CLPX-Ground: ISA Main Meteorological Data, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Elder, K. and A. Goodbody. 2004. CLPX-Ground: ISA Main Meteorological Data, Version 1. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/S2SOH1UNDKPW. [Date Accessed].

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National Snow and Ice Data Center

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1 DATA DESCRIPTION

Nine identical meteorological towers were located close to the center of each CLPX Intensive Study Area (ISA). Another meteorological tower was located close to the Local-Scale Observation Site (LSOS) within the Fraser MSA. At each site, measurements were made at 10 m above ground level (air temperature, relative humidity, radiation, leaf wetness, wind speed, and direction); approximately 1 m above maximum anticipated snow depth (air temperature, relative humidity, wind speed, wind direction and, in the North Park MSA only, precipitation); and snow depth, snow surface temperature, snow temperature profile, soil moisture, and soil temperatures. Snow pits were also dug at the meteorological sites, and snow density, temperature, and stratigraphy were recorded. Meteorological observations were recorded at a 10-minute temporal resolution between 20 September 2002 and 1 October 2003.

In addition to direct observations, some parameters were generated within the logger program (Station ID, Program Signature, HHMM – hour and minute, Day of Year [DOY], Standard deviation of wind direction) and some are a result of post processing (Decimal day of year [Deci-DOY], Day of Water Year [DOWY], Deci-DOWY, Hour, Minute). All time measurements were recorded in GMT (Greenwich Mean Time). At meteorological towers in the North Park MSA, the precipitation data was gathered using alter-shielded Belfort Universal Precipitation Gauges, located approximately 10 m away from each tower in a predominantly upwind direction. The gauges were raised so that the gauge orifice (20.3 cm in diameter) was at the same height off the ground as the lower cross-arm of the meteorological tower.

Each tower collected the following 92 specific parameters:

Year
Day of Year [DOY]
HHMM [hour, minute]
Deci-DOY (decimal day of year)
Day of Water Year [DOWY]
Deci-DOWY (decimal day of water year)
Hour
Minute
Station ID
Program Signature
Battery Voltage (V)
Minimum Battery Voltage (V)
Internal Logger Temperature (°C)
Logger Reference Temperature (°C)

AM25T Reference Temperature (°C)

Atmospheric Pressure (mb)

Precipitation (cm)

Leaf Wetness (K Ohms)

Air Temperature [lower] (°C)

Air Temperature [upper] (°C)

Relative Humidity [lower] (%)

Relative Humidity [upper] (%)

Maximum Wind Speed [lower] (ms-1)

Minimum Wind Speed [lower] (ms-1)

Maximum Wind Speed [upper] (ms-1)

Minimum Wind Speed [upper] (ms-1)

Wind Direction [lower] (Degrees)

Wind Direction [upper] (Degrees)

Average Wind Speed [lower] (ms-1)

Average Wind Direction [lower] (Degrees)

Standard Deviation Wind Direction [lower] (Degrees)

Average Wind Speed [upper] (ms-1)

Average Wind Direction [upper] (Degrees)

Standard Deviation Wind Direction [upper] (Degrees)

Ventilation

NRLite Net Radiation (Wm-2)

Corrected NRLite Net Radiation (Wm-2)

CNR1 SW-down Radiation (Wm-2)

CNR1 SW-up Radiation (Wm-2)

CNR1 LW-down Radiation (Wm-2)

CNR1 LW-up Radiation (Wm-2)

CNR1 Internal Temperature (°C)

Corrected CNR1 LW-down Radiation (Wm-2)

Corrected CNR1 LW-up Radiation (Wm-2)

CNR1 Net Radiation (Wm-2)

Apparent Ground / Snow Surface Temperature [IR Sensor] (°C)

IR Sensor Body Temperature (°C)

Corrected Ground / Snow Surface Temperature [IR Sensor] (°C)

Acoustic Depth Sounder Average Temperature (°C)

Acoustic Depth Sounder (m)

Hydraprobe Voltage 1 –5 cm (mV)

Hydraprobe Voltage 2 –5 cm (mV)

Hydraprobe Voltage 3 –5 cm (mV)

Hydraprobe Voltage 4 –5 cm (mV)

Hydraprobe Voltage 1 –20 cm (mV)

Hydraprobe Voltage 2 –20 cm (mV)

Hydraprobe Voltage 3 –20 cm (mV)

Hydraprobe Voltage 4 –20 cm (mV)

Hydraprobe Voltage 1 –50 cm (mV)

Hydraprobe Voltage 2 –50 cm (mV) Hydraprobe Voltage 3 –50 cm (mV)

Hydraprobe Voltage 4 –50 cm (mV)

Thermocouple String Temperature –50 cm (°C)

Thermocouple String Temperature –20 cm (°C)

Thermocouple String Temperature –5 cm (°C)

Thermocouple String Temperature 0 cm (°C)

Thermocouple String Temperature 10, 15 or 20 cm (°C)

Thermocouple String Temperature 20, 30 or 40 cm (°C)

Thermocouple String Temperature 30, 45 or 60 cm (°C)

Thermocouple String Temperature 40, 60 or 80 cm (°C)

Thermocouple String Temperature 50, 75 or 100 cm (°C)

Thermocouple String Temperature 60, 90 or 120 cm (°C)

Thermocouple String Temperature 70, 105 or 140 cm (°C)

Thermocouple String Temperature 80, 120 or 160 cm (°C)

Thermocouple String Temperature 90, 135 or 180 cm (°C)

Thermocouple String Temperature 100, 150 or 200 cm (°C)

Thermocouple String Temperature 110, 165 or 220 cm (°C)

Thermocouple String Temperature 120, 180 or 240 cm (°C)

Thermocouple String Temperature 130, 195 or 260 cm (°C)

Thermocouple String Temperature 140, 210 or 280 cm (°C)

Thermocouple String Temperature 150, 225 or 300 cm (°C)

Thermocouple String Temperature 160, 240 or 320 cm (°C)

Thermocouple String Temperature 170, 255 or 340 cm (°C)

Thermocouple String Temperature 180, 270 or 360 cm (°C)

Thermocouple String Temperature 190, 285 or 380 cm (°C)

Thermocouple String Temperature 200, 300 or 400 cm (°C)

Average Hydraprobe Temperature –5 cm (°C)

Average Hydraprobe Soil Water Content –5 cm (wfv - water fraction by volume)

Average Hydraprobe Temperature –20 cm (°C)

Average Hydraprobe Soil Water Content –20 cm (wfv)

Average Hydraprobe Temperature –50 cm (°C)
Average Hydraprobe Soil Water Content –50 cm (wfv)

Notes:

- Precipitation data are only available for sites within the North Park MSA.

- The ground surface represents a zero datum line; therefore, measurements prefixed by a negative symbol represents a depth beneath the ground surface.

- Upper and lower cross-arms are represented by [upper] and [lower].

- The three values presented for each thermocouple string represent measurement increments at North Park, Fraser, and Rabbit Ears MSAs, respectively.

- Water year starts on 1 October.

- For Deci-DOY and Deci-DOWY:

midnight on day 100 is 100.0
6 am on day 100 is 100.25
2 noon on day 100 is 100.5
6 pm on day 100 is 100.75<

Snow pit data were collected at or near each of the nine Main ISA Meteorological Towers, and the tower at Fraser Experimental Forest Headquarters (near the LSOS). Each of these pits were sampled once in the months of December 2002 and January, February, March, May, and June of 2003. For detailed information about snow pit measurements, please see the CLPX Snow Pit Measurements document.

1.1 File Information

1.1.1 Format

Meteorological data are presented in comma-delimited ASCII format. Each data file contains 92 parameters (columns), which are listed below, in consecutive 10-minute time intervals. Column header information for each data file is provided in a separate comma-delimited ASCII file (L1Headers_v1.3.csv). Double quotes are used to delimit text within fields, and commas contained within the double quotes do not indicate a new field.

Snow pit data are available in comma-separated ASCII text files, with a file extension of .csv, and in shapefiles, with various extensions. There are four types of snow pit files: summary, density profile, temperature, and stratigraphy. Missing data in the ASCII files are identified by "-999". In the shapefiles, missing dates are designated 9999-99-99, missing text fields are designated "NoData", and missing numeric fields are designated -999.

Standard CLPX pit sampling protocol was followed by met station pit surveyors. The purpose, however, of these snow pits was mainly for hydrological investigation of the snow pack rather than for remote sensing validation. Consequently, the standard set of pit photos (roughness board and/or surrounding terrain) were generally not taken at the met station pit locations. During IOP3 and IOP4, however, as some of the met station pits were surveyed by teams making IOP pit measurements, standard CLPX pit sampling protocol was followed and photos were taken at limited locations. These photos are available as downloadable jpeg images in the "photos" directory on the ftp site.

1.1.2 Naming Convention

There is one tarred and compressed (gzipped) file for each of the MSAs: `fraser.tgz`, `north_park.tgz`, and `rabbit_ears.tgz`. Within the compressed and tarred files, individual data files are named as follows:

`##L1master_v1.3.csv`

Where ## refers to the two- or three-letter MSA, ISA code:
NM = North Park, Michigan River
NI = North Park, Illinois River
NP = North Park, Potter Creek
RB = Rabbit Ears, Buffalo Pass
RS = Rabbit Ears, Spring Creek
RW = Rabbit Ears, Walton Creek
FS = Fraser, St.Louis Creek
FF = Fraser, Fool Creek
FA = Fraser, Alpine
FHQ = Fraser, Headquarters (near the LSOS)

Headers are not included in the first row of each data file. A separate file containing header information is provided, named `L1Headers_v1.3.csv`.

Snow pit data are in the tarred and compressed (gzipped) file `pit_met_v2.tgz`, which will extract into two directories: "`ascii/`" contains the .csv version of the data, and "`shape_files`/" contains the GIS-compatible shapefiles.

Snow pit ASCII files are named as follows (v# is the data version number):

`pit_met_v#_density.csv` = processed snowpit data – Density

`pit_met_v#_strat.csv` = processed snowpit data – Stratigraphy

`pit_met_v#_summary.csv` = processed snowpit data – Summary

`pit_met_v#_temperature.csv` = processed snowpit data - Temperature

Snow pit shapefile names are pit_met_v#_DATA.ext, where:

v# = Data release number (e.g., version 2)
DATA = type of data in the file: "summary," "density," "temperature," or "strat"
`.ext` = shape file extensions {`.dbf`, `.prj`, `.sbn`, `.sbx`, `.shp`, `.shx`}

Please see the "Data Set Version History" section of the CLPX Snow Pit Measurements document for information about the latest version release. This document also contains detailed information about snow pits.

1.1.3 Snow Pit's Id's

Met Pit IDs: MImet##{x}

M = MSA code (see standard IOP pit IDs for MSA codes)
I = ISA code (see standard IOP pit IDs for ISA codes)
met = indicates a met station pit
= 2-digit pit number (numbers are sequential through the winter), thus:
01 = December, 2002
02 = January, 2003
03 = February, 2003
04 = March, 2003
05 = May, 2003
06 = June, 2003
x = optional letter, {a or b}, only used in North Park in December 2002

1.2 Spatial Information

1.2.1 Coverage

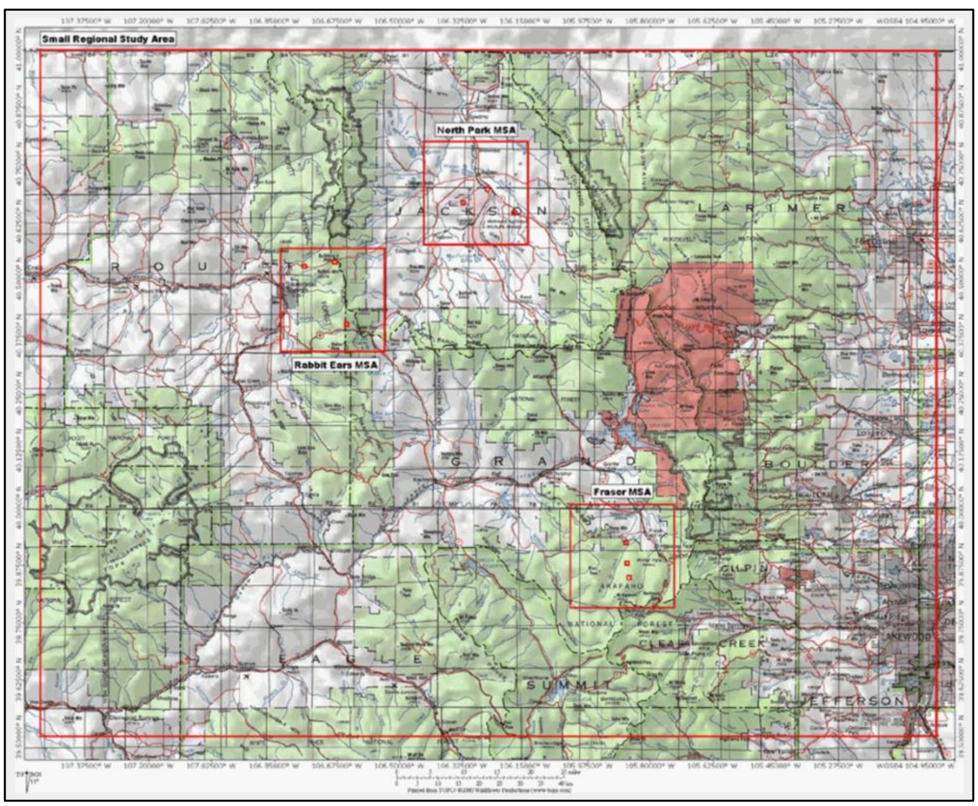
Spatial coverage consists of the three MSAs withing the SRSA (105° - 107.5° W, 39.5° - 41° N). One measurement tower was placed at, or close to, the center of each ISA, and one tower close to the LSOS, at the Fraser Experimental Forest Headquarters (Fraser HQ). Exact locations of each

10-m high instrument tower, using a UTM projection (Zone 13 North, based on the WGS84 datum), are as follows:

ISA Code	ISA Tower Location	UTME	UTMN	Elevation
FA	Alpine Met	426340	4411238	3585
FF	Fool Creek Met	425791	4414910	3100
FHQ	Fraser HQ Met	424440	4417564	2760
FS	St. Louis Creek Met	425729	4419936	2727
NI	Illinois River Met	394004	4505710	2475
NM	Michigan River Met	400146	4500029	2600
NP	Potter Creek Met	388157	4502717	2480
RB	Buffalo Pass Met	357887	4488407	3200
RS	Spring Creek Met	351126	4487974	2800
RW	Walton Creek Met	360335	4473447	2950

1.2.2 Spatial Coverage Map

The following map shows the CLPX study area:



1.3 Temporal Information

1.3.1 Coverage

Meteorological data were collected between 20 September 2002 and 1 October 2003. Snow pits were sampled once in the months of December 2002 and January, February, March, May, and June of 2003.

1.3.2 Resolution

Measurements of all parameters were made every 30 seconds. For all parameters except wind direction, snow depth, soil moisture content, and soil temperature (using the Stevens Vitel Hydraprobe), measurements were averaged over every 10-minute period to produce 10-minute data. For snow depth, soil moisture content, and soil temperature, no average was taken and instead a single sample measurement was recorded at the start of each 10-minute period. For wind direction, average measurements were taken over every 10 minutes and a single sample measurement was recorded at the start of each 10-minute period.

Snow pits were sampled once per month in December 2002 and January, February, March, May, and June of 2003.

2 DATA ACQUISITION AND PROCESSING

2.1 Parameter

Parameters presented in this data set are wind speed and direction, air temperature and relative humidity, leaf wetness, net radiation, shortwave and longwave incoming and outgoing radiation, snow depth, snow surface temperature, barometric pressure, soil moisture, and soil temperature. Snow density, temperature, and stratigraphy were recorded at snow pits in the study area

2.2 Quality Assessment

The available data product has been processed to a Level 1 standard. This means that raw data (Level 0 data), which were downloaded on approximately a monthly basis, have been concatenated into one continuous file per meteorological tower. Data have then been filtered twice for faulty values. The first filtering process was done manually in order to recognize instrument, wiring, or programming problems. The second filtering process was done computationally to remove blank values or any faulty values that fall outside of acceptable boundaries for each instrument (see table below). Faulty data and missing data were replaced with a default value of 8999.

Parameter	Minimum value	Maximum value
Atmospheric Pressure (mb)	500	800
Air Temperature [lower] (°C)	-50	50
Air Temperature [upper] (°C)	-50	50
Relative Humidity [lower] (%)	0	105
Relative Humidity [upper] (%)	0	105
Maximum Wind Speed [lower] (ms^{-1})	0	50
Minimum Wind Speed [lower] (ms^{-1})	0	50
Maximum Wind Speed [upper] (ms^{-1})	0	50
Minimum Wind Speed [upper] (ms^{-1})	0	50
Average Wind Speed [lower] (ms^{-1})	0	50
Average Wind Speed [upper] (ms^{-1})	0	50
NRLite Net Radiation (Wm^{-2})	-1000	1000
Corrected NRLite Net Radiation (Wm^{-2})	-1000	1000
CNR1 SW-down Radiation (Wm^{-2})	-10	1500
CNR1 SW-up Radiation (Wm^{-2})	-10	1500
CNR1 LW-down Radiation (Wm^{-2})	-1000	1000
CNR1 LW-up Radiation (Wm^{-2})	-1000	1000
CNR1 Internal Temperature (°C)	-50	50
Corrected CNR1 LW-down Radiation (Wm^{-2})	-1000	1000
Corrected CNR1 LW-up Radiation (Wm^{-2})	-1000	1000
Acoustic Depth Sounder Average Temperature (°C)	-50	50
Acoustic Depth Sounder – sample (m)	0	5
Thermocouple String Temperature –50 cm (°C)	-50	50
Thermocouple String Temperature -20 cm (°C)	-50	50
Thermocouple String Temperature –5 cm (°C)	-50	50
Thermocouple String Temperature 0 cm (°C)	-50	50
Thermocouple String Temperature 10, 15 or20 cm (°C)	-50	50
Thermocouple String Temperature 20, 30 or 40 cm (°C)	-50	50
Thermocouple String Temperature 30, 45 or 60 cm (°C)	-50	50
Thermocouple String Temperature 40, 60 or 80 cm (°C)	-50	50
Thermocouple String Temperature 50, 75 or 100 cm (°C)	-50	50
Thermocouple String Temperature 60, 90 or 120 cm (°C)	-50	50

Parameter	Minimum value	Maximum value
Thermocouple String Temperature 70, 105 or 140 cm (°C)	-50	50
Thermocouple String Temperature 80, 120 or 160 cm (°C)	-50	50
Thermocouple String Temperature 90, 135 or 180 cm (°C)	-50	50
Thermocouple String Temperature 100, 150 or 200 cm (°C)	-50	50
Thermocouple String Temperature 110, 165 or 220 cm (°C)	-50	50
Thermocouple String Temperature 120, 180 or 240 cm (°C)	-50	50
Thermocouple String Temperature 130, 195 or 260 cm (°C)	-50	50
Thermocouple String Temperature 140, 210 or 280 cm (°C)	-50	50
Thermocouple String Temperature 150, 225 or 300 cm (°C)	-50	50
Thermocouple String Temperature 160, 240 or 320 cm (°C)	-50	50
Thermocouple String Temperature 170, 255 or 340 cm (°C)	-50	50
Thermocouple String Temperature 180, 270 or 360 cm (°C)	-50	50
Thermocouple String Temperature 190, 285 or 380 cm (°C)	-50	50
Thermocouple String Temperature 200, 300 or 400 cm (°C)	-50	50
Average Hydraprobe Temperature –5 cm (°C)	-50	50
Average Hydraprobe Soil Water Content –5 cm (wfv)	0	0.7
Average Hydraprobe Temperature –20 cm (°C)	-50	50
Average Hydraprobe Soil Water Content –20 cm (wfv)	0	0.7
Average Hydraprobe Temperature –50 cm (°C)	-50	50
Average Hydraprobe Soil Water Content –50 cm (wfv)	0	0.7

Data that were considered suspect during manual filtering were left in Level 1 files even after they were identified as suspect. This was done when technicians recognized potential inconsistencies but were either unsure of the cause or were unable to verify their assumptions. Rather than alter the data set without definitive proof of faulty data, data were left for further interpretation and quality control by future investigators. Although the investigator has a high level of confidence in the products that are delivered in this data set, future investigators should implement their own quality control procedures. A qualitative assessment of potentially faulty data follows:

2.3 Error Sources

2.3.1 Meteorological Data

2.3.1.1 Thermocouple string:

A false diurnal pattern may be superimposed on some data due to solar loading of the instrument (copper-constant wire) away from the point of measurement. Care should be taken when interpreting air temperature measurements above the level of the snowpack due to lack of shielding and consequent solar loading of the sensors. Where any of the sensing increments exceed the height of the lower cross-arm, they should be discarded from any analysis.

2.3.1.2 Radiation:

Despite ventilation, sensors may accumulate snow during storm events, especially at sites enclosed in the canopy such as at Fool Creek ISA (Fraser MSA) and St. Louis Creek ISA (Fraser MSA). This will particularly affect values of downwelling longwave and shortwave radiation from the Kipp and Zonen CNR1 Net Radiometer, and net radiation from the Kipp and Zonen NR Lite Net Radiometer.

2.3.1.3 Ground/Snow surface temperature (Infrared thermocouple):

The Apogee IRTS-P5 IR thermocouple transducer is designed to operate between a temperature range of -5 to 45°C at an accuracy of ± 0.4°C. However, the IRTS sensor has an operating temperature that can withstand temperatures down to -45°C at unknown levels of accuracy. Consequently this data set should be treated as experimental, as it was intentionally operated outside its normal temperature range. On the manufacturer's advice, a cold temperature correction coefficient (using the temperature of the sensor body) can increase sensor performance around -5°C. Consequently, as well as an apparent ground/snow surface temperature and a sensor body temperature, temperature-corrected ground/snow surface temperatures were calculated. These temperature-corrected values, which were calculated using a Campbell program routine supplied by the manufacturer, are prone to large fluctuations that appear to occur erratically over time. Future investigators are strongly advised to independently compute a temperature-corrected value for the ground/snow surface temperature using the following correction coefficients:

Corrected Ground/Snow Surface Temperature = Apparent Temperature - SEC

$$SEC = (0.25/P) * (((T – H) 2) – K)$$

$$P = (– 0.0804 * X2) + (1.6735 * X) + 104.43$$

$$H = (0.0461 * X2) – (0.4405 * X) -54.174$$

$$K = (– 4.2989 * X2) + (157.456 * X) + 2931.47$$

Where:

X = Sensor Body Temperature
T = Apparent Target Temperature
SEC = Sensor Error Correction Factor

2.3.1.4 Atmospheric Pressure:

Unexplained drops in pressure may occur that are outside the range expected for a specific elevation.

2.3.1.5 Precipitation:

Precipitation in North Park was measured using a modified weighing bucket system. Significant evaporation occurred from the buckets during the observation period, and so all values less than 0.02 cm were removed from the data set.

2.3.1.6 Ventilation:

Due to power constraints at remote sites, radiometer ventilators were only activated for 1 minute out of each 10-minute interval if the power supply was above 11.5 volts. Additionally, if the power supply was greater than 11.75 volts, ventilators were activated when relative humidity was greater than 95% and wind speed was less than 1 m/s. The ventilator output in the data set tracks the number of 30-second execution intervals that radiometers were ventilated during each 10-minute output interval. Typically, the ventilators ran for “2” execution intervals, or 1 minute per 10-minute period.

2.3.2 Snow Pit Data

Met pit locations (UTME and UTMN coordinates) are not exact. Surveyors were not equipped with GPS receivers, so recorded pit locations are locations of the corresponding met station towers.

NSIDC received photocopies only. Electronic data entry was made from these copies, in the spring of 2004. Due to the time lag between data collection and data entry, some questions about data entry remain unresolved.

In December 2002, two pits were measured at each met tower, to measure a relatively "deep" and "shallow" pit in the vicinity of the tower. Also in that month, there was a shortage of soil sample containers, so one soil sample was taken at each location, rather than protocol two samples.

2.4 Instrumentation

Variable	Instrumentation
Battery Voltage	Campbell Scientific CR10X Datalogger
Internal Datalogger Temperature	Campbell Scientific CR10X Datalogger
Reference Temperature	Campbell Scientific 107 Temperature Probe
Multiplexer Reference Temperature	Campbell Scientific AM25T Solid State Multiplexer
Atmospheric Pressure	Vaisala PTB101B Pressure Transmitter
Precipitation	Belfort Universal Precipitation Gauges with 10 kg Rice Lake Weighing Systems Load Cell
Leaf Wetness Sensor Resistance	Campbell Scientific Model 237 Leaf Wetness Sensor
Air Temperature	Vaisala HMP45C Temperature and Relative Humidity Probe
Relative Humidity	Vaisala HMP45C Temperature and Relative Humidity Probe
Wind Speed	R. M. Young 05103 Wind Monitor
Wind Direction	R. M. Young 05103 Wind Monitor
Ventilation	Rebs RV2 radiometer ventilator
Net Radiation	Kipp and Zonen NR Lite Net Radiometer
Downwelling Shortwave Radiation	Kipp and Zonen CNR1 Net Radiometer
Upwelling Shortwave Radiation	Kipp and Zonen CNR1 Net Radiometer
Downwelling Longwave Radiation	Kipp and Zonen CNR1 Net Radiometer
Upwelling Longwave Radiation	Kipp and Zonen CNR1 Net Radiometer
CNR1 Sensor Temperature	Kipp and Zonen CNR1 Net Radiometer
Corrected Ground / Snow Surface Temperature [IR Sensor]	Apogee Precision Infrared Thermocouple Transducer (IRTS-P5)
Snow Depth	Judd Ultrasonic Depth Sensor
Thermocouple String Temperature	Copper-Constantan Wire Thermocouple
Average Hydraprobe Soil Temperature	Stevens Vitel Hyrda Soil Moisture Probe
Average Hydraprobe Soil Water Content	Stevens Vitel Hyrda Soil Moisture Probe

Future investigators should use manufacturers guidelines to calculate instrument error. No independent instrument calibration has been applied to these data.

A schematic (in PDF format) illustrates the assembly of each meteorological tower. Observations were made along an upper cross-arm of the meteorological tower (10 m above ground surface), a lower cross-arm (nominally 1 m above expected maximum seasonal snow depth), in the datalogger enclosure mounted directly on the tower beneath the lower cross arm, and between the lower cross-arm and 50 cm beneath the ground. The heights of the lower cross-arms above the ground surface were 2 m for sites in the North Park MSA, 3 m in the Fraser MSA, and 4 m in Rabbit Ears MSA. However, due to sloping ground beneath the cross-arms, these heights should only be considered as approximate values.

Measurement Location on Tower	Parameters
Upper cross-arm (10 m above ground surface)	Wind Speed and Direction, Air Temperature and Relative Humidity, Leaf Wetness, Net Radiation, Shortwave and Longwave Incoming and Outgoing Radiation
Lower cross-arm (Nominally 1 m above expected maximum seasonal snow depth)	Wind Speed and Direction, Air Temperature and Relative Humidity, Snow Depth, Snow Surface Temperature
Data logger enclosure (Nominally 0.5 m above expected maximum seasonal snow depth)	Barometric Pressure, Battery Voltage, Internal Logger Temperature, AM25T Reference Temperature
Between ground surface and lower cross-arm at intervals of 10 cm (North Park), 15 cm (Fraser) and 20 cm (Rabbit Ears)	Snow/Air Temperatures
At 5 cm, 20 cm and 50 cm beneath ground surface	Soil moisture content, soil temperature, snow density, snow temperature, snow stratigraphy

At North Park MSA locations, where precipitation data was recorded, alter-shielded Belfort Universal Precipitation Gauges were located approximately 10 m away from each tower in a predominantly upwind direction. The gauges were raised so that the gauge orifice (20.3 cm in diameter) was at the same height off the ground as the lower cross-arm of the meteorological tower. In addition to direct observations some parameters are generated within the logger program (Station ID, Program Signature, HHMM – hour and minute, Day of Year [DOY], Standard deviation of wind direction) and some are a result of post processing (Deci-DOY, Day of Water Year [DOWY], Deci-DOWY, Hour, Minute). All time measurements were recorded in GMT (Greenwich Mean Time).

3 RELATED DATA SETS

CLPX-Snow Measurements at the Local Scale Observation Site (LSOS)

4 CONTACTS AND ACKNOWLEDGMENTS

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5 DOCUMENT INFORMATION

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