly basis. If data is usually collected with a direct connection, leave the Enabled for Schedule Collection boxes unchecked. Click the FINISH button. The Wizard Complete page will open.

Wizard Complete

Once a datalogger has been configured, it can be edited directly in the Setup window, or you can edit it using the EZSetup Wizard. When editing in the EZSetup Wizard, click the step on the left side of the Introduction page to go directly to that step, or walk through each wizard page using the Next button.

Appendix I. High Elevation Climate Stations, Maintenance Log: Example

Todays Date =		3/25/2010												
Site Name	Code	Date of Last Visit	Date of Next Visit	Days until Next Visit	Battery Start Date	Battery End Date	Gauge (RG) Calibration Date	Last HMP Sensor Swap	HMP Swap Due	Wind Maintenance	Windset Swap Due	Soil Temp/Moisture Swap	Soil Temp/Moisture Swap	Snow Sensor Dessicant
Muir	MRU	12/19/2006	6/17/2007	-1012	12/19/2006	08-Dec-08	5/17/2006	8/19/2006	8/19/2007	8/16/2006	8/16/2007	8/22/2005	8/22/2007	10/11/2001
Sunrise	SUN	10/29/2006	4/27/2007	-1063	10/29/2006	18-Oct-08	10/12/2006	10/12/2006	10/12/2007	N/A		N/A		
Paradise	PVC	10/4/2006	4/2/2007	-1088	10/4/2006	23-Sep-08	10/4/2006	10/6/2006	10/6/2007	N/A		N/A		10/4/2006
Days until Next Vist will indicate red 180 days after Date of Last Visit.														
Battery End Date is calculated as Battery Installed plus 720 days.														
Last RG (Rain Gauge) Calibration date will indicate red when more than 360 days have past since TB calibration date.														
HMP (Air/RH sensor) Sw ap Due is calculated as date of last HMP sensor sw ap plus 360 days. Date will indicate red when more than 360 days have past.														
Wind Maintenance is calculated as date of last Windset calibration plus 360 days. Date will indicate red when more than 360 days have past.														
PAR Sw ap Due is calculated as date of last PAR sensor sw ap plus 720 days. Date will indicate red when more than 720 days have past.														

Appendix J. North Coast and Cascades Network Climate Station Site Visit Form

SITE OBSERVATIONS

TOPIC	DESCRIPTION
Site Name	DPO
Date of Site Visit?	
Time of Visit?	
Data File Name?	Start Record: End Record:
Datalogger Time Changed (Y/N)?	Datalogger Time = PC Time (Set to NIST on) =
Observers Name?	
Battery Swapped?	
Program Name on Arrival/Departure	Arrival: Departure:
Change(s) to Program	1) 2) 3)
Overall Site Condition?	
Wind speed sensor?	
Dessicant changed??	
Rain Gage cleaned?	
Empty Ethanol Glycol mixture	
Telemetry equipment?	
Access to the Site?	
Photo Documentation?	
Current Weather Conditions?	

Appendix J. North Coast and Cascades Network Climate Station Site Visit Form (continued).

DATA FIELD EXAMPLE

DEFINITION	UNITS	MONITORED DATA	EXCEPTABLE SENSOR RANGES	COMMENTS
Program ID	None		Julian Day.YY	
CR10 Battery Voltage	Volts		10.5 to 13.0v	
Tsoil Litter Surface	°C		-33°C to +48°C	
Tsoil 5 cm	°C		-33°C to +48°C	
Tsoil 15 cm	°C		-33°C to +48°C	
Tsoil 30 cm	°C		-33°C to +48°C	
Tair	°C		-20°C to +60°C	
Relative Humidity	%		0% to 100%	
PAR Up	μmol m-2 s-1		-5 to 2500	
Totalized Rain Fall	mm hr-1		0.01"@ 1 tip to 2"/hr	
Wind Speed	m s-1		0.447 m/s to 53 m/s	
Soil Moisture, Surface	v/v		0.0 to 1.0	
Soil Moisture, 0-20 cm	v/v		0.0 to 1.0	
Soil Moisture, 20-40 cm	v/v		0.0 to 1.0	
Soil Moisture, 40-60 cm	v/v		0.0 to 1.0	
Wind Direction	° True North		0-360°	
Snow Depth	Cm		0-250cm	
CR10 Panel Temp	°C		-25 ° C to 50 ° C	

CALIBRATIONS, VERIFICATIONS, SENSOR SWAPPING

SENSOR	IN OR OUT	PRODUCT/ MODEL #	SERIAL NUMBER	COMMENTS

Additional Comments:

Appendix K. Procedures for Replacement of Ethanol Glycol Mixture for ETI NOAA II Total Precipitation Gauge

The Sunrise precipitation site at Mount Rainier National Park is equipped with an ETI NOAA II Total Precipitation Gauge. Precipitation in the form of either rain or snow is collected in the chamber and mixed with a charge of antifreeze to keep the contents from freezing. A thin film of evaporation-suppressant oil manually placed in the gauge retards evaporation of the solution. (Appendix G, NOAA Precipitation Gauge Instruction Manual).

A drain-and-recharge feature automatically drains the gauge collection chamber when the level reaches a specific height. The gauge's electronics open a solenoid drain valve in the bottom of the collection chamber allowing the contents to drain into the waste reservoir. Once the chamber is emptied, a charge of specially formulated, environmentally friendly antifreeze solution is pumped into the collection chamber. This solution melts snow as it falls into the chamber, and it prevents the chamber contents from freezing. (Appendix G, NOAA Precipitation Gauge Instruction Manual).

Due to the heavy winter precipitation at Sunrise, two 55 gallon drums are used as waste reservoirs. They are connected together; as one drum reaches capacity, solution overflows into the second drum.

The drums must be emptied of waste once a year.

Items required to empty solution:

- Two 55 gallon empty drums for waste
- Siphon Pump to manually pump waste into empty drums
- ETI Blend #3 to replace antifreeze solution (see MSDS sheet).

Waste is pumped with a siphon pump into the empty drums. ETI Blend #3 is used to replace used antifreeze. At Mount Rainier National Park, waste is taken to the auto shop for disposal.

Contact information for ETI Blend #3:

Interstate Chemical Company
1-800-422-4485

Appendix K. Procedures for Replacement of Ethanol-Glycol Mixture for ETI NOAH II Total Precipitation Gauge (continued).

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INTERSTATE CHEMICAL COMPANY
MSDS for ETI BLEND #3

10 -Section X - Shipping Data

D.O.T. SHIPPING NAME: COMBUSTIBLE LIQUID, N.O.S.
(CONTAINS: ETHANOL, ISOPROPANOL)

PRODUCT NAME: ETI BLEND #3

DOT CLASSIFICATION: 3

UN/NA NUMBER: UN-1993

PACKING GROUP: III

COMPONENT RQ: NONE

PRODUCT LABEL: COMBUSTIBLE

SECONDARY LABEL: NONE

PLACARDED: COMBUSTIBLE

***** REGULATED IN BULK ONLY *****

11 -Section XI - Special Precautions

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in dry, cool area; keep containers closed; use adequate ventilation; wash thoroughly after handling; use protective clothing; no ignition sources present.

OTHER PRECAUTIONS: Clean equipment thoroughly prior to maintenance and/or repair.

12 -Section XII - SARA Title III

This product may contain toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Right-to-Know Act of 1986 and of 40 CFR Part 372.

Appendix K. Procedures for Replacement of Ethanol-Glycol Mixture for ETI NOAH II Total Precipitation Gauge (continued).

INTERSTATE CHEMICAL COMPANY MSDS for ETI BLEND #3	Date Printed: 02-12-2004 Page 1
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1 -Section I - General Information

MANUFACTURER'S NAME: INTERSTATE CHEMICAL COMPANY, INC.
EMERGENCY TELEPHONE NUMBER: (724) 981-3771
CHEMTREC EMERGENCY TELEPHONE NUMBER: (800) 424-9300
ADDRESS (NUMBER, STREET, CITY, STATE, ZIP): 2797 FREEDLAND RD.
HERMITAGE, PA 16148.
CHEMICAL NAME AND SYNONYMS: ORGANIC SOLVENT BLEND
TRADE NAME AND SYNONYMS: ETI BLEND #3
CHEMICAL FAMILY: MIXTURE
FORMULA: See Ingredients
DATE OF PREPARATION: 2/12/04
PREPARED BY: F. JAMES CORBETT, QC MANAGER
ICC MSDS #: IC-02003
DISCLAIMER: All information contained in this data sheet is believed to be true and accurate at this time. However, there is no guarantee expressed or implied. The physical data has been calculated from available information.

2 -Section II - Hazardous Ingredients

COMPONENT:	CAS#	VOL %	TLV(units)
ETHANOL	64-17-5	40-60	1000 PPM
PROPYLENE GLYCOL	57-55-6	40-60	N/L
ISOPROPYL ALCOHOL	67-63-0	1-10	400 PPM
METHANOL	67-56-1	1-5	200 PPM

3 -Section III - Physical Data

BOILING POINT (INDICATE IF "F" OR "C"): 174-369

Appendix K. Procedures for Replacement of Ethanol-Glycol Mixture for ETI NOAH II Total Precipitation Gauge (continued).

INTERSTATE CHEMICAL COMPANY MSDS for ETI BLEND #3	Date Printed: 02-12-2004 Page 2
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3 -Section III - Physical Data (continued)

VAPOR PRESSURE (mm Hg): 16.8 @ R.T.

VAPOR DENSITY (AIR = 1): 1.96

SPECIFIC GRAVITY (H2O=1): 1.1911

PERCENT VOLATILE BY VOLUME (%): 100

EVAPORATION RATE (But Ac = 1): 1.3

SOLUBILITY IN WATER: COMPLETE

APPEARANCE AND ODOR: CLEAR, COLORLESS LIQUID, MILD ALCOHOL ODOR.

4 -Section IV - HMIS Ratings

HEALTH		FLAMMABILITY	REACTIVITY	
2		3	0	
0 = Minimal	1 = Slight	2 = Moderate	3 = Serious	4 = Severe

5 -Section V - Fire and Explosion Hazard Data

FLASH POINT (METHOD USED): 110 F (TCC)

FLAMMABLE LIMITS: Volume % in Air
LEL: 4.8
UEL: 25.2

EXTINGUISHING MEDIA: CO2, dry chemical, alcohol foam, water mist (fog).

SPECIAL FIRE FIGHTING PROCEDURES: Use SCBA, wear protective equipment.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None.

Appendix K. Procedures for Replacement of Ethanol-Glycol Mixture for ETI NOAH II Total Precipitation Gauge (continued).

INTERSTATE CHEMICAL COMPANY
MSDS for ETI BLEND #3

Date Printed: 02-12-2004 Page 3

6 -Section VI - Health Hazard Data

THRESHOLD LIMIT VALUE: See sect. II.

EFFECTS OF OVEREXPOSURE:

EYE CONTACT: Slightly irritating but does not injure eye tissue.

SKIN CONTACT: Low order of toxicity. Frequent or prolonged contact may cause irritation and/or dermatitis.

INHALATION: High vapor/aerosol concentrations (greater than approximately 1000ppm) are irritating to the eyes and the respiratory tract; may cause headaches, dizziness, anesthesia, drowsiness, unconsciousness, and other central nervous system effects, including death.

INGESTION: Minimal toxicity. Small amounts of this product aspirated into the respiratory system during ingestion or vomiting may cause mild to severe pulmonary injury, possibly progressing to death.

EMERGENCY AND FIRST AID PROCEDURES:

EYE CONTACT: Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT: Immediately flush with large amounts of water; use soap if available. Remove contaminated clothing, including shoes, after flushing has begun.

INHALATION: Using proper respiratory protection, immediately remove the affected victim to fresh air. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

INGESTION: If swallowed, DO NOT induce vomiting. Keep at rest. Get prompt medical attention.

7 -Section VII - Reactivity Data

STABILITY (choose one): () UNSTABLE
(x) STABLE

* CONDITIONS TO AVOID: Heat, sparks, open flame.

Appendix K. Procedures for Replacement of Ethanol-Glycol Mixture for ETI NOAH II Total Precipitation Gauge (continued).

INTERSTATE CHEMICAL COMPANY MSDS for ETI BLEND #3	Date Printed: 02-12-2004 Page 4
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7 -Section VII - Reactivity Data (continued)

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: CO & CO2

HAZARDOUS POLYMERIZATION (choose one): () MAY OCCUR
(x) WILL NOT OCCUR

* CONDITIONS TO AVOID: None.

8 -Section VIII - Spill or Leak Procedures

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Contain spill; provide adequate ventilation; keep people away; EXTINGUISH ALL IGNITION SOURCES; keep material out of public waters; use dry absorbent on small spills.

WASTE DISPOSAL METHOD: Dispose of according to all federal, state and local regulations.

9 -Section IX - Special Protection Information

RESPIRATORY PROTECTION (SPECIFY TYPE): NIOSH approved organic vapor cartridge.

VENTILATION:

LOCAL EXHAUST: preferred
MECHANICAL (GENERAL): acceptable
SPECIAL: N/A
OTHER: N/A

PROTECTIVE GLOVES: Rubber or neoprene.

EYE PROTECTION: Safety glasses or goggles.

OTHER PROTECTIVE EQUIPMENT: Rubber apron and boots; eye bath, safety shower.

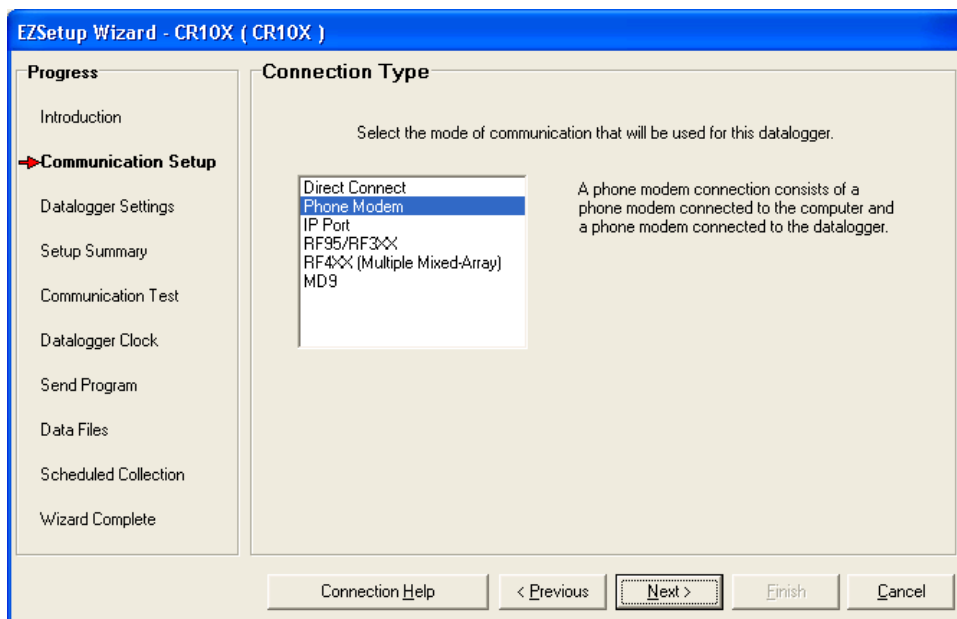
Appendix L. Automated Data Transmittal and Programming

Automated data transmission within the NWAC and NPS High Elevation Mountain Weather sites is accomplished through two types of communication modes: Phone Modem and Phone Modem to RF. LoggerNet allows the user to program the datalogger for the appropriate mode of communication and to set up and automate the data collection process by managing a station scheduler. This appendix describes the steps to program the datalogger for both modes of communication and the steps needed to download the data.

Phone Modem

The EZSetup Wizard is designed to walk you through the setup and configuration of your datalogger network. The following steps describe the steps to set up a phone modem connection.

The first step of the configuration process is to select the datalogger type and give it a name. Next you choose the mode of communication that will be used for the datalogger. Select phone modem. If a phone modem is the mode of communication, the following screens will prompt for type of modem, phone numbers, and response times.



Appendix L. Automated Data Transmittal and Programming (continued).

The next screen will prompt you to choose the phone modem and enter the phone number. If the desired modem is not on the list, you will be able to add a new one:

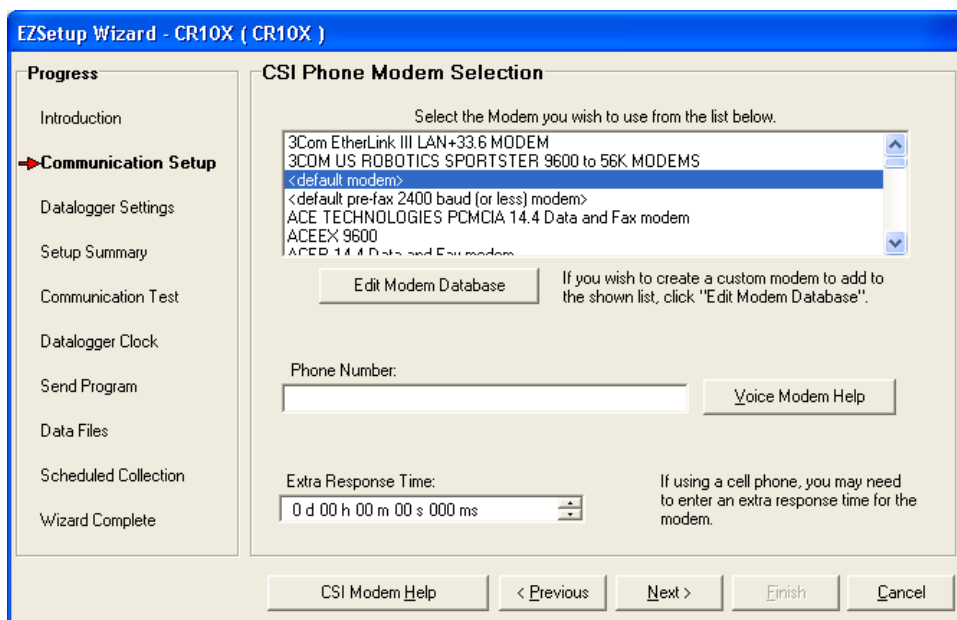
Sunrise Base: 360-663-2686

Sunrise Knob: 360-663-2346

Muir: 360-569-2168

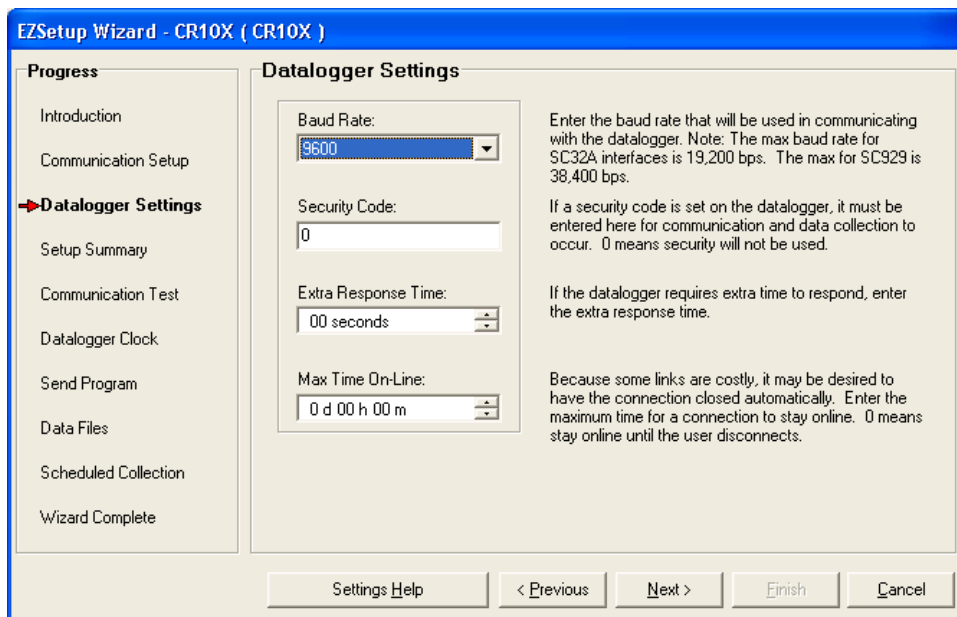
Paradise Precipitation site: 360-569-2849

Paradise Wind site: 360-569-2930



Appendix L. Automated Data Transmittal and Programming (continued).

The following screen allows you to list datalogger modem baud rate and to determine extra response times depending on the type of communication. While entering extra response times can be a trial and error process, normally the default response times will work (the shortest interval that allows for effective communication is normally the best).

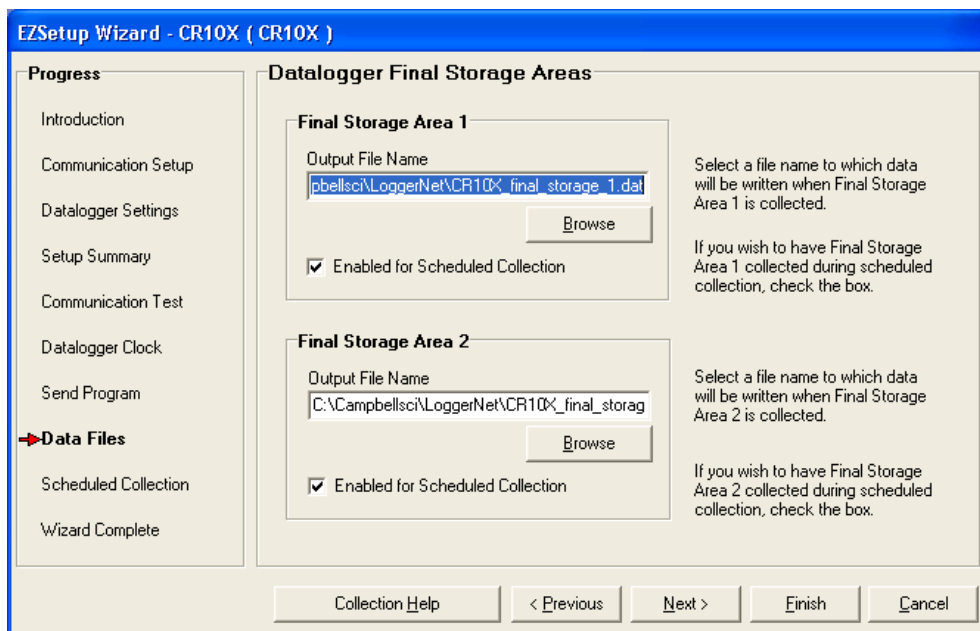


The screenshot shows the 'EZSetup Wizard - CR10X (CR10X)' window. The 'Progress' pane on the left lists steps: Introduction, Communication Setup, **Datalogger Settings** (highlighted with a red arrow), Setup Summary, Communication Test, Datalogger Clock, Send Program, Data Files, Scheduled Collection, and Wizard Complete. The main area is titled 'Datalogger Settings' and contains four input fields with explanatory text to their right:

- Baud Rate:** A dropdown menu showing '9600'. Text to the right: 'Enter the baud rate that will be used in communicating with the datalogger. Note: The max baud rate for SC32A interfaces is 19,200 bps. The max for SC929 is 38,400 bps.'
- Security Code:** A text box containing '0'. Text to the right: 'If a security code is set on the datalogger, it must be entered here for communication and data collection to occur. 0 means security will not be used.'
- Extra Response Time:** A spinner box showing '00 seconds'. Text to the right: 'If the datalogger requires extra time to respond, enter the extra response time.'
- Max Time On-Line:** A spinner box showing '0 d 00 h 00 m'. Text to the right: 'Because some links are costly, it may be desired to have the connection closed automatically. Enter the maximum time for a connection to stay online. 0 means stay online until the user disconnects.'

At the bottom are buttons: Settings Help, < Previous, Next >, Finish, and Cancel.

The Data Files tab allows you to designate the output file once the data is automatically collected.



The screenshot shows the 'EZSetup Wizard - CR10X (CR10X)' window. The 'Progress' pane on the left lists steps: Introduction, Communication Setup, Datalogger Settings, Setup Summary, Communication Test, Datalogger Clock, Send Program, **Data Files** (highlighted with a red arrow), Scheduled Collection, and Wizard Complete. The main area is titled 'Datalogger Final Storage Areas' and contains two sections for 'Final Storage Area 1' and 'Final Storage Area 2':

- Final Storage Area 1:** Includes an 'Output File Name' text box with 'pbelsci\LoggerNet\CR10X_final_storage_1.dat' and a 'Browse' button. Below it is a checked checkbox 'Enabled for Scheduled Collection'. Text to the right: 'Select a file name to which data will be written when Final Storage Area 1 is collected. If you wish to have Final Storage Area 1 collected during scheduled collection, check the box.'
- Final Storage Area 2:** Includes an 'Output File Name' text box with 'C:\Campbellsci\LoggerNet\CR10X_final_storag' and a 'Browse' button. Below it is a checked checkbox 'Enabled for Scheduled Collection'. Text to the right: 'Select a file name to which data will be written when Final Storage Area 2 is collected. If you wish to have Final Storage Area 2 collected during scheduled collection, check the box.'

At the bottom are buttons: Collection Help, < Previous, Next >, Finish, and Cancel.

Finally, the collection interval at which the LoggerNet server requests new data from the datalogger is set up on the Schedule Collection tab for that datalogger. If automatic interrogation is desired, this is where such scheduling is initiated.

EZSetup Wizard - CR10X (CR10X)

Progress

- Introduction
- Communication Setup
- Datalogger Settings
- Setup Summary
- Communication Test
- Datalogger Clock
- Send Program
- Data Files
- Scheduled Collection**
- Wizard Complete

Scheduled Collection

☐ Scheduled Collection Enabled

If you wish to have scheduled collection enabled for this datalogger check the box.

When to Collect

Base Date: 12/27/2006 Time: 12:00:00 AM

Enter the base date and time. This is when the first attempt to collect will occur. If the base is in the past, data collection will be attempted immediately when the schedule is enabled.

Collection Interval: 0 d 00 h 05 m 00 s 000 ms

Enter the Collection Interval. The collection interval is relative to the Base Date and Time entries. For instance, if the Base Time is set at 12:15 and the interval is set for 1 hour, data collection will be attempted at 12:15, 1:15, etc.

Schedule Help < Previous Next > Finish Cancel

Phone to RF

RF to Phone communication links requires the use of the Setup feature in the main Loggernet screen. Connecting a datalogger at the RF Base in a Phone to RF system requires some additional configuration.

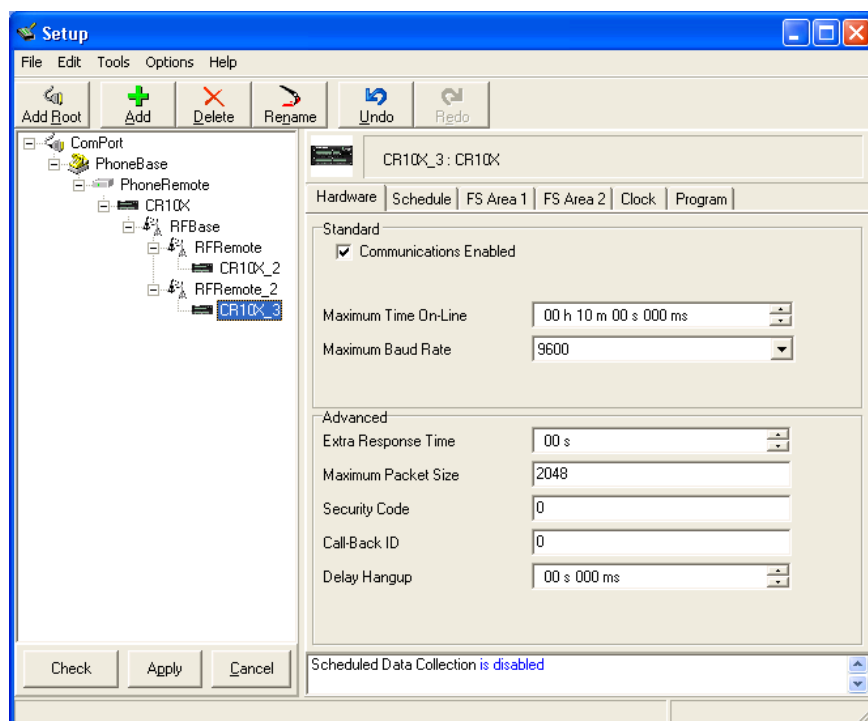
Setup

To begin, add a Serial Port to the device map. Add a Phone Modem to the Serial Port. To this Phone Modem, add a Remote Phone Modem. Setting up a datalogger at the RF base in a Phone to RF system requires that the datalogger be connected as a child of the remote phone modem, and the RF Base be connected as a child of the remote phone modem. Then the RF network is connected to the RF Base.

To do this, add a datalogger to the Remote Phone Modem. Next, add an RF base modem and then an RF remote modem. To complete the network, add your datalogger to the remote RF modem. Review all of the setting for each device, and make any changes to customize the setting for your network configuration.

The device map in the Setup Screen for a Phone to RF link with a datalogger at the remote site and base station would look similar to the communications network below. As with phone modem setup, depending on the type of RF connection, the phone to RF link, and the number of repeaters, the user may have to tweak the “Extra Response Times” settings to maximize reliable communications. Campbell Scientific Technical Support personnel (radio engineers) may be helpful in the event of communication difficulties.

Appendix L. Automated Data Transmittal and Programming (continued).



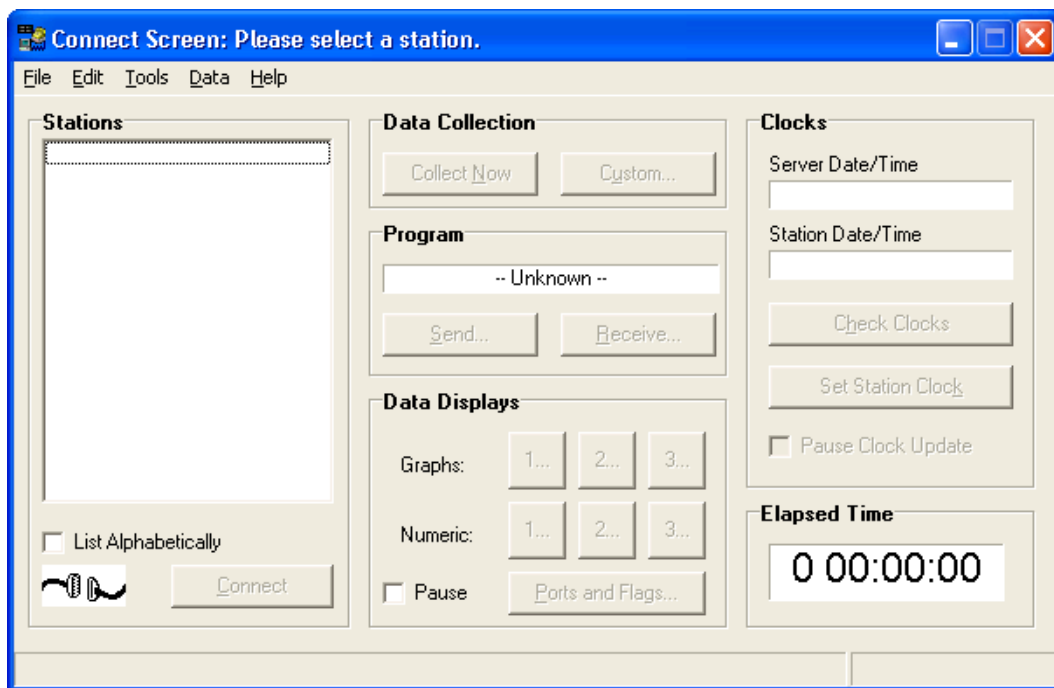
Appendix M. Climate Station Field Data Collection: Laptop

Downloading weather data from a CR10X datalogger in the field is accomplished with either a laptop or a Palm PDA. To collect data in the field via a laptop, Campbell Scientific, Inc. LoggerNet software is required. The following is a summary of the steps followed to download climate data in the field with a laptop.

LoggerNet Software must be installed on the laptop used in the field to download data. Detailed descriptions can be found in the Campbell Scientific, Inc. *Instruction Manual for LoggerNet, Version 3.3*, available with the purchase of LoggerNet or available online at <ftp://ftp.campbellsci.com/pub/outgoing/manuals/loggernet3-3.pdf>

Collecting Data in the Field

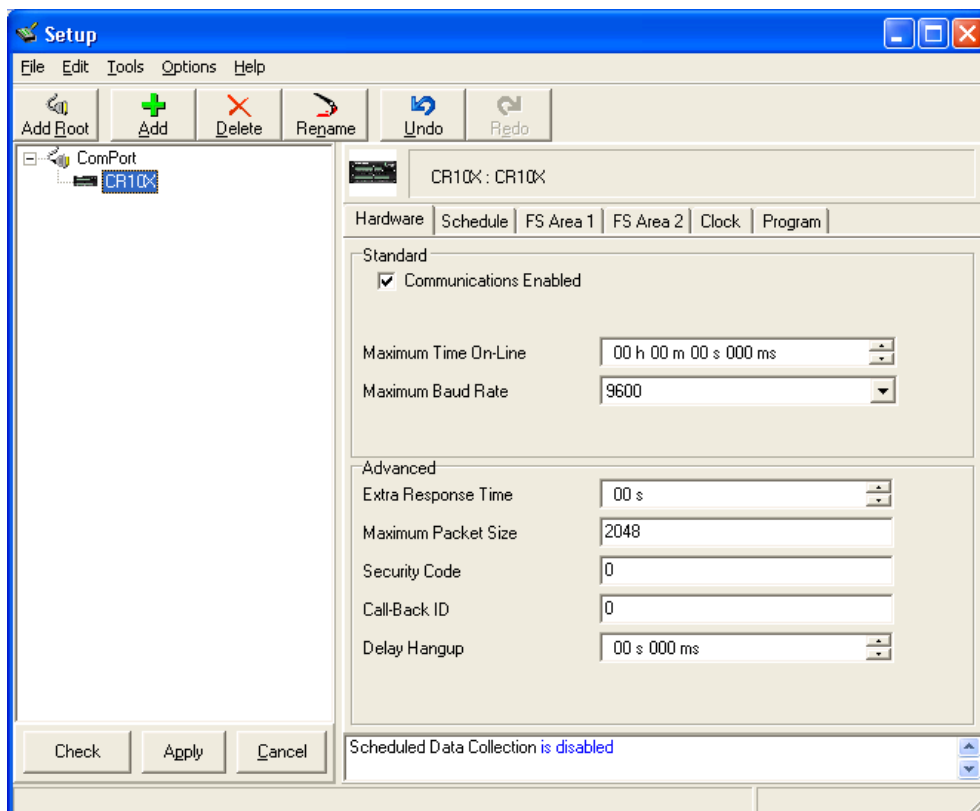
1. Connect the datalogger to the laptop using the 9-pin CSI serial cable for battery powered laptops.
2. Open LoggerNet and click **Connect** on the LoggerNet toolbar. The station name should appear in the box on the left. If it doesn't go back to **Setup** and add the station (see step 6). Click on the station and then click **Connect** at the bottom of the screen.



3. After you hit the connect tab, the icon at the lower left should show that you are connected and the elapsed time indicator will start.
4. Click on **Collect Now** under **Data Collection**. The data manually from the datalogger will be collected and stored in a file named *stationname.dat* in the LoggerNet file under the Campbell Scientific default directory folder: C:\Campbellsci\LoggerNet.
5. Once you have started data collection with **Collect Now**, you can stop it by clicking the **Cancel** button on the animated screen.

Appendix M. Climate Station Field Data Collection: Laptop (continued).

6. If the station does not appear in the station list, you may need to add the station. In LoggerNet hit the **Setup** button and add the name of the station you are visiting under ComPort.. The default will say CR10X. Click the **Rename** button up top and then **Apply**. It is important to name the station at this point. After this step is completed, proceed to Step 2.



Appendix N. Climate Station Field Data Collection: PDA

Downloading weather data from a CR10X datalogger in the field is accomplished with either a laptop or a Palm PDA. To collect data in the field with a PDA, Campbell Scientific, PC Connect software is required. The following is a summary of the steps followed to download data in the field using a Palm PDA.

Detailed descriptions can be found in the manual provided by 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 is 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.

Appendix N. Climate Station Field Data: PDA (continued).



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**. 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. 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.

Appendix O. Northwest Avalanche Center Data Flag System

Data quality flag 1 (numeric).

Flag	Description
0	valid data, original = adjusted
2	invalid data, replacement follows
3	invalid data, no replacement
4	unknown validity, original = adjusted
5	unknown validity, no replacement
6	invalid data, needs adjusting, no replacement
8	missing data, replacement follows
9	missing data, no replacement

Appendix O. Northwest Avalanche Center Data Flag System (continued).

Data problem flag 2 (lower case).

Flag	Description
a	accumulated
b	failed all tests
c	inaccurate due to calibration problem
d	under estimate of precipitation from evaporation due to over heated gauge
e	measuring melting snow from previously capped or previously unheated gauge; time span invalid
f	condensation from propane
g	grounding differences
h	logger battery voltage lower/higher, values may be different than expected
i	intermittent land line shorts; data values higher/lower than normal
j	full land line short
k	induced voltage on sensor lines; data values higher/lower than normal
l	lightning damage/power surge or sag; data values higher/lower than normal
m	missing
n	faulty micrologger
o	tower tips over
p	power outage
q	intermittently inaccurate due to partial or total riming; values lower or different than expected
r	radiation shield plugged with snow; values different than expected
s	snow depth intermittently inaccurate do to blowing precipitation
t	radiation shield plugged with snow; values different than expected.
u	-----
v	vandalism / natural disaster
w	-----
x	-----
y	snow depth erratic due to low depth & protruding brush
z	sensor malfunctioning

Appendix O. Northwest Avalanche Center Data Flag System (continued).

Data adjustment technique flag 3 (upper case).

Flag	Description
A	manually edited value
B	time shifted value
C	precipitation estimated from snowfall
D	
E	changed units
F	wind speed adjustment based on riming coefficient
G	RH adjusted: if <20% delete, if >80% then RH=100 if precipitation, else nearest neighbor
H	RH adjusted: if precipitation then =100% else nearest neighbor
I	data values mostly good, no adjustment
J	subjectively derived
K	extracted from accumulated value (handar data)
L	estimated from nearest neighbor
M	-----
N	substitute with 3 nearest station mean
O	switched snow & precipitation values
P	calculated snow depth from precipitation [ppt]
Q	calculated precipitation from snowdepth
R	precipitation not reported: estimated at 0
S	time averaged
T	-----
U	temperature estimated from climate data
V	normal ratio method estimate
W	inverse weight estimate
X	optimal interpolation estimate
Y	-----
Z	-----

Rules

Current format of one line of data is:

**YYMMDD, HHMM, FLAG1, FLAG2, ORIGINAL DATA ELEMENT, FLAG3,
ADJUSTED DATA ELEMENT,**

1. If Flag1 = #0 [VALID], then Flag2 & Flag3 are Null. The original data element will be in the Adjusted Value Column.
2. If Flag1 = #2 [INVALID, REPLACEMENT FOLLOWS], then the problem will be listed in Flag2. Adjustment technique listed in Flag3. The adjusted value will be in the Adjusted Value Column.
3. If Flag1 = #3 [INVALID, NO REPLACEMENT], then the problem will be listed in Flag2. Flag3 will be Null; the Adjusted Value Column will be Null.
4. If Flag1 = #4 [UNKNOWN, VALIDITY], the problem will be listed in Flag2. Flag3 will be Null. The original value will be in the Adjusted Value Column.
5. If Flag1 = #5 [UNKNOWN VALIDITY, NO REPLACEMENT], the problem will be listed in Flag2. Flag3 and the Adjusted Value Column will be Null.
6. If Flag1 = #6 [INVALID DATA, NEEDS ADJUSTMENT, NO REPLACEMENT], then Flag2 lists the problem. Flag3 and the Adjusted Value Column are Null.
7. If Flag1 = #8 [MISSING DATA, REPLACEMENT FOLLOWS], then the problem is listed in Flag2. Adjustment technique listed in Flag3. The adjusted value is in the Adjusted Value Column.
8. If Flag1 = #9 [MISSING DATA, NO REPLACEMENT], then Flag2 lists the problem, Flag3 and the Adjusted Value Column are Null.

DELIMITER = "," (CHR\$ 44)

NULL = (CHR\$ 32) default blank character for any null value

Appendix P. High-Elevation Weather Station Equipment Lists and Costs

Precipitation, snow depth, air temperature, and relative humidity system: RF Access. Assumes no AC power or phone line is available.

Sensor	Cost
2-ea Nello 45N 10' tower sections	\$413
Nello 5 ft short base section for concrete	\$82
1-short base section	\$100
30 sacks Redi-mix concrete	\$150
ETI Total precipitation gauge, automated, 12 inch collection chamber, 55 gallon waste reservoir	\$2,800
ETI Antifreeze 55 gallon drum (propylene glycol/ethanol)	\$550
Nello 45N bearing plate	\$108
CSI Air Temp. & Relative Humidity sensor	\$345
CSI/RM Young 6-plate Gill Radiation Shield/crossarm mount	\$150
CSI 12x14 enclosure with two conduits & 7839 mount	\$225
CSI CR10X datalogger	\$1,250
CSI Charger/regulator	\$185
CSI 450 Mhz UHF Transceiver	\$430
CSI RF Modem	\$810
2-Deep cycle RV Batteries, box & cables	\$180
Antenex 7.1 dBb gain yagi antenna	\$172
Judd-2 Snowdepth sensor, 2.5 V, with quick disconnect	\$550
CSI Solar Panel, 20 watt regulated	\$450
Site sub-total	\$8,537

Appendix P. High Elevation Equipment Lists and Costs (continued)

Phone line base station. Assumes AC power and phone line is available.

Sensor	Cost
CSI 12x14 enclosure with two conduits & 7839 mount	\$225
CSI Charger/regulator	\$185
CSI 18V 1.2 amp wall charger, 6ft cord	\$30
Deep cycle RV Battery, box & cables	\$150
CSI 450 Mhz UHF Transceiver	\$430
CSI RF Base Station	\$810
Telephone Modem	\$340
Antenex 7.1 dBb gain yagi antenna	\$172
Site sub-total	\$2,342

Wind, Air Temperature and Relative Humidity system: RF Access. Assumes no AC power or phone line is available.

Sensor	Cost
Taylor Scientific Unheated Wind Speed (pulse output)	\$1,590
Taylor Scientific lightning protection	\$120
Taylor Scientific Double Cross Arm Assembly	\$375
Taylor Sci. Hoffman Junction box, 24ckt Fuse & Tranzorb	\$375
Electric Speed Indicator- Split tail Wind Direction transmitter	\$1,000
CSI Air Temp. & Relative Humidity sensor	\$345
CSI/RM Young 6-plate Gill Radiation Shield/cross arm mount	\$150
CSI 12x14 enclosure with two conduits & 7839 mount	\$230
CSI CR10X datalogger	\$1,250
CSI Charger/regulator	\$185
CSI 18V 1.2 amp wall charger, 6ft cord	\$30
2 ea Deep cycle RV Batteries, boxes & cables	\$180
2 ea Nello 45N 10 ft tower sections (previous Rohn 45G)	\$405
2 ea Nello 45N joint bolt kits	\$6
Nello Concrete Base plate	\$188
CSI UHF transceiver 450 Mhz	\$430
CSI RF modem	\$295
Antenex 7dBd omnidirectional antenna	\$134
CSI Solar Panel, 20 watt regulated	\$450
Site Sub-Total	\$7,740

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 3: Product Delivery, Posting, and Distribution

Version 5/26/2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Suggested citation:

Boetsch, J. R. 2010. Standard operating procedure #3: Product Delivery, Posting, and Distribution. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

This SOP provides a schedule, product specifications, and instructions for delivering completed data sets, reports and other project deliverables for long-term storage (Table 3.1). Details are also provided on posting products to websites and clearinghouses, and on responding to data requests. This SOP is adapted from SOP #16 in the NCCN Forest Vegetation Monitoring Protocol (Acker et al. in review).

Table SOP 3.1. Product delivery schedule and specifications.

Deliverable Product	Primary Responsibility	Target Date	Instructions
Field season report	Project Lead	November 30 of the same year	Upload digital file in MS Word format to the NCCN Digital Library ¹ submissions folder.
Raw GPS data files	Field Crew Lead	October 15 of the same year	Zip and send all digital files to the GIS Specialist.
Processed GPS data files	GIS Specialist	November 30 of the same year	Zip and upload raw and processed files to the NCCN Digital Library ¹ .
Digital photographs	Project Lead	March 15 of the following year	Organize, name and maintain photographic images in the project workspace
Certified working database	Project Lead	November 30 of the same year	Refer to the following section on delivering certified data and related materials.
Certified geospatial data	Project Lead with GIS Specialist	same year	
Data certification report	Project Lead		
Metadata interview form	Project Lead and NPS Lead		
Full metadata (parsed XML)	Data Manager and GIS Specialist	March 15 of the following year	Upload the parsed XML record to the NPS Data Store ² , and store in the NCCN Digital Library ¹ .
Annual I&M report	Project Lead and NPS Lead	May 31 of the following year	Refer to the following section on reports and publications.
Comprehensive Climate Reports	Project Lead, NPS Lead, Data Analyst	Periodic; as needed	
Other publications	NPS Lead, Project Lead, Data Analyst	as completed	
Field data forms	NPS Lead and Project Lead	Every 5 years by May 31	Scan original, marked-up field forms as PDF files and upload these to the NCCN Digital Library ¹ submissions folder. Originals go to the Park Curator for archival.
Specimen curation	Project Lead	deliver by November 30 of following year	NPS Curation Facility
Other records	NPS Lead and Project Lead	review for retention every January	Organize and send analog files to Park Curator for archival. Digital files that are slated for permanent retention should be uploaded to the NCCN Digital Library. Retain or dispose of records following NPS Director's Order 19 ⁴ .

¹The NCCN Digital Library is a hierarchical digital filing system stored on the NCCN file servers. Network users have read-only access to these files, except where information sensitivity may preclude general access.

²NPS Data Store is a clearinghouse for natural resource data and metadata (<http://science.nature.nps.gov/nrdata>). Only non-sensitive information is posted to NPS Data Store. Refer to the protocol section on sensitive information for details.

³NatureBib is the NPS bibliographic database (<http://www.nature.nps.gov/nrbib/index.htm>). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record.

⁴NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: <http://data2.itc.nps.gov/npspolicy/DOrders.cfm>

NCCN Digital Library

The NCCN Digital Library is a hierarchical document management system maintained on the NCCN servers. NPS users have read-only access to these files, except where information sensitivity may preclude general access.

Contents of the NCCN Digital Library can be viewed from within the NPS firewall at: <http://www.nccn.nps.gov/im/library/index.aspx>. Documents may be uploaded by network users through the NCCN team site: <http://www.nccn.nps.gov/im/library/documents1.aspx>.

Upon uploading files to the Digital Library, the upload page will request the following information about the uploaded files to enable filing and searching:

- Document title
- Project code (e.g., "CLa01" for Climate Monitoring)
- Park(s) to which the file(s) apply; multiple parks may be selected for each upload
- Document type (e.g., formal report, database, protocol, etc.)
- Document topic (e.g., Coastal/Marine Systems)
- Date of publication or last revision
- Author name(s)
- Description - Document abstract, additional authors and credits, special use instructions, etc.

For project staff without access to the NPS intranet, files may be sent by email or CD/DVD to the NPS Lead or Data Manager for upload, along with the above information in a text file or accompanying email.

Delivering Certified Data and Related Materials

Data certification is a benchmark in the project information management process that indicates that the data: 1) are complete for the period of record; 2) have undergone and passed the quality assurance checks; and 3) are appropriately documented and in a condition for archiving, posting and distribution as appropriate. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data.

The following deliverables should be delivered as a package:

- Certified back-end database: Database containing data for the current season that has been through the quality assurance checks. Delivery of this item is only applicable in cases where the back-end database is implemented in Microsoft Access and/or is deployed outside the NPS firewall during the quality review. In all other cases, the Data Manager will already have access to the certified data.
- Certified geospatial data: GIS themes in ESRI coverage or shapefile format. Refer to NCCN GIS Development Guidelines (NCCN 2007a) and NCCN GIS Product Specifications (NCCN 2007b) for more information.

- Data certification report: A brief questionnaire in Microsoft Word that describes the certified data product(s) being delivered. A template form is available on the NCCN website at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.
- Metadata interview form: The metadata interview form is a Microsoft Word questionnaire that greatly facilitates metadata creation. It is available on the NCCN website at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. For more information, refer to Section 4.7 of the protocol narrative (Metadata Procedures).

After the quality review is completed, the Project Lead should package the certification materials for delivery as follows:

1. Create a compression file (using WinZip® or similar software, or by right-clicking in Windows Explorer). This file should be named in accordance with general file naming standards, and the name should include the project code ("CLa01") and the year or span of years for the data being certified. For example: CLa01_2009_certification_pkg.zip.
2. In cases where the back-end database is implemented in Microsoft Access and/or is deployed outside the NPS firewall during the quality review:
 - a. Open the certified back-end database file and compact it (in Microsoft Access version 2003 and earlier, Tools > Database Utilities > Compact and Repair Database). This will make the file size much smaller. Back-end files are typically indicated with the letters "_be" in the name (e.g., Climate_CLa01_be_2009.mdb).
 - b. Add the back-end database file to the compression file.
 - c. Note: The front-end application does not contain project data and as such should not be included in the delivery file.
3. Add the completed metadata interview and data certification forms to the compressed file. Both files should be named in a manner consistent with the file naming standards described in SOP 13: Project Workspace and Records Management.
4. Add any geospatial data files that are not already in the possession of the GIS Specialist. Geospatial data files should be developed and named according to NCCN GIS Naming Conventions (NCCN 2007c).
5. Deliver the compressed file containing all certification materials to the Data Manager by placing it in the Data folder of the project workspace and notifying the Data Manager by email. If the Project Lead does not have network access, then certification materials should be delivered as follows:
 - a. If the compressed file is under 9.5 mb in size, it may be delivered directly to the Data Manager by email.
 - b. If the compressed file is larger than 9.5 mb, it should be copied to a CD or DVD and delivered in this manner.

Upon receiving the certification materials, the Data Manager will:

1. Review them for completeness and work with the Project Lead if there are any questions.
2. Check in the delivered products using the NCCN project tracking application.
3. Notify the GIS Specialist if any geospatial data are delivered. The GIS Specialist will then review the data, and update any project GIS data sets and metadata accordingly, and post those products to the NCCN Digital Library.
4. Work with the GIS Specialist to finalize coordinate data in the database.
5. Upload the certified products to the NCCN Digital Library.
6. Merge the certified data into the master project database, if applicable.
7. Notify the Project Lead that the year's data have been successfully reviewed and processed. The Project Lead may then proceed with data summarization, analysis and reporting.
8. Develop, parse and post the XML metadata record to the NPS Data Store.
9. After a holding period of two years, the Data Manager will upload the certified data to the NPS Data Store. This holding period is to protect professional authorship priority and to provide sufficient time to catch any undetected data quality problems.

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or another publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses – these may not contain sensitive information.

Instructions for Reports and Publications

Annual reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Annual reports will use the Natural Resource Report template, and trend analysis and other peer-reviewed technical reports will use the Natural Resource Technical Report template. These templates and documentation of the NPS publication standards are available at: <http://www.nature.nps.gov/publications/NRPM/index.cfm>.

The procedures for annual reports, technical reports, and publications are as follows. (Note: This is optional for field season reports, which are intended to be internal communications only.)

1. The Project Lead or Data Analyst formats the document according to the NPS Natural Resource Publications standards.
 - a. Formatting according to NPS standards is easiest when using the report template from the very beginning, as opposed to reformatting an existing document.
 - b. When creating the file, use appropriate naming standards (described in this document), and add "DRAFT" to the file name.

- c. Open the document and add "DRAFT" to the header or document watermark as appropriate.
2. The document should be peer reviewed at the appropriate level. For example, I&M Annual Reports should be reviewed by other members of the project work group. The Network Coordinator will also review all annual reports for completeness and compliance with I&M standards and expectations. Before sending the document for review, rename the document by adding a date stamp to the end of the file name using the YYYYMMDD format.
3. Upon completing the peer review, the Project Lead should acquire a publication series number from the appropriate regional or national key official. Instructions for acquiring a series number are available at: <http://www.nature.nps.gov/publications/NRPM/index.cfm>.
4. The Project Lead should finalize the document:
 - a. Ensure that the publication/version date (last saved date field code in the document header, if used) and file name (field code in the document footer, if used) are updated properly throughout the document.
 - b. Remove the word "DRAFT" from watermarks, document headers, and file name.
 - c. Remove any previous date stamp from the file name.
 - d. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
 - e. Create a PDF version of the document and upload the PDF copy to the NCCN Digital Library at: <http://www.nccn.nps.gov/im/library/documents1.aspx>.
 - f. Store both the Word document and PDF copy in the appropriate section of the project workspace (see SOP 13: Project Workspace and Records Management).
5. Notify the Park Curator and Data Manager that the report is available, and send a printout to the Park Curator to add to the host park collections.
6. The Data Manager (or a designee) will create a bibliographic record and upload the PDF copy to NatureBib according to document sensitivity.

File Naming Standards

Prior to delivering or uploading digital products, files should be named according to the naming conventions appropriate to each product type.

Reports and Publications

- No spaces or special characters in the file name.
- Use the underbar (" _ ") character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- As appropriate, include the project code (e.g., "VCa02"), network code ("NCCN") or park code, and year in the file name.

Examples:

- NCCN_ CLa01_2009_Annual_report.pdf
- NCCN_ CLa01_2009_Field_season_report.doc
- NCCN_ CLa01_2009_Certification_report.doc

Other Files

General naming standards as described in SOP 13: Project Workspace and Records Management apply to all deliverables. When delivering files to the Digital Library, file names should be modified as needed to include the project code (e.g., “CLa01”), network code (“NCCN”) or park code, and year as appropriate (e.g., NCCN_ CLa01_2010_cert_package.zip). Specific standards for images are described in SOP 4: Managing Photographic Images and in SOP 13: Revising the Protocol for protocol documents.

Product Posting

Once digital products have been delivered and processed, the Data Manager or a designee will post them to or otherwise update the following applications to make them generally available:

1. NPS Data Store is the agency's internet clearinghouse for natural resource data and metadata (<http://science.nature.nps.gov/nrdata>). Only non-sensitive information is posted to NPS Data Store. Full metadata records will be posted to the NPS Data Store as they are created; data sets will be posted after a two-year hold to protect professional authorship priority and to provide sufficient time to catch any undetected quality assurance problems.
2. NatureBib is the NPS bibliographic database (<http://www.nature.nps.gov/nrbib>). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record. For reports and other publications, a record will be created after first verifying that a record does not already exist. The digital report file in PDF format will then be uploaded and linked to the NatureBib record.
3. NPSpecies is the NPS database and application for maintaining park-specific species lists and observation data (<http://science.nature.nps.gov/im/apps/npspp/index.htm>). Species observations will be extracted from project data sets and uploaded into NPSpecies.
4. NCCN Web Site is maintained by NCCN staff as part of the NPS Inventory and Monitoring web site (<http://science.nature.nps.gov/im/units/nccn>) to describe our program, the vital signs selected for monitoring, and to highlight certain products and information derived from inventory and monitoring work at NCCN. The site has both internet and intranet components. Select products such as annual reports and technical reports will be posted to the web site.

These applications serve as the primary mechanisms for sharing reports, data, and other project deliverables with other agencies, organizations, and the general public.

Holding Period for Project Data

To protect professional authorship priority and to provide sufficient time to complete quality assurance measures, there is a two-year holding period before posting or otherwise distributing

certified project data. This means that certified data sets are first posted to publicly-accessible websites (i.e., the NPS Data Store) approximately 24 months after they are collected (e.g., data collected in June 2008 becomes generally available through the NPS Data Store in June 2010). In certain circumstances, and at the discretion of the Project Lead, data may be shared before a full two years have elapsed.

Note: This hold only applies to raw data, and not to metadata, reports or other products which are posted to NPS clearinghouses immediately after being received and processed.

Responding to Data Requests

Occasionally, a park or project staff member may be contacted directly regarding a specific data request from another agency, organization, scientist, or from a member of the general public. The following points should be considered when responding to data requests:

- For all Inventory and Monitoring projects in NCCN, NPS is the originator and steward of the data, and the NPS Inventory and Monitoring Program should be acknowledged in any professional publication using the data.
- NPS retains distribution rights; copies of the data should not be redistributed by anyone but NPS.
- The data that project staff members and cooperators collect using public funds are public records and as such cannot be considered personal or professional intellectual property.
- No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or another publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared.
- For quality assurance, only certified, finalized versions of data sets should be shared with others. In exceptional cases where a provisional data set needs to be shared with others prior to certification:
 - Any accompanying communications should clearly indicate that the data set is provisional and subject to change according to our quality review process.
 - File names and the media it is sent on should be clearly labeled as containing provisional data not for distribution.

The Project Lead will handle all data requests as follows:

1. Discuss the request with other Park Biologists as necessary to make those with a need to know aware of the request and, if necessary, to work together on a response.
2. Notify the Data Manager if s/he is needed to facilitate fulfilling the request in some manner.
3. Respond to the request in an official email or memo.
4. In the response, refer the requestor to the NPS Data Store (<http://science.nature.nps.gov/nrdata>), so they may download the necessary data and/or metadata. If the request cannot be fulfilled in that manner – either because the data

products have not been posted yet, or because the requested data include sensitive information – work with the Data Manager to discuss options for fulfilling the request directly (e.g., writing data to CD or DVD). Ordinarily, only certified data sets should be shared outside NPS.

5. It is recommended that documents and presentation files be converted to PDF format prior to distribution. This is to maximize portability and to reduce the ability for others to alter and redistribute files.
6. After responding, provide the following information to the Data Manager, who will maintain a log of all requests in the NCCN project tracking database:
 - a. Name and affiliation of requestor
 - b. Request date
 - c. Nature of request
 - d. Responder
 - e. Response date
 - f. Nature of response
 - g. List of specific data sets and products sent (if any)

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The Project Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. In Review. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—XXXX/XXX. National Park Service, Fort Collins, Colorado.

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North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 4: Managing NCCN Climate Stations Photographic Images

Version 5/26/2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Suggested citation:

Baccus, B. 2010. Standard operating procedure #4: Managing NCCN Climate Stations Photographic Images. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

This SOP covers photographic images collected by NPS staff during the course of installing or servicing NPS climate stations. Images that are acquired by other means – e.g., downloaded from a website or those taken by a cooperating researcher – are not project records and should be handled separately. Information on Image Acquisition was adapted from the Western Regional Climate Center (Kelley Redmond) Photographic Documentation of Long-term Stations.

Purpose/Overview

Photographic documentation is needed to leave a permanent record of site conditions and to show relationships between climate instrumentation and the factors that affect what they observe and record. Photos should record any factor relating to site conditions that could affect the interpretation of the historical climate sequence from this station. Photos associated with climate stations will include the following categories:

- A systematic series of photos taken at a 180° sweep from an established photo point, in order to document the position of a climate station and its relationship to landscape characteristics surrounding it. These photos will be taken on a standard 5 year rotation to document potential changes to landscapes or whenever environmental events have changed those landscapes.
- A systematic series of photos from the station in all azimuths to cover a 360 ° sweep of the landscape. These photos will also be taken on a standard 5 year rotation to document potential changes to landscapes or whenever environmental events have changed those landscapes.
- Photos documenting instruments or wiring of a specific station at a specific time. It is important that photos are taken and archived whenever major changes are made to the climate station.
- Photos documenting damage to a station or a station's equipment, or other unusual circumstances that might affect climate measurements.
- Miscellaneous photos documenting maintenance or other site activities.

Photos associated with climate stations will provide a tool to help interpret trends and anomalies in climate data but do not represent actual data. For this reason they will not be linked to specific records within the database but rather refer to periods of time when data was collected.

Photo Management

Effectively managing hundreds of photographic images requires a consistent method for downloading, naming, editing and documenting. The general process for managing data photos proceeds as follows:

- A. File Structure Setup – Set up the file organization for images prior to acquisition
- B. Image Acquisition
- C. Download and Process
 - a. Download the files from the camera
 - b. Rename the image files according to convention
 - c. Copy and store the original, unedited versions

- d. Review and edit or delete the photos
- e. Move into appropriate folders for storage

D. Deliver Image Files for Final Storage

A. File Structure Setup

Prior to data collection for any given year, project staff will need to set up a new folder under the Images folder in the project workspace as follows:

[Park_Code] Identifier of NPS unit where climate station is located – OLYM, MORA

[Station_ID] Unique identifier for the specific climate station – DPH, HOO

[Year] Arranged by year of photo

[Processing] Processing workspace

[Originals] Renamed but otherwise unedited image file copies

[Photo_Point] Photopoint used for documenting station
and locatioin within landscape

[View] View of landscape from station

[Other-Misc] Other images taken by project staff

This folder structure permits data images to be stored and managed separately from non-record and miscellaneous images collected during the course of the project. It also provides separate space for image processing and storage of originals.

Folder Naming Standards: In all cases, folder names will follow these guidelines:

- No spaces or special characters in the folder name
- Use the underbar (“_”) character to separate words in folder names
- Try to limit folder and file names to 20 characters or fewer
- Date names should be formatted as YYYYMMDD
- Station ID names are typically a 3 or 4-character string (e.g., HRS – Hoh Ranger Station)

B. Image Acquisition

Timing of Photos

Day-end lighting (morning/evening) shows subtle landscape variations best, however, azimuthal differences (into/away from sun) can be very pronounced. Early/late in the day, into the sun, important detail can be lost. Direct sunlight can also create shadows that interfere with details of landscape features. For these reasons morning thru mid-day to afternoon lighting is best for landscape documentation combined if possible with overcast days without shadows. Maintenance trips that will include 5 year documentation photos should plan to maximize appropriate lighting conditions.

Focal length and Resolution

In general, use the widest angle lens setting available at all times, except for distance photos designed to compress distance and show spatial relationships. The best is the equivalent from a 35 mm film camera of a 28 mm focal length lens. These wide angles are not yet available on many digital cameras. Typically the best that is currently available is equivalent to a 35 mm focal length lens, a moderate wide angle.

A 35 mm focal length lens typically requires about 12 overlapping photos to pan 360° around the horizon and back to the starting point. 6 to 8 overlapping photos will suffice for a 180° pan of the station and surroundings. To ensure the same sequence of photos in subsequent years, always start from the north or northern most azimuth and work clockwise around the compass.

With digital cameras, typically medium or higher resolution is preferred. This should result in photos that are about 600 to 1000 Kb in .jpg format that can be enlarged somewhat.

Photo Points

A typical climate site would require the use of 1 to 3 photopoints depending on the complexity of the surrounding landscape. Photopoints should be easily identifiable in the field, using permanent aluminum markers on trees, epoxy on rocks or marked rebar in the ground. In addition to marking, photopoints should be recorded as waypoints using a GPS and carefully documented with photographs so that they are easily refound.

Station Landscape Photos

Landscape views are achieved by creating panoramas from an overlapping sequence of photos. When taking panoramas, make sure that there is overlap from one photo to the next (typically 5-15 percent of the frame width), so that the photos can be adequately pieced together. It is helpful that the first and last picture overlap as well, to insure that the full circuit has been completed and to be able to reconstruct the photo sequence many weeks or months later.

Panoramas can be side to side, or up and down, or both. These can later be combined to form mosaics, so that all of the main features relevant to how a sensor will respond can be shown at once.

When choosing photo points or taking photos, it is important to consider the landscape characteristics and ensure the photos will allow interpretation of that landscape and how it might affect climate measurements. Almost every climate site will have a bias arising from its situation in the landscape. Of particular interest would be any obstructing features that might affect wind or rainfall, or features altering reflective or direct solar radiation and temperature. The following station dependent characteristics should be considered and recorded in site photos:

- Status (e.g. height, density and health) of vegetation
- Growth or loss of vegetation
- Ground cover type and condition
- Proximal vegetative shielding or overhanging vegetation
- Death of vegetation from disease or fire and/or subsequent recovery

- Vertical surfaces that emit infrared radiation, or bounce solar radiation:
 - Buildings
 - Trees, forest canopy, trunks or other vegetation
 - Rock walls, cliffs and canyons (within a mile or two)
 - Intermittent or seasonal wetlands
- Surface conditions immediately adjacent to sensors:
 - Rock, cobbles, grass, gravel, pavement, etc
 - Effects of artificial watering
 - Addition of pavement
- Nearby factors that change regional energy balances:
 - Large scale agriculture
 - Pivot irrigation (operate some years, others not)
- Orientation or height of instruments
- Topographic features that affect sensor readings
 - Slopes (hold camera exactly horizontal to show these)
 - Small hollows and bumps
 - Concave and convex upward surfaces
 - Distance to
 - Water surfaces
 - Nocturnal drainage channels (a meter is enough)
 - Cliff edges or canyon walls
 - Changes in slope above or below instruments
 - Wind channeling influences

Also consider adding familiar objects to show scale, especially in panorama views from the stations. (Panoramas with a view of the station have the station itself for scale)

Photos of the climate setting are generally taken from a close proximity; however it may be helpful to also archive photos of the general landscape from as far away as several miles. This may enable you to record all relevant elements at once. For example, a river, a large talus field and a mountain slope all in the same image containing the station of interest.

When taking panoramas, stand at your photopoint, and starting in the north most direction, sweep from left to right making sure each image overlaps by 15%. Keep the relationship of the station constant to the horizon. Swivel on the point, but do not walk. In some cases you may want to pan up and down to record tree height, ridgelines or slopes. (See Figure SOP 4.1.)

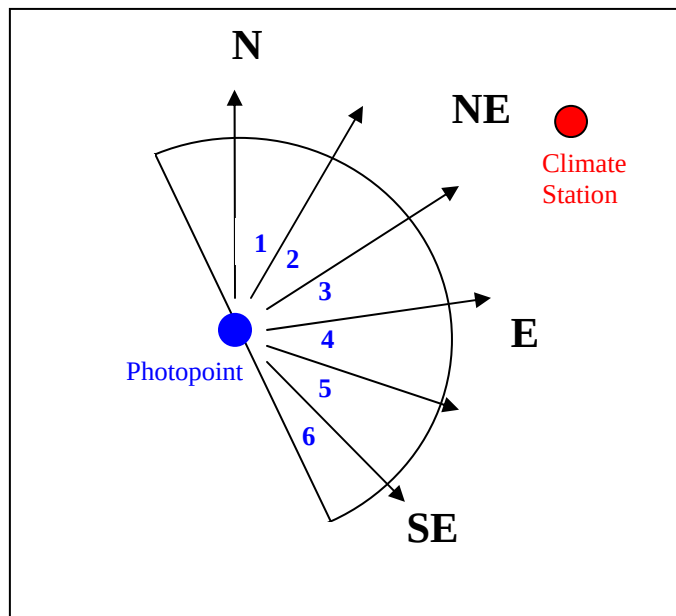


Figure SOP 4.1. Photopoint panoramas.

When taking panoramas from the station, first use an accurate compass or GPS to ascertain the cardinal directions to within 5 degrees. Note landmarks on the horizon to fix the directions in your head. With the station at your back, take the first photo facing due north, then, walking slowly around the station in a clockwise position, continue taking photos, ensuring your 15% overlap. Finish with an adequate overlap of the north azimuth (See Figure SOP 4.2).

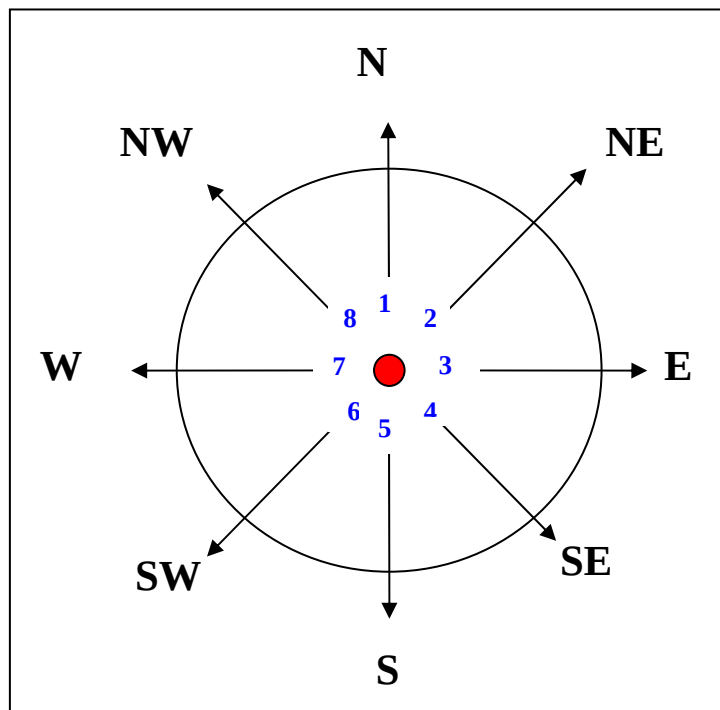


Figure SOP 4.2. Panorama view photos from a climate station.

Photographic Log

Record the date and time of day of each visit. Record notes and comments on the Photographic Log form to document the documentation process, special conditions, circumstances of note, etc. (see Figure SOP 4.3).

Climate Monitoring Protocols Photo Documentation Log							
Station Name:							
Photopoint Number	Azimuth from Station	UTM E	UTM N	Description			

Date	Time	Image #	Azimuth	UTM E	UTM N	Photographer	Description (including written details of the subject)

Figure SOP 4.3. Example of photographic log: NCCN Climate Stations

C. Download and Processing Procedures

1. Download the raw, unedited images from the camera into the appropriate “Processing” folder.
2. Rename the images according to convention (refer to the image naming standards section). If image file names were noted on the field data forms, be sure to update these to reflect the new image file name prior to data entry. Field form annotations should be done in a different color ink from the original notation, after first drawing a line through the original entry.

3. Copy the images to the “Originals” folder and set the contents as read-only by right clicking in Windows Explorer and checking the appropriate box. These originals are the image backup to be referred to in case of unintended file alterations (e.g., file deletion, loss of resolution, or loss of image metadata upon rotation).
4. Process the photos in the _Processing folder. At a minimum, the following processing steps should be performed on all image files:
 - Poor quality photos should be deleted, except where the subject is highly unique or the photo is an irreplaceable data photo.
 - General photos (i.e., not data photos) of medium quality should be assessed against existing photos of the same subject in the park photo library. If the photos duplicate the subject with no enhancement of quality or perspective, the photo may not be worth saving.
 - Photos should be rotated to make the horizon level.
 - Photos of people should have ‘red eye’ glare removed.
 - Photos should be cropped to remove edge areas that grossly distract from the subject.
5. When finished, move the image files that are to be retained and possibly linked in the database to the appropriate folder. To minimize the chance for accidental deletion or overwriting of needed files, no stray files should remain in the processing folder between downloads.

Image File Naming Standards

In all cases, image names should follow these guidelines:

- No spaces or special characters in the file name
- Use the underbar (“_”) character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Park code and year should either be included in the file name or conclusive by the directory structure.

The image file name should consist of the following parts:

1. The date of data capture (formatted as YYYYMMDD)
2. The climate station ID code (varies by type of photograph)
 - Photopoint Panoramas:
 - a. PP[#]
 - b. A sequential letter (starting with “A” for the north most of multiple images captured)
 - View Panoramas from Climate Sites:
 - a. VIEW
 - b. A sequential letter (starting with “A” for the north most of multiple images captured)
 - Other Miscellaneous Photos
 - a. A brief descriptive word or phrase

Examples:

- 20070621_DPO_PP1_A.jpg (First panoramic photo taken of climate station DPO, from photo point 1, taken on June 21, 2007)
- 20070621_DPO_PP1_B.jpg (Second panoramic photo taken of climate station DPO, from photo point 1, taken on June 21, 2007)
- 20070621_DPO_VIEW_C.jpg (Third panoramic photo taken from climate station DPO, taken on June 21, 2007)
- 20070621_DPO_WiringPanelCloseUp.jpg (documents the wiring panel of station DPO on June

21, 2007)

E. Deliver Image Files for Final Storage

At the end of the season, and once the year's data are certified, data images for the year may be delivered along with the working copy of the database to the Data Manager on a CD or DVD. To do this, simply copy the folder for the appropriate year(s) and all associated subfolders and images onto the disk. These files will be loaded into the project section of the NCCN Digital Library, and the database links to data images will be updated accordingly.

Prior to delivery, make sure that all processing folders are empty. Upon delivery, the delivered folders should be made read-only to prevent unintended changes.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 5: Remote Automated Fire Weather Stations (RAWS)

Version 5/26/2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Suggested citation:

Lofgren, R. 2010. Standard operating procedure #5: Remote Automated Fire Weather Stations. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

Introduction

This SOP provides information on Remote Automated Fire Weather Stations (RAWS). The RAWS network is comprised of climate stations located on land managed by federal, state and local agencies. These stations are supported by the respective agencies and are used by fire-management personnel (including NCCN park staff) to estimate a fire-danger rating in support of preventive measures, and to forecast the behavior of wildland fires.

RAWS stations have been incorporated into NCCN climate monitoring program due to their abundance throughout the PNW, ease of maintenance and data transmission, and the ability to add an entire suite of automated sensors. RAWS stations may operate year round or only during summer months.

RAWS stations consist of automated sensors that record air temperature and relative humidity, precipitation, wind speed and direction, fuel moisture and fuel temperature. Snow depth sensors may also be added to RAWS stations. RAWS stations generally gauge. For this reason, winter and annual precipitation cannot be collected from RAWS locations where winter precipitation routinely includes snow and Alternate Current (AC) power is not available.

Data are recorded every 15 minutes and are automatically transmitted to the National Interagency Fire Center (NIFC) in Boise, Idaho via the Geostationary Operational Environmental Satellite (GOES). The GOES is operated by the National Oceanic and Atmospheric Administration (NOAA).

RAWS stations located in the NCCN parks require maintenance by park staff prior to the beginning of each fire season.

This SOP includes information on the set-up, maintenance, shut-down of and collection of data from RAWS stations. This SOP directs the reader to handbooks and other information stored on the NCCN server at <http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm> and on the website of other agencies, primarily RAWS (<http://www.fs.fed.us/raws/>).

Fire Danger Rating System: NFDRS Standards

The National Fire Danger Rating System (NFDRS) is a system used by wildland fire management agencies to assess current fire danger at local and national levels. It consists of a variety of indices that portray current potential fire danger conditions. It is designed to provide common standards for weather stations used by the wildland fire agencies for calculation of NFDRS indices. It is published by the National Wildlife Coordinating Group and is updated frequently.

Information on NFDRS standards is available on the RAWS web site (<http://www.fs.fed.us/raws/standards.shtml>). Documentation available in February 2010 included the August 2009 version of fire weather station standards and guidelines (NWCG 2009), published by the National Wildfire Coordinating Group (<http://www.nwcg.gov/>).

Inspection, Check-out, and Shut-down of RAWs Stations

The RAWs web site hosts documentation on pre-season preparation, maintenance, and end-of-season check-out of RAWs climate stations. In early 2010, documentation was stored under the tab for Field Guide, Forms, Tech Notes (<http://www.fs.fed.us/raws/book/>). This documentation includes extensive information on stations manufactured by Vaisala (<http://www.vaisala.com/> formerly known as Handar) (<http://www.fs.fed.us/raws/book/vaisala/>), the type of station sited in or near NCCN parks. In early 2010, the documentation included the 2009 version of the annual maintenance guide and field checklists for RAWs weather stations manufactured by Vaisala (<http://www.fs.fed.us/raws/book/vaisala/annualmaintenanceguide.shtml>).

RAWs Repair and Return Form

The RAWs Depot Repair Facility maintains a centralized rotatable pool of RAWs component parts and modules. When an instrument needs repair, fill out the RAWs Repair and Return Form located at: <http://www.fs.fed.us/raws/forms/repairandreturn.shtml>. Include the instrument for repair and ship to the address located at the bottom of the Repair and Return Form.

Handar 555 Data Collection Platform

The RAWs documentation pages (<http://www.fs.fed.us/raws/book/vaisala/>) also include information for programming the Handar 555 data collection platform.

ASCADS System

Data from individual RAWs stations can be accessed through the Automated Sorting, Conversion and Distribution System (ASCADS) distributed by the National Interagency Fire Center (NIFC) RAWs Depot in Boise, Idaho. The ASCADS system is used to log all of the maintenance information and sensor data from climate station maintenance visits. It helps track serial numbers, annual maintenance dates, sensor lists, and includes a narrative field for comments. The system also provides a watchdog system by alerting operators if a measurement value is out of range or remains constant for too many counts.

For additional assistance call the Remote Sensing Support Unit at (208) 387-5475.

Accessing the ASCADS System

You must set up an account to access the system through the Wildland Fire Management Information web site (<http://www.nifc.blm.gov/>). Instructions to request access to the site are located at: <https://www.nifc.blm.gov/cgi/WfmiHome.cgi>.

Downloading Historical RAWs Data

Data from RAWs weather stations will be used in conjunction with information from other climate networks to generate annual climate summaries, to identify climatic extremes, and to aid in the analysis and interpretation of trends in other monitored vital signs. Western Regional Climate Center in Reno, Nevada (WRCC) is the official repository for RAWs data. Data are downloaded with the following procedures.

Procedures

1. Access the following WRCC Web page (<http://www.wrcc.dri.edu/wraws/>).
2. A map of the US will appear on the screen. Left-click inside the state of Washington to access RAWs data for stations in the NCCN. A map of RAWs stations within the

selected state will appear along with an alphabetic list of RAWs sites which is displayed on the left-hand side of the screen.

3. Click on the desired station in the alphabetized list. This will result in displaying the Data Availability list (Figure SOP 5.1) on the right-hand side and the Station Retrieval Options on the left hand side of the screen (Figure SOP 5.2).

Marblemount Washington												
BOLD, Red indicates some data available for month and year.												
2005	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Figure SOP 5.1. Data Availability List

NOTE:
To print data frame (right side), click on right frame before printing.

- [Daily Summary](#)
- [Daily Summary \(with Wind Chill and Heat Index\)](#)
- [Daily Summary Time Series](#) 
- [Monthly Summary](#)
- [Monthly Summary \(w/ Et data\)](#)
- [Graph of last 7 days](#)
- [Time Series Graph](#)
- [Wind Rose Graph and Tables](#)
- [Wind Stability/Wind Rose Graph and Tables](#)
- [Hourly Frequency Distribution/Histogram](#)
- [Data Lister](#)
- [Data Inventory \(Monthly Graphic\)](#)
- [Station Metadata](#)
- [Current 7-day forecast \(NWS\) \(May not work correctly for some Central and Southern U.S. states.\)](#)

*Western Regional Climate Center,
wrcc@dri.edu*

Figure SOP 5.2. Station Retrieval Options

4. Click on “Data Lister” in the Station Retrieval Options list. The Station Data Retrieval window will appear.

5. In the Station Data Retrieval display, set the desired starting and ending date. Under Options, set desired options.
6. Under the *Password Access to data more than 30 days old* command, you must enter the password provided to the NCCN by WRCC.
7. After completing all required fields, click on Submit Info above the Password Access box. Processing time will vary with the amount of requested data, but eventually you will be queued to Open or to Save the Excel file. Always elect to Save the file. After selecting Save, a standard Windows Save As dialogue box will appear. Enter a valid local directory and a file name to save the Excel file. These data are stored, however, as ASCII files. In Excel, save each downloaded file in Text (MS-DOS) (*.txt) format.

Literature

National Wildfire Coordinating Group (NWCG). 2009. Interagency Wildland Fire Weather Station Standards and Guidelines. PMS 426-3. NWCG, National Interagency Fire Center, Boise, Idaho. Online.
(http://www.fs.fed.us/raws/standards/Weather_station_standards_rev08_2009_FINAL.pdf). Accessed 12 February 2010.

Remote Automated Fire Weather Stations (RAWS). 2009. Annual Maintenance Guide for Vaisala Manufactured Equipment. Online.
(<http://www.fs.fed.us/raws/book/vaisala/annualmaintenanceguide.shtml>). Accessed 12 February 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 6: Snowpack Telemetry (SNOTEL) Stations

Version 5/26/2010

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in Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for
the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—
2010/XXX. National Park Service, Fort Collins, Colorado

Introduction

The cooperative snow survey program was initiated in 1935 by the Department of Agricultural, Soil Conservation Service (SCS), to aid in forecasting summer water supplies. Manual snow surveys require two-person teams to measure snow depth and water content at designated snow courses. A snow course is a permanent sampling transect that represents snowpack conditions at a given elevation in a given area. A particular snowpack may have several courses. Generally, the snow courses consist of 10 sample locations, are about 300 m long, and are situated in small meadows protected from the wind. Measurements are taken on or near the first of every month during the snowpack season from January to May.

The cooperative snow survey program is the pre-cursor to the Snowpack Telemetry (SNOTEL) program. In 1977, the SCS (renamed Natural Resource Conservation Service, NRCS in 1994) began developing a network of automated radio telemetry data sites for collecting snow survey data in the mountainous regions of the Western United States. This SNOTEL network provides NRCS offices with daily or more frequent information on streamflow potential. The NRCS currently installs, operates, and maintains an extensive, automated system.

SNOTEL stations provide real-time snow and climate data using automated remote sensing. Basic SNOTEL sites have a pressure sensing snow pillow (snow water equivalent), storage precipitation gage, and air temperature sensor. In addition, some SNOTEL sites are being upgraded to include soil temperature and moisture readings. These stations are operated year round and provide useful winter and summer data to the NCCN Network. Most stations report data hourly.

The major purpose of the SNOTEL network is to aid in providing long-term climatic information to support water supply forecasting, detect short and long-term trends, and to provide basic hydroclimatic information in support of water resource management functions. The information collected by the telemetry system and snow surveyors is translated into water supply forecasts that NRCS State offices issue monthly from January to June in cooperation with the NWS.

This Standard Operating Procedure (SOP) lists documentation covering SNOTEL and snow course sampling. The NRCS (<http://www.nrcs.usda.gov/snotel/>) posts forms and instructions for recording snow measures, as well as historical data from across the country. Documents include a snow sampling survey guide (*Agricultural Handbook 169*) with step-by-step directions on snow sampling procedures (NRCS). This document is also stored on the NCCN server at <http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>.

Procedures for downloading SNOTEL climate data and snow course data from the NRCS web site are also included.

Downloading SNOTEL Data

Data from SNOTEL stations located within the NCCN and from the other climate networks will be used to generate annual climate summaries, to identify climatic extremes, and to aid in the analysis and interpretation of trends in other monitored vital signs. Data are easily extracted from the NRCS web page.

Procedures

1. Access the following NRCS web page
(<http://www.wcc.nrcs.usda.gov/snotel/Washington/washington.html>)
2. A list and map of SNOTEL stations in WA will appear. Place the cursor over the SNOTEL site of interest and left click, or use the pull down tab.
3. Choose to work with either the site reports or individual element reports. Select the desired start and end dates, parameters, and desired output format.
4. A graph and/or data table will be displayed.

Downloading Snow Course Data

Snow Course sites located within the NCCN provide measures of snow depth and snow-water equivalence once to twice a month during winter. Although these data are limited in scope, this site has been in operation since the 1930's, and thus offers insight to the temporal variation in snow pack. Data are downloaded from the NRCS web page using the following procedures.

Procedures

1. Access the following NRCS web page
(ftp://ftp.wcc.nrcs.usda.gov/data/snow/snow_course/utsnow.txt).
2. Data for all stations in WA will be displayed in a tabular format. Scroll through the display until the desired station appears.
3. To copy the contents from the screen, depress the left mouse button and highlight the desired data. Then while holding down the CTRL button on your key board, depress the "C" key. This will copy the highlighted data to the clip board. On your local computer, open an Excel sheet and copy the data into the sheet by depressing CTRL key and the "V" key at the same time. Save the data as a Text (MS-DOS) (*.txt) file.

Literature

Natural Resources Conservation Service (NRCS) [formerly the Soil Conservation Service].
Agricultural handbook 169: Snow survey sampling guide. Online.
(<http://www.wcc.nrcs.usda.gov/factpub/ah169/ah169.htm>). Accessed 10 February 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 7: Field Procedures for Weather Service (NWS) Cooperative Observer Program (COOP) Climate Stations

Version 5/26/2010

Revision History Log

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Lofgren, R. 2010. Standard operating procedure #7: National Weather Service Cooperative Observer Program (COOP) Climate Stations. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

Introduction

The NWS-COOP Program is a nationwide weather and climate monitoring network comprised of volunteer citizens and institutions observing and reporting weather information on a 24-hour basis. NWS-COOP observations form the backbone of temperature and precipitation (including snowfall) records describing U.S. climate.

The Cooperative Observer Program was formally created in 1890 under the Organic Act and operated under the Weather Bureau (renamed in 1967 to the National Weather Service). Its mission is two-fold:

- To provide observational meteorological data, usually consisting of daily maximum and minimum temperatures, snowfall, and 24-hour precipitation totals, required to define the climate of the United States and to help measure long-term climate changes
- To provide observational meteorological data in near real-time to support forecast, warning and other public service programs of the NWS.

Core observations from the NWS-COOP stations include 24-hour minimum and maximum temperatures and 24-hour precipitation (rain and water-equivalent of snow fall). Additionally, observations of precipitation duration and other general climatic conditions may be recorded daily. Park personnel are responsible for recording daily measures, reporting daily measures to regional NWS offices, and reporting monthly tallies of all climatic observations to the NWS. The NWS-COOP stations have the longest period of record of all weather stations deployed in the NCCN and are commonly referenced for analyzing annual and long term trends.

This Standard Operating Procedure (SOP) lists documentation covering essential aspects of the field procedures for National Weather Service (NWS) Cooperative Observer Program (COOP) climate stations including:

- General station operation and maintenance (recording and reporting observations and equipment installation and calibration)
- Measuring snow attributes
- Recording climate data
- Accessing climate data

Overall Station Operation and Maintenance

Documentation for recording and reporting observations and equipment installation and calibration was available on the web site for the NWS COOP (<http://www.nws.noaa.gov/om/coop/training.htm>) as of 8 February 2010. This site contained a link to a handbook for station operation and maintenance (NWS 1989).

Measuring Snow Attributes

Documentation for measuring snow attributes was available on the web site for the NWS COOP (<http://www.nws.noaa.gov/om/coop/training.htm>) as of 8 February 2010. This site contained a link to the snow measurement guidelines (<http://www.nws.noaa.gov/om/coop/snowguid.htm>) (NWS 1996).

Recording COOP Climate Data

Forms for the COOP program were available on the COOP website (<http://www.nws.noaa.gov/om/coop/forms.htm>) as of 8 February 2010. These included links to form B91: Record of River and Climatological Observations. Procedures for recording climate data are detailed in the notes to Form 91, available on the NWS web site (<http://www.nws.noaa.gov/om/coop/forms/b91-notes.htm>).

These documents are also stored on the NCCN server at <http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>.

Accessing COOP Climate Data

NWS COOP stations located within the NCCN will be used to generate annual climate summaries, to identify climatic extremes, and to aid in the analysis and interpretation of trends in other monitored vital signs. The Western Regional Climate Center in Reno, Nevada (WRCC) is the official repository for NWS COOP data, and has provided the NCCN access to daily measures for COOP stations on National Park Service lands. Summary data can be accessed on-line through the WRCC <http://www.wrcc.dri.edu/climsum.html>.

Procedures

1. To obtain daily data, send an email to wrcc@dri.edu with a list of the NWS COOP stations and the desired dates. Station names and IDs are listed in Appendix C of the NCCN Climate Monitoring Protocol Narrative.
2. WRCC will generate ASCII files for the requested stations and time periods, store the files on an anonymous ftp site, and contact you with the location of the files. Use standard ftp protocols to download the ASCII data.

Literature

National Weather Service (NWS). 1989. National Weather Service observing handbook No. 2: Cooperative station handbook. National Oceanic and Atmospheric Administration, NWS, Silver Spring, Maryland. Online. (<http://www.nws.noaa.gov/om/coop/Publications/coophandbook2.pdf>). Accessed 8 February 2010.

National Weather Service (NWS). 1996. Snow measurement guidelines. National Oceanic and Atmospheric Administration, NWS, Silver Spring, Maryland. Online. (<http://www.nws.noaa.gov/om/coop/snowguid.htm>). Accessed 8 February 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 8: Climate Reference Network (CRN)

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Lofgren, R. 2010. Standard operating procedure #8: Climate Reference Network. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

Introduction

The CRN is a network of climate stations developed as part of a NOAA initiative. The primary goal is to provide long-term observations of temperature and precipitation that can be coupled with past long-term observations for the detection of climatic change. The automated CRN stations are designed to operate over a wide range of environmental conditions but are located in areas that are anticipated to be unaffected by factors that could modify local environmental conditions (e.g., urban expansion). The final network was established as of September 2008 and consists of approximately 114 stations nationwide.

The CRN records air temperature, precipitation, ground-surface temperature, solar radiation, wind speed, and sensor performance. Data are 5 minute temperature and precipitation readings and are aggregated to 15 minute, hourly, and daily summaries. Data are automatically transmitted to the NCDC data management and processing facility in Asheville, NC. NCDC provides data ingest, quality control, data processing and archiving, and eventually distributes data to the climate research community and the public.

This SOP directs readers to detailed information on the establishment, maintenance and system requirements of Climate Reference Network (CRN) climate stations. Instructions to access CRN climate data are also included. Additional information is available on the CRN web site (<http://www.ncdc.noaa.gov/crn/>).

Site Establishment and Maintenance: CRN Documentation

Documentation for CRN sites is available from the CRN web site (<http://www.ncdc.noaa.gov/crn/docs.html>). Documentation includes the CRN Site Information Handbook (NESDIS 2002); Field Site Maintenance Plan (NESDIS 2003a); and CRN Functional Requirements Document (NESDIS 2003b), which covers requirements for measurement parameters, communications, and data access, processing, and archiving.

These documents are also stored on the NCCN server at <http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>.

Accessing CRN Climate Data

Data from CRN stations located within the NCCN will be used to generate annual climate summaries, to identify climatic extremes, and to aid in the analysis and interpretation of trends in other monitored vital signs. Data can be accessed from the University of Utah website.

Procedures

1. Access the following University of Utah web page (<http://climate.usurf.usu.edu/products/data.php>).
2. Select the CRN tab at the top of the map and zoom to Washington State.
3. Select the desired start and end dates, and parameters. Submit the query.
4. The query will be located under the download tab. Choose the desired output of a table or CSV file.

CRN weather data collected within the last 12 hours, daily summaries, and monthly summaries can be viewed online (<http://www.ncdc.noaa.gov/crn/hourly>).

Literature

National Environmental Satellite, Data, and Information Service (NESDIS). 2002. U. S. Climate Reference Network Site Information Handbook. CRN Report series NOAA-CRN/OSD-2002-0002R0UD0. National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service (NESDIS), Silver Spring, Maryland. Online.

(<http://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/program/X030FullDocumentD0.pdf>). Accessed 12 February 2010.

National Environmental Satellite, Data, and Information Service (NESDIS). 2003a. U.S. Climate Reference Network Field Site Maintenance Handbook. Online. CRN Report series NOAA-CRN/OSD-2003-0010R0UD0. National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service (NESDIS), Silver Spring, Maryland. Online.

(http://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/program/X041_d0.pdf). Accessed 12 February 2010.

National Environmental Satellite, Data, and Information Service (NESDIS). 2003b. U.S. Climate Reference Network Functional Requirements Document. Online. CRN Report series NOAA-CRN/OSD-2003-0009R0UD0. National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service (NESDIS), Silver Spring, Maryland. Online.

(http://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/program/X040_d0.pdf). Accessed 12 February 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 9: Automated Surface Observation System (ASOS)

Version 5/26/2010

Revision History Log

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Lofgren, R. 2010. Standard operating procedure #9: Automated Surface Observation System. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

Introduction

Automated Surface Observing System (ASOS) is an automated observing system sponsored by the Federal Aviation Administration (FAA), NWS and the Department of Defense (DOD). ASOS provides weather observations which include: temperature, dew point, wind, barometric pressure, visibility, sky condition, and precipitation and are installed at airports throughout the country. Implementation of ASOS began in the mid-1990s. ASOS stations with a period of record prior to 1990 relied on manual hourly observations until the ASOS platform and sensor complement was deployed in the mid-1990s. The earlier type of hourly stations often resulted in what has been called the Surface Observation (SAO) program.

ASOS's functions include measurement of weather elements, data processing and display, communication, and data storage (archiving). The ASOS automatically collects, processes, and error checks data and formats, displays, archives, and reports the weather elements included in a surface weather observation.

This Standard Operating Procedure (SOP) lists documentation covering essential aspects of the ASOS including:

- Data acquisition and processing, and report formatting and dissemination
- Maintenance
- Data Documentation

ASOS Station Operation

Information regarding the operation of ASOS stations was available on the web site for the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) ASOS (<http://www.weather.gov/asos/>), as of 11 March 2010. Among other information, this site contained a user's guide (NOAA 1998).

ASOS Station Maintenance

Overall site maintenance is provided for by the ASOS Automated Operations and Monitoring Center (AOMC). The AOMC is part of the Systems Operations Center. The AOMC provides around-the-clock operational and maintenance support for ASOS. Maintenance of ASOS equipment is accomplished following authorized guidance (e.g., technical manuals, modification notes, maintenance notes).

Information on ASOS maintenance was available on the NOAA NWS web site at <http://www.nws.noaa.gov/directives/030/030.htm> as of 29 January 2010. Information included a description of maintenance roles and responsibilities for ASOS stations (NWS 2003).

These documents are also stored on the NCCN server at <http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>.

ASOS Data Access

Historical ASOS data is stored by the National Climatic Data Center (NCDC). Information on ASOS data sets was available on the NCDC web site (<http://lwf.ncdc.noaa.gov/oa/ncdc.html>).

ASOS weather data collected within the last 24 hours can be viewed online (http://www.faa.gov/airports_airtraffic/weather/asos/).

Prior to field season each year, staff should check the NWS web sites for any updates to manuals or procedures.

Literature

National Oceanic and Atmospheric Administration (NOAA). 1998. Automated surface observing system (ASOS) user's guide. NOAA, National Weather Service, Silver Spring, Maryland. Online. (<http://www.weather.gov/asos/pdfs/aum-toc.pdf>). Accessed 12 February 2010.

National Weather Service (NWS). 2003. Maintenance, Logistics, and Facilities. ASOS Maintenance. National Weather Service Instructions 30-2111, August 29, 2003. National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland. Online. (<http://www.nws.noaa.gov/directives/sym/pd03021011curr.pdf>). Accessed 12 February 2010.

National Climatic Data Center (NCDC). 2005. Data Documentation for Data set 3283 (DSI-3283. ASOS Surface Airways Hourly Observations, May 4, 2005. NCDC, Asheville, North Carolina. Online. (<http://www1.ncdc.noaa.gov/pub/data/documentlibrary/tddoc/td3283.pdf>). Accessed 12 February 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 10: Upper Air Radiosonde Balloon

Version 5/26/2010

Revision History Log

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Suggested citation:

Lofgren, R. 2010. Standard operating procedure #10: Upper Air Radiosonde Balloon. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

Introduction

Understanding and accurately predicting changes in the atmosphere requires adequate observations of the upper atmosphere. Since the late 1930s the (NWS) has measured vertical profiles of pressure, temperature, relative humidity, and wind velocity through the use of balloon-borne radiosondes. Observations from network stations are made twice daily. The NWS Upper-air Observations Program is managed by the Observing Systems Branch (OSB), which is part of NWS Headquarters located in Silver Spring, Maryland. Radiosonde observations are applied to a broad spectrum of efforts. Data applications include: input for computer based weather prediction models, local severe storm, aviation, and marine forecasts, weather and climate change research, input for air pollution models, and ground truth for satellite data.

The Quillayute Radiosonde is located west of OLYM and has provided data on Pacific air masses as they approach land and pass over the Olympic Mountains since 1948.

This Standard Operating Procedure (SOP) lists documentation and procedures essential to the National Weather Service (NWS) Upper-Air Program. The NWS posts information and instructions for upper-air operational requirements (<http://www.ua.nws.noaa.gov/>). All aspects of the upper-air observation are covered from preparing the instruments to processing and disseminating upper-air data, and maintaining radiosonde balloon equipment. This SOP also lists documentation and procedures to access data from the NWS Upper-Air Program.

This document is also stored on the NCCN server at <http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>.

Downloading Upper Air Climate Data

The single radiosonde site in the NCCN exists just outside the OLYM boundary at the Quillayute airport. The Upper air data consists of temperature, relative humidity, atmospheric pressure, and wind. Data are downloaded from the Integrated Global Radiosonde Archive web page using the following procedures.

Procedures

1. Access the following NOAA/NCDC website (<http://www.ncdc.noaa.gov/oa/climate/igra/index.php>)
2. Follow the link on the left (Access ASCII files). Access either the FTP site (<ftp://ftp.ncdc.noaa.gov/pub/data/igra>) or the HTTP site (<http://www1.ncdc.noaa.gov/pub/data/igra>).
3. The sites contain the following directories:
data-por Period of record data files (base version through 2003 + daily updates; one file per station)
data-ytd Daily updates since January 1, 2004 (one file per station)
monthly-por Period of record monthly-mean files (updated monthly)

A complete description of the files and formats used in this dataset is available in the IGRA README text located at <http://www1.ncdc.noaa.gov/pub/data/igra/readme.txt> and within the FTP and HTTP sites listed in step 2.

4. Open up the desired data set and scroll down the list until you reach the WMO # for Quillayute: 72797. Unzip the file and open with Excel.

Literature

National Weather Service (NWS). 2007. Operations and Services. Upper Air Program NWSPD 10-14, May 23, 2007. National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland. Online.
(<http://www.nws.noaa.gov/directives/sym/pd01014001curr.pdf>). Accessed 12 February 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 11: Preparation for Field Work

Version 5/26/2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Suggested citation:

Baccus, B. 2010. Standard operating procedure #4: Managing NCCN Climate Stations Photographic Images. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

This Standard Operating Procedure (SOP) provides a list of activities and field equipment which must be prepared prior to visiting climate sites. Unlike many NCCN protocols, climate sites are visited and maintained continuously so preparations are not annual but generally the same for each visit, any time of the year.

Inventory

12 Volt Batteries

NPS, NWAC High Elevation, SNOTEL and RAWS stations generally rely on 12V power provided by solar panels, deep cycle 12 volt batteries or a converted 120 AC power source with battery backup. When servicing stations, a fully charged 12 volt battery should be available to replace failed or malfunctioning batteries in the field.

Routinely check backup batteries to make sure they are fully charged on a float charger so that charged batteries are available whenever necessary. Batteries swapped out from remote sites should be pulse charged before putting onto a float charger.

Desiccant Packs

Fresh desiccant packets are placed in automated climate station enclosures during every servicing. Desiccant helps maintain electronic equipment by removing excess moisture from the datalogger environment. Always keep a ready supply of desiccant available for servicing trips. Desiccant is reactivated by placing in a drying oven at 240° F for 16 hours. After drying, desiccant is stored in doubled ziplock bags within a sealed “Rubbermaid” box. Desiccant packs should be stored with indicator cards to ensure they remain dry before use. Throughout the year, a supply of dry desiccant packs should be maintained for servicing trips.

Replacement Equipment

When possible, replacement equipment should be readily available if failure occurs. Spare dataloggers and newly calibrated instruments should be available in the lab or office. Manufacturer calibrations are normally scheduled during summer months when the best field conditions for equipment change outs occur. In spring, calibrated replacement sensors should be available and ready to cycle out to field sites.

Field Preparation

Park staff will keep a calendar or spreadsheet for the purposes of planning various climate related activities. Snow Course calendars are issued by the NRCS and outline days available for sampling. Site visits to automated climate stations will either be emergency or routine maintenance. Field preparation for each of these site visits will be discussed.

Emergency Maintenance

1. Contact agency (if Non-NPS) to confirm the type of repairs required.
2. Acquire special instructions, contact information and replacement equipment and tools necessary for repairs.
3. Monitor weather and schedule appropriate days for repair activities.
4. Organize tools and equipment (using the appropriate Field Checklist – next section).

5. Contact local rangers or maintenance staff to assess conditions at the field site and ensure that the area is accessible.
6. Check field notes from prior trips and determine if other maintenance activities could or should be accomplished at the site.

Routine Maintenance

1. Check calendar of maintenance events to determine activities during the next site visit (calibrations, equipment change, etc.).
2. Review previous site observation forms and note potential issues or comments about upcoming maintenance needs.
3. Review the most recently downloaded or real-time data to confirm that all sensors are functioning properly.
4. If calibration or sensor change-outs are required, bring the appropriate instruments and calculate new multipliers (if necessary). Update datalogger program if necessary. Make sure that the previous as well as new datalogger programs are loaded on laptop or other communication device.
5. Contact local rangers or maintenance staff to assess conditions at the field site and ensure that the area is accessible.
6. Organize tools and equipment (using the appropriate Field Checklist – next section).

Returning from the Field

1. Clean and dry all tools.
2. Replace any used supplies.
3. Place backup or changed-out batteries on battery charger.
4. Dry used desiccants.
5. For NPS managed sites, download data from laptop or PDA to network servers (see SOP 1, NPS Climate Stations).
6. Download and file photographs from site visit.
7. Update calendar of maintenance events to indicate activities accomplished and note activities on next visit.
8. Copy and file site observation forms.
9. Mail replaced sensors to manufacturer for calibration.

Field Visit Checklists

Snow Course

- | | | |
|---|--|---|
| ☐ Skis / Snowshoes | ☐ Emergency Heat Pads | ☐ Gaiters |
| ☐ Poles | ☐ Snow Course Map | ☐ Outer Shell Jacket |
| ☐ Poles | ☐ Federal Sampler | ☐ Outer Shell Pants |
| ☐ Avalanche Beacon | ☐ Water Bottle(s) | ☐ Extra Gloves |
| ☐ Probes | ☐ Extra Food | ☐ Mitts |
| ☐ Shovel | ☐ Boots | ☐ Insulation Layers |
| ☐ First Aid Kit | | |
| ☐ Ten Essentials | | |

RAWS, NPS, NWAC-High Elevation Climate Sites

- | | |
|---|--|
| ☐ Ladder | ☐ Small Hand Level (magnetic) |
| ☐ Key or Access Code (for Enclosure) | ☐ Tape Measure (English/metric) |
| ☐ Clipboard w/ Site Observation Form | ☐ Spare Battery Cables |
| ☐ Pencil/Pen | ☐ Spare 16, 14, 12 AWG wire |
| ☐ 12 Volt Battery | ☐ Electricians Tape |
| ☐ Desiccant Packs | ☐ DryConn waterproof repair connectors |
| ☐ PDA or Laptop | ☐ 3M Scotchlok waterproof repair connectors |
| ☐ 9 Pin Serial Cable | ☐ Assorted wire connectors |
| ☐ SC32A | ☐ Shrink Tubing |
| ☐ Volt Meter | ☐ Plastic Putty |
| ☐ Wire Strippers | ☐ 3-1 Oil |
| ☐ Wire Cutters | ☐ WD-40 Lubricant |
| ☐ Needle Nose Pliers | ☐ Bleach Solution |
| ☐ Channel Locks | ☐ Soap Solution |
| ☐ Screwdriver, Slotted (Large) | ☐ Rags (in plastic bag) |
| ☐ Screwdriver, Slotted (Small) | ☐ Toothbrush |
| ☐ Screwdriver, Slotted (XSmall) | ☐ Scrub Brush |
| ☐ Screwdriver, Phillips (Med) | ☐ Pipe Cleaner |
| ☐ Screwdriver, Phillips (Small) | ☐ Zip Ties (multiple sizes 4" to 12") |
| ☐ Screwdriver, Phillips (XSmall) | ☐ 50 ml Nalgene® Transparent Buret |
| ☐ Hex Wrench Set (1/4" - .050") | ☐ Water Bottle |
| ☐ T Hex Wrench (5/32") | ☐ Calculator |
| ☐ Adjustable Wrench (Small) | ☐ Digital Camera |
| ☐ 7/16" Nut Driver | ☐ Replacement (Calibrated) |
| ☐ 1/2" Nut Driver | ☐ Sensors/Datalogger |
| ☐ 8 mm Open/Box End Wrench | |

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 12: Instructions for Accessing Climate Sites

Version 5/26/2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

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This Standard Operating Procedure (SOP) provides access instructions to climate stations located inside NCCN Park boundaries.

Olympic National Park Stations

Buckinghorse Ridge: SNOTEL

The Buckinghorse Ridge SNOTEL can only be accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with OLYM's aviation office. Obstruction Point is the routine helibase for this operation. If maintenance flights are conducted at the same time as Mt. Crag (Olympic National Forest), NRCS technicians may fly directly from Mt. Crag to the Buckinghorse Ridge Site. Emergency maintenance and winter snow surveys may originate from Forks, Olympia or Port Angeles airports.

Emergency escape from the Buckinghorse Ridge SNOTEL is via Buckinghorse Ridge. Follow the ridge due north until the end of the old burn, approximately 1.5 miles. Drop down the NE ridge (2.0 miles) until reaching the main Elwha Trail just west of the Godkin Creek bridge. Follow the trail north, 4.2 miles to Hayes Guard Station where emergency shelter and supplies are available. It is 16.5 miles from this point to the Whiskey Bend trailhead.

Cox Valley: Snow Course

From Port Angeles, drive the Hurricane Ridge Road to the Hurricane Ridge Lodge. The federal sampler (snow course tubes) is stored in the Hurricane Ridge Ranger Station. Drive down the road and pass the signed snow play area on the west side of the road. At .6 miles from the parking lot, park on the right side of the road. Ski south, down steep slopes through patchy trees using a GPS unit to identify the start of the snow course.

Deer Park Ranger Station: NPS Climate Station

From Port Angeles, take Hwy 101 east to the Deer Park Road. Follow the Deer Park Road to the park boundary. From the boundary, drive the steep dirt road to Deer Park area. Take a right at the first junction near the top and park at the Deer Park Ranger Station. The climate station is located on a tower NE of the station.

Deer Park Road: NPS Climate Station

From Port Angeles, take Hwy 101 east to the Deer Park Road. Follow the Deer Park Road to the park boundary. From the boundary, drive 2.6 miles and park on a wide turnout just before the inside turn (drainage) where the access trail begins. (Elevation 3250') Check the GPS to make sure you are in the appropriate location. From the road, hike upslope 150 yards following an obvious animal trail to the location of the climate station.

Deer Park: Snow Course

From Port Angeles, take Hwy 101 east to the Deer Park Road. Follow the Deer Park Road to the park boundary. From the boundary, drive the steep dirt road to snow line and park. Ski or snowshoe up the road to the first junction near the top and follow the road to the Deer Park Ranger Station. The federal sampler is stored in the Deer Park Ranger Station.

From the station, ski upward to the large open meadow at the crest of the hill. Ski downward to the east, following open areas to the lower campground. The snow course begins at the edge of the 1988 burn.

Elwha Ranger Station: NWS Coop Station

From Port Angeles, take Hwy 101 west approximately 10 miles. Turn south on the Olympic Hot Springs road and drive to the park boundary. From the park boundary, drive several more miles until you see the Elwha Ranger Station on your left. Park at the station. The NWS equipment is located adjacent to the main ranger station.

Hayes Guard Station: NPS Climate Station

From Port Angeles, take Hwy 101 west approximately 10 miles. Turn south on the Olympic Hot Springs road and drive to the park boundary. From the park boundary, drive several more miles until you pass the Elwha Ranger Station on your left. Turn left just beyond the station, and follow the Whiskey Bend road to the trail head at its terminus.

From the trailhead, hike 11.3 miles to the Elkhorn Ranger Station and spend the night. Hike 5.2 miles up trail to a junction marked with sign for Hayes Guard Station. Take this .1 mile spur trail to the south where it terminates at the ranger cabin. The climate station is located near the south side of the cabin in a small wood shelter (NWS cotton region shelter). The key to the shelter door hangs from a hook underneath the box.

Hoh Ranger Station: NWS Coop Station

From Port Angeles, take Hwy 101 west. Drive 65 miles, passing through the city of Forks. Turn left on the Hoh Road and follow the road to the visitor center parking lot. From the right hand side of the parking lot, drive the maintenance road 100 yards and turn left into the housing area. The NWS Coop station is located in the grassy area in the center of the area. It is collocated with the park NADP (National Atmospheric Deposition Program) and NWS Hydrology site.

Hoh Valley, East Twin: NPS Climate Station

From Port Angeles, take Hwy 101 west towards Forks. Drive 65 miles, passing through the city of Forks. Turn left on the Hoh Road and follow the road NE to the park boundary. From the park boundary, drive the road 3.5 miles to the Big Spruce turnout. From the turnout, turn around and head SW .8 miles and park on the right side of the road just before the sharp turn and the East Twin Creek bridge. Follow a flagged trail NE .3 miles to the permanent forest plot and climate station.

Hurricane Ridge: NWAC/RAWS

From Port Angeles, drive the Hurricane Ridge Road to the Hurricane Ridge Lodge. From the parking lot, follow the paved path to the generator house and radio tower where the climate station is located.

Hurricane: Snow Course

From Port Angeles, drive the Hurricane Ridge Road to the Hurricane Ridge Lodge. The federal sampler (snow course tubes) is stored in the Hurricane Ridge Ranger Station. Ski .5 miles west along the Hurricane Hill road until reaching the Wolf Creek trail. Travel down the trail, approximately 1.2 miles until reaching the orange snow course marker. It is located on a large fir on the left hand side of the trail. The snow course is located at 4500' elevation.

Lake Crescent: NPS Climate Station

From Port Angeles, take Hwy 101 west towards Forks. Drive past Lake Sutherland and before reaching Lake Crescent, turn right on the East Beach Road. Follow the road past the Log Cabin Resort. Take the second left after the resort, following signs to the Spruce Railroad Trail. Drive 150 yards past the trailhead and veer left down the first driveway. Park at the NPS Lake Crescent lab. The weather station is located on the dock behind the lab.

Ozette Ranger Station: NPS Climate Station

From Port Angeles, take Hwy 101 west towards Forks. At Sapho, turn right on Hwy 113 towards Clallam Bay. Pass through Clallam Bay and Sekiu on Hwy 112 then turn left on the Hoko-Ozette Road. Follow the road to its terminus at the Ozette Trailhead. The climate station is located in an open field south of the parking lot.

Quinault 4 NE: Climate Reference Network Site

From Port Angeles, take Hwy 101 west towards Forks. Continue on Hwy 101 through the town of Forks and south towards Aberdeen. Turn left on the North Shore Quinault Road just before reaching the town of Amanda Park. Follow the road east, past the Quinault Ranger Station. Pass the station and drive 1.2 miles to a marker on the right which reads 1081. Turn left at this driveway, stay left and drive until it ends at a locked gate. The gate is secured with an AB1 lock. The CRN station is located in a large open field, several hundred yards beyond this gate.

Quinault Valley, Bunch Field: NPS Climate Station

From Port Angeles, take Hwy 101 west towards Forks. Continue on Hwy 101 through the town of Forks and south towards Aberdeen. Turn left on the North Shore Quinault Road just before reaching the town of Amanda Park. Follow the North Shore Road east, past the Quinault Ranger Station. Follow the road east 8.3 miles to a paved segment of road passing through large open meadows (Bunch Field). The station is located at the northwest corner of the large field north of the road.

Waterhole: SNOTEL

From Port Angeles, drive the Hurricane Ridge Road to the Hurricane Ridge parking lot. During summer months, take a hard left at the parking lot onto the Obstruction Point road. Follow this narrow gravel road 4 miles east to the P.J. Lake trailhead. At the trailhead, unlock the chain blocking a small access road on the south side of the Obstruction Point road. Drive 100 yards to the terminus of the access road at the Waterhole Hut and SNOTEL. During winter months you must ski the 4 mile stretch of Obstruction Point Road between the lodge parking lot and the Waterhole SNOTEL.

Mt. Rainier National Park Stations

Camp Muir: High Elevation Site

From Longmire, drive the Nisqually Road 11 miles to Paradise. Park at the upper parking lot at Paradise at the Alta Vista Trailhead. Take the Alta Vista Trail to the Skyline Trail to the Pebble Creek Trail. From the Pebble Creek Trail, continue up the snowfield to Camp Muir. Total hiking distance is five miles to from Paradise to Camp Muir. The station is located on the Rohn tower which is attached to the gumbu building at Camp Muir.

Carbon River: NPS station

Access Carbon River via SR 165 through Wilkeson. Continue past the Carbon River entrance approximately .1 miles. Take the access road on your left to the maintenance area. The station is located on the 20-foot tower on the south side of the maintenance area.

Carbon River: COOP

Access Carbon River via SR 165 through Wilkeson. Continue past the Carbon River entrance approximately .1 miles. Take the access road on your left to the maintenance area. The precipitation gauge is located on the south side of the maintenance area to the east of the tower.

Cayuse Pass: SNOTEL

From Hwy 410 eastbound, park 300 feet above Windy Point (approximately mile post 67.8). Walk south up a short hill approximately 100 feet. The station is located in a small enclave of trees

Longmire: NWS COOP

The Longmire-COOP station is located approximately 150 feet to the south of the Wilderness Information Center. From the Wilderness Information Center in Longmire, walk south and cross the main entrance road to Longmire. The COOP stations is located to the west of the Macy Dorm

Ohanapecosh: NWS COOP

Access Ohanapecosh from Hwy 123 on the east side of the Park. From the entrance road to Ohanapecosh, take a left to the Ohanapecosh Ranger Station. Park at the Ranger Station. The Ohanapecosh-COOP is located approximately 20 feet from the main door of the Ranger Station at Ohanapecosh.

Ohanapecosh: RAWs

Access Ohanapecosh from Hwy 123. From the entrance road to Ohanapecosh, take a left to the Ohanapecosh Ranger Station. Continue straight past the right turnoff to the Ranger Station. Park at the apartment building located furthest to the east. The Ohanapecosh RAWs is located behind the apartment building.

Paradise Ranger Station: NWS COOP

From Longmire, drive the Nisqually Road 11 miles to Paradise. Take a left at the lower lot at Paradise. Park at the Nisqually Vista Trailhead. Take the Nisqually Vista Trail approximately .2 miles. The station is located just left of the trail below the old lift tower.

Paradise Ranger Station: High Elevation Site (Precipitation Site)

From Longmire, drive the Nisqually Road 11 miles to Paradise. Take a left at the lower parking lot at Paradise. Park at the Nisqually Vista Trailhead. Take the Nisqually Vista Trail approximately .2 miles. The station is located just left of the trail on the old lift tower. The datalogger, air/RH sensor, and total snow depth sensor are located on the tower. The 24-hr snowboard is located on the ground below the tower.

Paradise Ranger Station: High Elevation Site (Wind Site)

From Longmire, drive the Nisqually Road 11 miles to Paradise. Take a left at the lower parking lot at Paradise. Park near the Nisqually Vista Trailhead. The wind speed/direction sensors are located on a 30-foot tower on the small vegetated island in front of the Ski Dorm.

Paradise: SNOTEL/Snow Course

From Longmire, drive the Nisqually Road towards Paradise and park at the sewage treatment plant (approximately mile post 18.4). Walk east for approximately 150 feet. The station is located in a meadow.

Sunrise: High Elevation Site (Precipitation)

From Hwy 410 on the east side of the Park, take the Sunrise Road to Sunrise. Park on the north side of the parking lot near the Visitor Center. Take the service road located to the north of the visitor center and continue towards the stockade located behind the Visitor Center. The station is located on a 30-foot tower located approximately 25 feet to the west of the stockade.

Sunrise: High Elevation Site (Wind)

From Hwy 410 on the east side of the Park, take the Sunrise Road to Sunrise. Park on the north side of the parking lot at the Sourdough Ridge Trailhead. Take the Sourdough Ridge Trail and go west (left) at the Y

(approximately .2 miles from the trailhead). Approximately .2 miles from the Y, veer offtrail to the north up the hill. The station is located on a knoll on a 10-foot Rohn tower on Sourdough Ridge.

Tahoma Woods: CASTNET

From the Park Administrative Headquarters located approximately 2 miles west of Ashford, continue past the gate to the education center. This gate is closed after hours and requires a key. Park at the education center. The station is located in the meadow to the west of the education center

North Cascades National Park Stations

Beaver Pass: SNOTEL/Snow Course

The SNOTEL/Snow Course is only accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office.

Brown Top Ridge: Modified SNOTEL

During spring and winter months, site can only be accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office. The closest helibase will be used for this operation. Access during summer months will be in coordination with the NOCA glacier monitoring trips. For foot traffic directions, see Riedel, Burrows, and Wenger 2008.

Darrington 21 NNE: CRN

From Sedro-Woolley, take SR 20 to Marblemount. Turn left on Ranger Station Road (mile post 105.3) and continue 1 mile to the end of the road.

Diablo Dam: NWS COOP

From Sedro-Woolley, take SR 20 to Diablo Dam.

Easy Pass AM: Modified SNOTEL/Snow Course

During spring and winter months, site can only be accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office. The closest helibase will be used for this operation. Access during summer months will be in coordination with the NOCA glacier monitoring trips. For foot traffic directions, see Riedel, Burrows, and Wenger 2008.

Hozomeen: RAWS

The station is located in the Hozomeen campground. By car, the site is accessible only through Canada. From the town of Hope, British Columbia, turn south on Silver-Skagit Road. Drive south for 39 miles to the campground at the north end of Ross Lake.

Jasper Pass: Snow Course

The snow course is only accessed by helicopter and is organized by NRCS staff in coordination with NOCA's aviation office.

Marblemount Ranger Station: NWS COOP

From Sedro-Woolley, take SR 20 to Marblemount. Turn left on Ranger Station Road (mile post 105.3) and continue 1 mile to the end of the road. The station is located adjacent to the Wilderness Information Center.

Marblemount: RAWS

From Sedro-Woolley, take SR 20 to Marblemount. Turn left on Ranger Station Road (mile post 105.3) and continue 1 mile to the end of the road. Turn right on Powerline Road.

Meadow Cabins: Snow Course

The snow course is only accessed by helicopter and is organized by NRCS staff in coordination with NOCA's aviation office.

Newhalem: NWS COOP

From Sedro-Woolley, take SR 20 to Newhalem.

Noisy Glacier: Modified SNOTEL

During spring and winter months, site can only be accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office. Marblemount is the routine helibase for this operation. Access during summer months will be in coordination with the NOCA glacier monitoring trips. For foot traffic directions, see Riedel, Burrows, and Wenger 2008.

Park Creek Ridge: SNOTEL/Snow Course

The SNOTEL/Snow Course is only accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office.

Ross Dam: NWS COOP

From Sedro-Woolley, take SR 20 to Ross Dam.

Silver Glacier: Modified SNOTEL

During spring and winter months, site can only be accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office. The closest helibase will be used for this operation. Access during summer months will be in coordination with the NOCA glacier monitoring trips. For foot traffic directions, see Riedel, Burrows, and Wenger 2008.

Stehekin: NWS COOP

Travel to Stehekin is by air or by boat. The RAWS station is located at the Stehekin State Airport.

Stehekin: RAWS

Travel to Stehekin is by air or by boat. The RAWS station is located at the Stehekin State Airport.

Thunder Basin: SNOTEL/Snow Course

The SNOTEL/Snow Course is only accessed by helicopter. Emergency and routine maintenance requires a formal flight request and should be arranged by a park helicopter manager in conjunction with NOCA's aviation office.

San Juan Island National Historic Park

There are no stations located inside the Park boundary.

Lewis and Clark National Historic Park

Fort Clatsop: COOP

The station is located north of Fort Clatsop Headquarters.

Ebey's Landing National Historic Reserve

Coupeville: COOP

From Coupeville, take Ebey's Road towards Ebey's Landing. The station is approximately ½ mile past Cook Road on the right.

Oak Harbor Airpark: ASOS

From Coupeville, take State Hwy 20 to Penn Cove Road. Take a left at Monroe Landing and a right at Oak Harbor Airpark

Fort Vancouver National Historic Site

Pearson Airpark: ASOS

From the FOVA Headquarters Building, take E. Reserve Street south to the Pearson Airfield.

Literature Cited

Riedel, J. L., R. A. Burrows, and J. M. Wenger. 2008. Long term monitoring of small glaciers at North Cascades National Park: A prototype park model for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2008/066. National Park Service, Fort Collins, CO. Online. (https://science1.nature.nps.gov/naturebib/biodiversity/2008-10-16/NCCN_Glacier_Protocol_NOCA_20081006.pdf or http://science.nature.nps.gov/im/monitor/protocols/NCCN_Glacier_Protocol_NOCA_20081006.pdf). Accessed 11 March 2010.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 13: Project Workspace and Records Management

Version 5/26/2010

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Suggested citation:

Boetsch, J. R. 2010. Standard operating procedure #13: Project Workspace and Records Management. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

This Standard Operating Procedure describes how and where project files and records are managed by project staff. Workspace structure, naming conventions, and procedures for handling project files are included. This SOP is adapted from SOP #1 in the NCCN Forest Vegetation Monitoring Protocol (Acker et al. in review).

NCCN File Workspace

NCCN has a centralized file system and project workspaces available for use by field crews and project staff at: \\inpolymfs\parkwide\NCCN. This can be mapped to any available drive letter in Windows Explorer using Tools > Map Network Drive. This will help avoid the problem of NCCN projects having several versions of files on different servers around the network. These folders are set up so that park and network staff members at the network parks all have read privileges throughout the directory structure. Project leads and a few other individuals associated with each project have full privileges for their project folder so they can manage their own permissions. These workspaces are intended to be a more familiar and convenient way of storing information, as an adjunct to the NCCN sharepoint site. Project leads will decide what is to be stored locally in these project workspaces as opposed to on the team sharepoint site. Examples of files kept in these project workspaces include: working files for project field crews, GPS downloads, GIS map files, database files, and other project records.

The NCCN workspace is organized as follows under four main folders: Libraries, Projects, Temp, and Workspace. Project staff members will primarily be working in one or more of the project folders under Projects, and may wish to make shortcuts to one or more of the project subfolders by right-clicking on the desired folder and selecting Send To > Desktop (create shortcut).

Instructions for Mapping a Network Drive to the NCCN Workspace

1. Open an instance of Windows Explorer. One way is from the Start menu: go to: All Programs > Accessories > Windows Explorer. Another is to open My Documents, My Computer, or any other folder browser shortcut.
2. On the menu click Tools > Map Network Drive.
3. Under drive, select any free drive letter (though project documentation often refers to this drive as the X: or I: drive).
4. Under folder, type in: \\inpolymfs\parkwide\NCCN
5. Make sure the Reconnect at Logon checkbox is checked. This drive letter should now be available each time you log in to that particular computer.

Project Workspace

A section of the NCCN workspace is reserved for this project. The recommended file structure within this workspace is shown in Figure SOP 13.1.



Figure SOP 13.1. Recommended file structure for project workspace. Note: The workspace folder name includes 'CLa01', the NCCN project code.

Each major subfolder is described as follows:

- Analysis – Contains working files associated with data analysis.
- Data – Contains the front-end database application file for the season. The back-end database for the project is maintained in Microsoft SQL Server. Database exports and other intermediate summary information can be stored here as well; these files are most effectively managed within subfolders named by calendar year.
- Documents – Contains subfolders to categorize documents as needed for various stages of project implementation. Additional folders and subfolders may be created as needed to arrange information in a way that is useful to project staff.
- GPS data – Contains GPS data dictionaries, and raw and processed GPS data files. This folder contains subfolders to arrange files by year. Each of these subfolders also contains the project code to make it easier to select the correct project folder within the GPS processing software.
- Images – For storing images associated with the project. This folder has subfolders named by calendar year to make it easier to identify and move files to the project archives at the end of each season. Refer to SOP 4: Managing Photographic Images for more details.
- Spatial info – Contains files related to visualizing and interacting with GIS data.
 - GIS data – New working shapefiles and coverages specific to the project.

- o GIS layers – Pointer files to centralized GIS base themes and coverages.
- o Map documents – Map composition files (.mxd).

Seasonal Workspace

In addition to these permanent folders, a temporary seasonal workspace is established at the beginning of each field season (e.g., "2009_field_crew"). This temporary workspace provides a place for field crew members to create and modify files while limiting access privileges for the remainder of the project workspace. Subfolders are created for Images and GPS data to allow field crew members to process incoming files as needed. Temporary workspaces may also be established on other servers to provide local access to crews stationed at other parks. At the end of the season, files in these temporary workspaces are then filed in the appropriate permanent folder(s).

Folder Naming Standards

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name.
- Use the underbar (" _ ") character to separate words in folder names.
- Try to limit folder names to 20 characters or fewer.
- Dates should be formatted as YYYYMMDD (this leads to better sorting than other date naming conventions).

File Naming Standards

Unless otherwise specified, file names should follow these guidelines:

- No spaces or special characters in the file name.
- Use the underbar (" _ ") character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- Correspondence files should be named as YYYYMMDD_AuthorName_subject.ext.

Workspace Maintenance Procedures

Prior to each season, the Project Lead should:

1. Make sure that network accounts are established for each new staff member, or reactivated for returning staff members. By default, the IT staff puts new user accounts into a group that has read-only access to all files.
2. Create new folders named by year under the Images and GPS data sections.
3. Create the seasonal workspace, with subfolders for Images and GPS data.
4. Add user logins for the seasonal crew members to the seasonal workspace, with modify privileges. This can be done by right-clicking on the seasonal workspace folder, selecting Properties > Security, then adding users one at a time and checking the box in the Allow column for Modify privileges.

5. Provide the Data Manager with a list of user logins that need access to the database.

After each season, the Project Lead should:

1. Review the workspace organization and clean up any temporary files and subfolders that are no longer needed.
2. Move files from the seasonal workspace folders into the appropriate permanent folder(s), and archive or delete the seasonal workspace folders as desired. See SOP 4: Managing Photographic Images for specific instructions for images.
3. Compare older files against the retention schedule in NPS Director's Order 19 (available at: <http://data2.itc.nps.gov/npspolicy/DOrders.cfm>). Dispose of files that are beyond their retention schedule if they are no longer needed. As a long-term project, many files associated with this project are likely to be scheduled for permanent retention. This makes it all the more imperative to clean out unneeded files before they accumulate and make it harder to distinguish the truly useful and meaningful ones.
4. Convert older files to current standard formats as needed to maintain their usefulness.
5. Post final documents and files to the NCCN Digital Library for long-term storage. See SOP 3: Product Delivery, Posting and Distribution.
6. Send analog (non-digital) materials to the park collections for archiving.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. In Review. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—XXXX/XXX. National Park Service, Fort Collins, Colorado.

North Coast and Cascades Network Climate Monitoring Protocol Standard Operating Procedure (SOP) 14: Revising the Protocol Narrative and SOPs

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Revision History Log

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Boetsch, J. R., R. Lofgren, and R. Holmes. 2010. Standard operating procedure #14: Revising the Protocol. *in* Lofgren, R., B. Samora, B. Baccus, and B. Christoe. 2010. Climate monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2010/XXX. National Park Service, Fort Collins, Colorado

Overview

This SOP is adapted from SOP #18 in the NCCN Forest Vegetation Monitoring Protocol (Acker et al. in review). Revisions to the Protocol Narrative and to specific Standard Operating Procedures (SOPs) are to be expected. Careful documentation of changes to the protocol and a library of previous protocol versions are essential for maintaining consistency in data collection and for appropriate treatment of the data during data summary and analysis.

The Climate Monitoring Protocol Narrative and SOPs were based on cost-effective and logical methods for acquiring climate data, and on current perceptions of the types of analyses and reports most useful to park managers and researchers. However, the protocol narrative and SOPs will require modifications as climate sensors, data retrieval capabilities, and information needs change. Changes first should be evaluated in terms of cost and benefit, then subjected to appropriate review, and if approved, implemented in a timely manner.

This SOP describes how to make and track changes to the NCCN Climate Monitoring Protocol, including its accompanying SOPs. Project staff should refer to this SOP whenever edits are necessary, and should be familiar with the protocol versioning conventions in order to identify and use the most current versions of the protocol documents. Required revisions should be made in a timely manner to minimize disruptions to project operations.

The following procedures must be followed when making changes to ensure that previous data collection and processing procedures are clearly understood when using and interpreting historical data sets. Similarly, clearly articulating new methods is key to credible interpretation of data acquired since the implementation of changes. Personnel making changes must be familiar with this SOP to ensure that proper reviews are conducted, and that documentation standards are followed.

Peer Review

This protocol attempts to incorporate the best and most cost-effective methods for monitoring and information management. As new technologies, methods, and equipment become available, this protocol will be updated as appropriate, by balancing current best practices against the continuity of protocol information.

All edits require review for clarity and technical soundness. Small changes to existing documents – e.g., formatting, simple clarification of existing content, minor changes to the task schedule or project budget, or general updates to information management SOPs – may be reviewed in-house by project and NCCN staff. However, changes to data collection or analysis techniques, sampling design, or response design are usually more significant in scope and impact and will typically trigger an outside review to be coordinated by the Pacific West Regional Office of the National Park Service.

Document Life Cycle

Protocol documents may be maintained as separate files for each component (e.g., narrative, SOPs, appendices in separate document files) or unified into a single document file. During its life cycle, each document file can be classified in one of six life cycle stages:

1. Draft documents – Documents that have been drafted or revised but have not been reviewed and approved yet.

2. Review documents – Draft documents that have been sent out for peer review or administrative review.
3. Active documents – The current, reviewed and accepted version of each protocol component in Microsoft Word format. These documents have been reviewed and approved at the appropriate level, and are currently implemented for active monitoring projects.
4. Inactive documents – Older versions of approved protocol components that are no longer in active implementation.
5. Archived documents – Comprehensive set of active protocol components plus older, inactive versions of approved protocol components in Microsoft Word format. These are stored as read-only and have a date stamp to identify their approval date. The history of the protocol versions through time should be entirely traceable from within the document archive.
6. Distribution copies – PDF versions of approved, date-stamped protocol components, used to post to websites or otherwise share outside NPS.
- 7.

Protocol documents are stored in the project workspace in separate subfolders named for each life cycle stage, except for inactive documents which are filed together with date-stamped copies of active documents in the archive folder. See SOP 13 Project Workspace and Records Management, for additional details about the project workspace.

Document Versioning Conventions

Rather than using a sequential numeric versioning convention, we use date stamps to distinguish document versions because they are more intuitive and informative than version numbers. Date stamps are embedded within the document header and are also included in the document name.

Document Header

Within each document, the upper right section of the document header should show the date that the document was last saved. By using save date instead of current date, printouts and document previews will show the correct version number. The following is the field code to be used within the header to indicate the version number:

"{ SAVEDATE \@ "MMMM d, yyyy" * MERGEFORMAT }"

File Naming Conventions

All documents except for active documents and draft documents should include the last edit date as a suffix, using the YYYYMMDD format so that documents will sort by date rather than month or day (e.g., NCCN_Climate_Protocol_DRAFT_20100525.doc for the review draft on 5/25/2010).

Active documents and draft documents that have not been shared with others (as review documents) should not include the date because – unlike documents in other life cycle stages – they are not "point in time" document snapshots. By omitting the date stamp from these documents, they can more easily be distinguished from review drafts and archive or distribution copies. Draft documents should clearly contain the word "DRAFT" in the file name.

Revision Procedures

Proposed changes to protocol components should be discussed among project staff prior to making modifications. It is especially important to consult with the Data Manager prior to making changes because certain types of changes may jeopardize data set integrity unless they are planned and executed with the continuity of the data set in mind. Because certain changes may require altering the database structure or functionality, advance notice of changes is important to minimize disruptions to project operations. Consensus should be reached on who will be making the agreed-upon changes and in what timeframe.

The protocol narrative contains a Revision History Log, located just before the narrative 'Introduction,' that will be filled out each time the narrative or any SOP is revised to document when and why the change was made, who authored the change, and to assign a new Version Date to the revised protocol or SOP. Each SOP also has its own Revision History Log with the same fields to be populated. The new version of the protocol narrative and/or SOP will then be archived in the in the project workspace in the appropriate folder as well as in NCCN Digital Library.

Note: A change in one document may also necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly renumbering an SOP may mean changing document references in several other sections of the protocol. The project task list and other appendices also may need to be updated to reflect changes in timing or responsibilities for the various project tasks.

The Project Lead is the primarily responsible for making edits and ensuring document review at the appropriate level. The process for creating and revising protocol documents is shown in Figure 1, and outlined below:

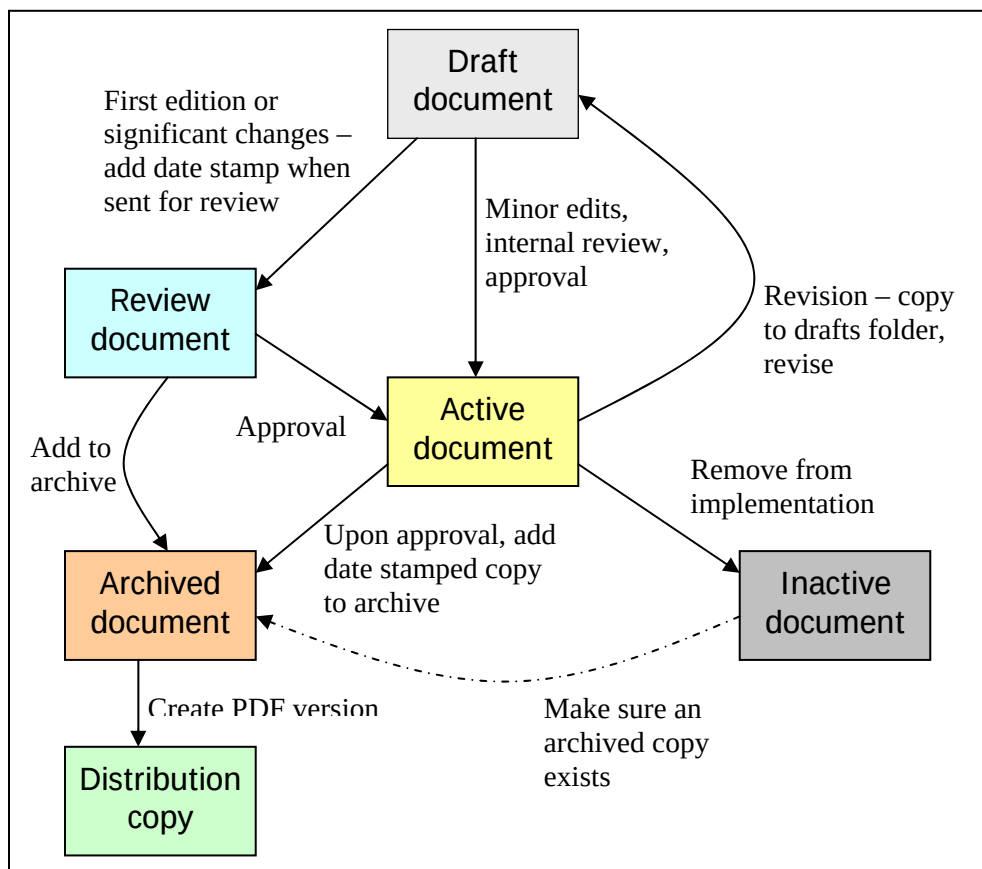


Figure 1. Process for creating and revising protocol documents. Boxes represent document life cycle stages, and connecting arrows indicate procedures.

1. Create the draft document in Microsoft Word format. If modifying an existing document (usually an active document), copy the document to the draft document folder, remove any date stamp from the name. Add "DRAFT" to the file name. Open the document and add "DRAFT" to the header or document watermark as appropriate.
2. Track revision history. If modifying an existing document, document all edits in the Revision History Log embedded in the protocol narrative and each SOP. Log changes only for the section of the document being edited (i.e., if there is a change to an SOP, log those changes only in the revision history log for that SOP). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, describe the change and cite the paragraph(s) and page(s) where changes are made, and briefly indicate the reason for making the changes.
3. Document review. Circulate the changed document for internal review among project staff and cooperators. If the changes are significant enough to trigger peer review (as defined above), create a review document by adding a date stamp to the end of the file name using the YYYYMMDD format, copy the file to the archive folder, and submit the document for peer review according to current instructions.
4. Finalize and archive. Upon approval and final changes:

- a. Ensure that the version date (last saved date field code in the document header) and file name (field code in the document footer, if used) are updated properly throughout the document.
 - b. Move the approved document to the active folder. Remove the word "DRAFT" from watermarks, document headers, and file name. Remove any previous date stamp. This is now an active, implemented document.
 - c. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
 - d. Create a copy of the file and add the revision date to the end of the file name using the YYYYMMDD format. Move this copy to the archive folder.
 - e. Inform the Data Manager so the new version number can be incorporated into the project metadata.
5. Create distribution copies. As needed, create a PDF version of the archived document to post to the internet and share with others. These PDF versions should have the same date-stamped name as the archived Microsoft Word file. Post the distribution copy to the NCCN Digital Library (<http://www.nccn.nps.gov/im/library/documents1.aspx>), the NCCN Reports and Publications webpage (<http://science.nature.nps.gov/im/units/nccn/reportpubs.cfm>) and forward copies to all individuals who had been using a previous version of the affected document.
6. Remove from implementation. If it is decided that a document needs to be removed from implementation – either because it is no longer necessary (e.g., an unneeded SOP), or because it has been superseded by a more recent version – this can be easily done by removing the document from the active document folder, after first checking that a copy of that version already exists in the archive folder.

Literature Cited

Acker, S. A., A. Woodward, J. R. Boetsch, K. Hutten, M. Bivin, R. Rochefort, C. C. Thompson, and L. Whiteaker. In Review. Forest vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—XXXX/XXX. National Park Service, Fort Collins, Colorado.

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