



# CLPX-Ground: Snow Measurements at the Local Scale Observation Site (LSOS), Version 1

---

## USER GUIDE

### How to Cite These Data

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

Hardy, J., J. Pomeroy, T. Link, D. Marks, D. Cline, K. Elder, and R. Davis. 2003. *CLPX-Ground: Snow Measurements at the Local Scale Observation Site (LSOS), Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/447J139006A9>. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT [NSIDC@NSIDC.ORG](mailto:NSIDC@NSIDC.ORG)

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/NSIDC-0169>



National Snow and Ice Data Center

# TABLE OF CONTENTS

1	DETAILED DATA DESCRIPTION.....	2
1.1	Format .....	2
1.1.1	Snow Depth Data.....	2
1.1.2	Snow Wetness Data .....	2
1.1.3	Snow Pit Data .....	3
1.2	File and Directory Structure.....	3
1.3	File Naming Convention .....	4
1.3.1	Snow Pit IDs .....	5
1.4	File Size.....	6
1.5	Spatial Coverage.....	6
1.5.1	Spatial Resolution.....	6
1.6	Temporal Coverage.....	8
1.7	Parameter or Variable .....	8
1.8	Quality Assessment.....	8
2	DATA ACQUISITION AND PROCESSING.....	9
2.1	Quality Assessment.....	10
3	REFERENCES AND RELATED PUBLICATIONS .....	10
3.1	Related Data Collections.....	11
4	CONTACTS AND ACKNOWLEDGMENTS .....	11
5	DOCUMENT INFORMATION.....	11
5.1	Publication Date .....	11
5.2	Date Last Updated.....	11

# 1 DETAILED DATA DESCRIPTION

This data set presents snow depth, snow water equivalence (SWE), derived snow wetness, and snow pit data from two pine sites and a small clearing at the CLPX Local Scale Observation Site (LSOS) in northern Colorado. The LSOS is a 0.8-ha study site located within the Fraser Intensive Study Area (ISA). The study area has flat topography with a uniform pine forest, a discontinuous pine forest, and a small clearing.

## 1.1 Format

---

Snow depth and snow wetness data are available as tab-delimited text files. Missing data are identified by "-999".

### 1.1.1 Snow Depth Data

**Snow Depth** headers are:

Sample  
 Canopy Type  
 Grid Location  
 Depth (cm)

***Snow Depth Data Sample:***

Sample	Canopy	Grid Location	Depth (cm)
1	Uniform	"E82,S70.5"	53.3
2	Uniform		54.0
3	Uniform		55.2
4	Uniform		58.4
5	Uniform		59.7
6	Uniform		59.1
7	Uniform		53.3
8	Uniform	"E78.5S61"	52.1

Note: Snow depth measurements along a transect between two locations are delineated by "|". Snow depths at uncertain locations are designated by a "-".

### 1.1.2 Snow Wetness Data

**Snow Wetness** headers are:

IOP  
 Snow Pit  
 Canopy Type  
 Date  
 Time

Snow Height (cm)  
Density (kg m<sup>-3</sup>)  
Wetness (% volume)

**SWE Survey** headers are:

Sample  
Canopy Type  
Grid Location  
Location Description  
Depth (cm)  
SWE (cm)  
Density (kg m<sup>-3</sup>)

The locations refer to the grid on the LSOS map and are approximate locations. Snow depth measurements are to the nearest centimeter in both the uniform and discontinuous pine canopies.

### 1.1.3 Snow Pit Data

Snow pit data are provided in comma-separated ASCII text files, with a file extension of .csv, and in shapefile spatial data format, with various file extensions. The ASCII files contain summary, density profile, temperature profile, and stratigraphy profile information. Missing data in the ASCII files are identified by "-999". Double quotes are used to delimit text within fields, and commas contained within the double quotes do not indicate a new field. The shapefiles contain GIS-compatible summary, density profile, temperature profile, and stratigraphy profile information. Shapefiles contain everything included in the text files, except for general pit comments, which were too verbose for import into shape format. In the shapefiles, missing dates are designated 9999-99-99, missing text fields are designated "NoData", and missing numeric fields are designated -999.

The extra LSOS pit during IOP3, designated Isos03aux, was sampled once on the first day of IOP3. It is an extra snow pit measured approximately 5 m south of Isos03, designated "aux" because it was taken off the planned schedule for the IOP. There is no special reason for it, except that there were extra snow pit samplers on hand that day (personal communication from J. Hardy).

For more detailed information about the snow pit files, please refer to the [CLPX Snow Pit Measurements document](#).

## 1.2 File and Directory Structure

---

Data are archived in three compressed (tarred and zipped) files:

data\_lsos.tgz photos\_lsos.tgz pit\_lsos\_v#.tgz

Please see the "Data Set Version History" section of the [CLPX Snow Pit Measurements](#) document for information about the latest version release (v#) of the snow pit data.

The *data\_lsos.tgz* file untars to ASCII text files for snow depth, snow wetness, and SWE.

The uncompressed photos files are provided by type (roughness, terrain, pitwall, and other) and by "look" (compass) direction.

Snow pit data are provided as a compressed (tarred and zipped) file, *pit\_lsos\_v2.tgz*, which extracts into two directories: "ascii/" contains the .csv version of the data, and "shape\_files/" contains the GIS-compatible shapefiles.

### 1.3 File Naming Convention

Snow depth, wetness, and SWE data files are named as follows:

Table 1. Snow Depth, Wetness, and SWE Data File Names

File Name	Description
SnowDepths_IOP1_Feb23_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow depth data for IOP1 (23 February 2002)
SnowDepths_IOP2_Mar27_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow depth data for IOP2 (27 March 2002)
SnowDepths_IOP2_Mar30_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow depth data for IOP2 (30 March 2002)
SnowDepths_IOP3_Feb19.20_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow depth data for IOP3 (19-20 February 2003)
SnowDepths_IOP4_Mar24.25_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow depth data for IOP4 (24-25 March 2003)
SnowDepths_IOP4_Mar28_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow depth data for IOP4 (28 March 2003)
SWE_IOP3_030219_Hardy.txt	Uniform Pine sub-canopy SWE data for IOP3 (19 February 2003; 1500-1700 hours)
SWE_IOP3_030220_Hardy.txt	Uniform Pine sub-canopy SWE data for IOP3 (20 February 2003; 1000-1100 hours)

File Name	Description
SWE_IOP3_030223_Hardy.txt	Uniform and Discontinuous Pine sub-canopy SWE data for IOP3 (23 February 2003; 1300-1600 hours)
SWE_IOP4_030326_Hardy.txt	Uniform and Discontinuous Pine sub-canopy SWE data for IOP4 (26 March 2003; discontinuous: 1030-1200 hours; uniform: 1500-1700 hours)
SWE_IOP4_030030_Hardy.txt	Uniform and Discontinuous Pine sub-canopy SWE data for IOP4 (30 March 2003; 1630-1730 hours)
Wetness_2002_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow wetness data for IOP1 and IOP2
Wetness_IOP4_Hardy.txt	Uniform and Discontinuous Pine sub-canopy snow wetness data for IOP4

Photo files are named "type\_LSOS(pitnumber)\_look\_XY\_hardy.JPG" where

type = other, pitwall, terrain, or roughness XY = compass direction (e.g., S, SW, E)

Snow pit ASCII files are named pit\_lsos\_v#\_DATA.csv, where

v# = Data release number (e.g., version 2) DATA = type of data in the file: "summary," "density," "temperature," or "strat" .csv = comma-separated value text file

Snow pit shapefiles are named pit\_lsos\_v#\_DATA.ext, where:

v# = Data release number (e.g., version 2) DATA = type of data in the file: "summary," "density," "temperature," or "strat"

Please see the "Data Set Version History" section of the [CLPX Snow Pit Measurements document](#) for information about the latest version release (v#) of the snow pit data.

### 1.3.1 Snow Pit IDs

LSOS Pit IDs: LABEL##x  
 LABEL = snow (iop1); lsos (iop2-4)  
 ## = 2-digit pit number  
 x = letter {a,b,c, etc.}

## 1.4 File Size

---

Snow depth, wetness, and SWE files range in size from 1.1 to 11.4 KB.

Snow pit ASCII files range in size from 20 to 300 KB, and shapefile sizes range from 1 to 8 MB.

Photo files range in size from 54 to 749 KB.

## 1.5 Spatial Coverage

---

This data set covers the CLPX Local Scale Observation Area (LSOS) in northern Colorado. This site is 100 m x 100 m (39.9066°N, 105.8829°W).

All surveys were conducted by walking along established paths in the approximate same order each survey. At both pine sites, the snow survey includes depth measurements at the array datalogger box, and radiating out to each radiometer in order (1-10) at approximately 1 m intervals. In addition to measuring snow depths along the path to each radiometer, depth was also measured along the paths to the meteorological towers, eddy covariance system (uniform met site only), snow pit, trucks, etc.

LSOS snow pit locations changed between 2002 and 2003. No UTM locations were recorded for the 2002 LSOS snow pits. Instead, a general location of 424492 E, 4417690 N was used for all IOP1 and IOP2 pits. For the 2003 snow pits, a GPS location was recorded for each individual pit.

### 1.5.1 Spatial Resolution

The following maps show the CLPX LSOS, with the uniform pine area to the south and east of clearing, and the discontinuous pine site to the north of the clearing.

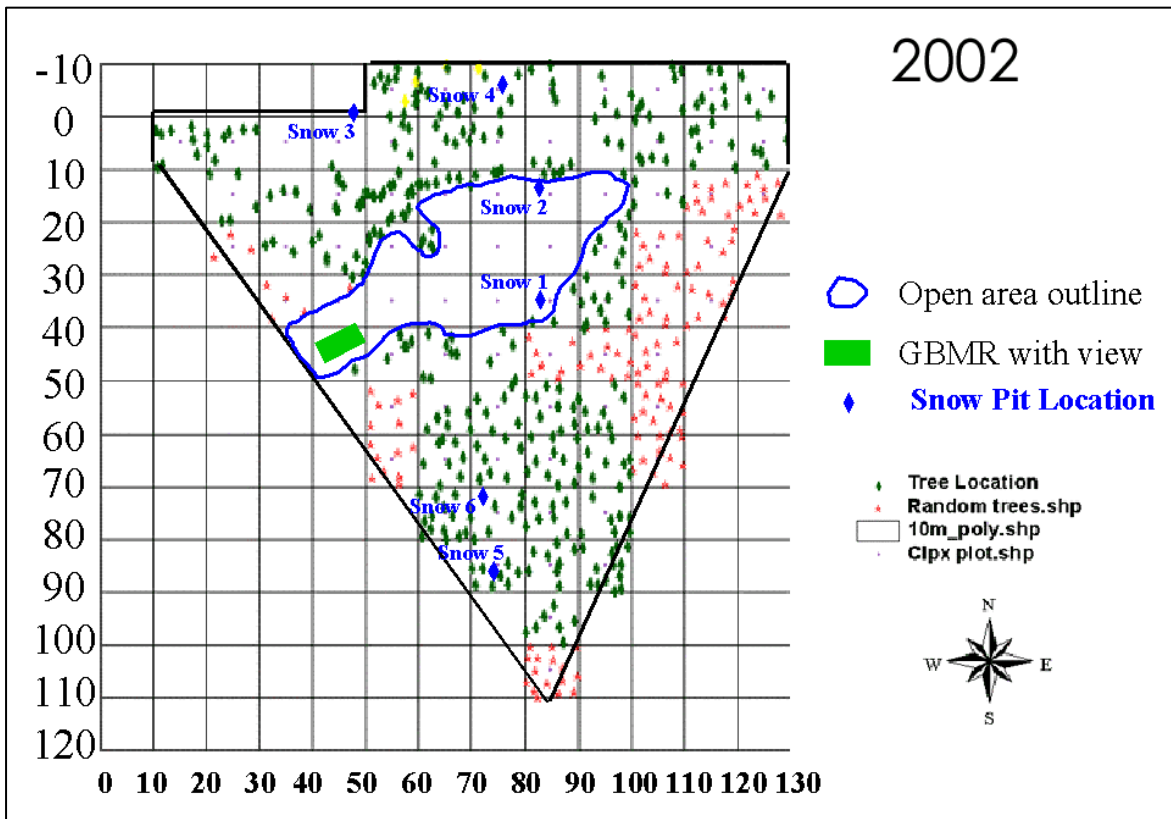


Figure 1. 2002 CLPX LSOS

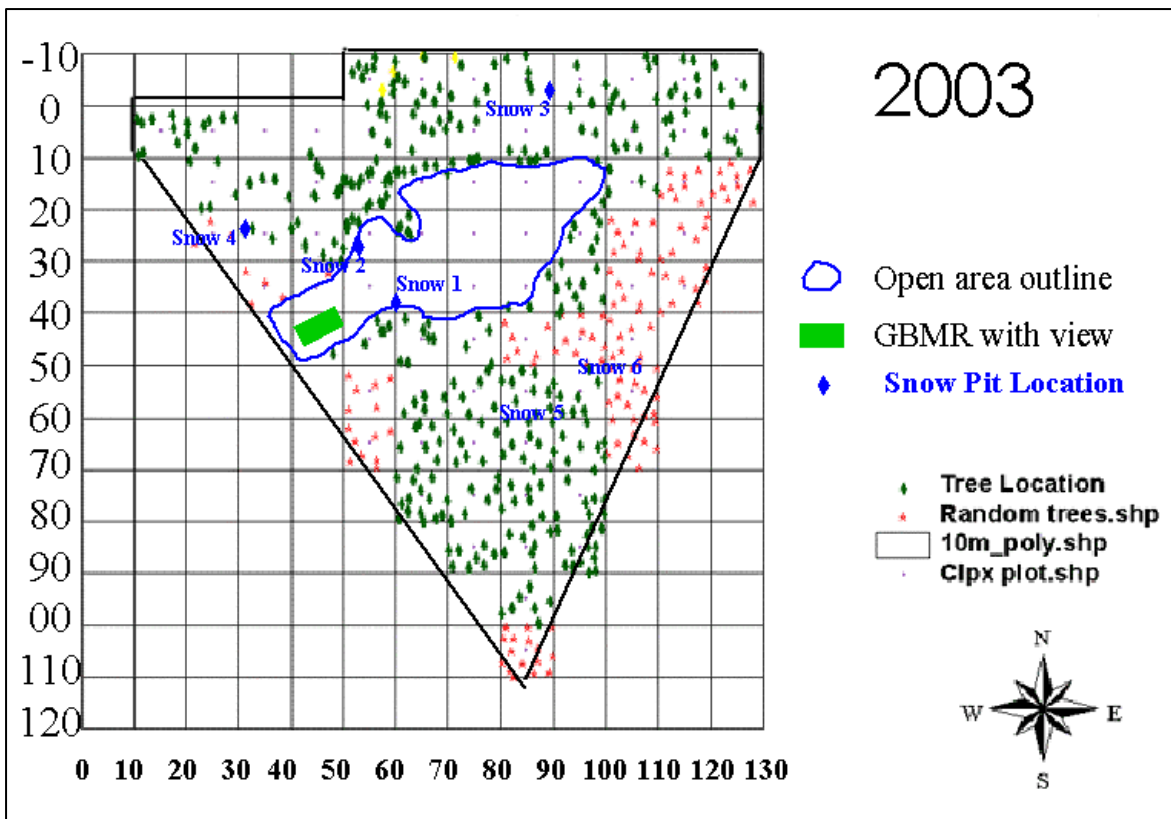


Figure 2. 2003 CLPX LSOS



## 1.6 Temporal Coverage

---

Data were collected during IOP1 (February 2002), IOP2 (March 2002), IOP3 (February 2003), and IOP4 (March 2003).

LSOS snow pits were measured during the four IOPs. On each of the following days in 2002, three snow pits were sampled:

Table 2. Snow Pits Sampled in 2002 and 2003

2002 Snow Pits	2003 Snow Pits
19 February – Pits 1, 3, and 5	19 February – Pits 2, 4, and 6
20 February – Pits 2, 4, and 6	20 February – Pits 1, 3, and 5
21 February – Pits 1, 3, and 5	21 February – Pits 2, 4, and 6
22 February – Pits 2, 4, and 6	22 February – Pits 1, 3, and 5
23 February – Pits 1, 3, and 5	23 February – Pits 2, 4, and 6
24 February – Pits 2, 4, and 6	24 February – Pits 1, 3, and 5
25 March – Pits 2, 4, and 6	25 March – Pits 2, 4, and 6
26 March – Pits 1, 3, and 5	26 March – Pits 1, 3, and 5
27 March – Pits 2, 4, and 6	27 March – Pits 2, 4, and 6
28 March – Pits 1, 3, and 5	28 March – Pits 1, 3, and 5
29 March – Pits 2, 4, and 6	29 March – Pits 2, 4, and 6
30 March – Pits 1, 3, and 5	30 March – Pits 1, 3, and 5

## 1.7 Parameter or Variable

---

Parameters presented in this data set are snow depth, snow wetness, snow density, snow temperature, snow stratigraphy, snow grain size, and derived snow water equivalence.

## 1.8 Quality Assessment

---

NSIDC received soft copies of the LSOS snow pit spreadsheets, rather than handwritten originals. There remain two discrepancies to be resolved when the originals are obtained (most likely typos in data entry):

- IOP3 Isos01c: there is a gap in the measured stratigraphy layers
- IOP3 Isos05c: there is an overlap in the measured stratigraphy layers.

## 2 DATA ACQUISITION AND PROCESSING

Snow depth surveys were conducted by walking along established paths in the approximate same order each time. At both pine sites, the snow survey includes depth measurements at the array datalogger box and radiating out to each radiometer in order (1-10) at approximately 1 m intervals. In addition to measuring snow depths along the path to each radiometer, depth was also measured along the paths to the met towers, eddy covariance system (uniform met site only), snow pit locations, trucks, etc.

In general, snow depth transects were conducted between two points with approximately one-meter spacing. Snow depth measurements along a transect between two locations are delineated by "|". For Example:

Canopy	Grid Location	Depth (cm)
Uniform	E83,S77	52
Uniform		53
Uniform		49
Uniform		55
Uniform		57
Uniform		59
Uniform	E80,S72	56

In this example, a transect of one-meter spacing was conducted between the uniform canopy locations: E83,S77 and E80,S72. The snow depth at the start of the transect (E83,S77) was 52 cm and the snow depth at E80,S72 was 56 cm. Differences in length of transects between dates is related to slight differences in the location of pyranometers between IOP3 and IOP4 (in each canopy type, ten of the transects extend from the datalogger box to each of the ten pyranometers). Additionally, depths were not always taken at exactly the same spot.

All SWE measurements were completed with an ESC-30 sampler (120-cm length), with a tare (empty tube weight) of 48 cm. The ESC-30 sampler is ~1.5 m long plastic tube of approximately 10-cm diameter (see figure, below). The SWE measurement is taken by inserting the tube vertically into the snowpack and weighing, on a hanging scale, the tube and snow. The scale is graduated to give the "weight" in SWE (cm).



Figure 3. Scientists taking the SWE measurement

For complete information about data acquisition and processing, please see the [CLPX Snow Pit Measurements document](#).

## 2.1 Quality Assessment

---

Measurements of snow wetness were made using a Denoth snow moisture meter at each snow pit and calculating the percent snow wetness using the provided equation. Any values of wetness that are negative are currently considered to be equal to zero (dry snow), though future work will further investigate the output from the Denoth meter.

## 3 REFERENCES AND RELATED PUBLICATIONS

Hardy, J., D. Cline, K. Elder, R. Davis, R. Armstrong, G. Castres Saint-Martin, R. DeRoo, T. Graf, Y. Koh, T. Koike, H-P. Marshall, K. McDonald, T. Painter, and K. Sarabandi (submitted). An Overview of Data from the Local Scale Observation Site of the Cold Land Processes Field Experiment (CLPX). *Journal of Hydrometeorology*.

Hardy, JP, D. Cline, K. Elder, R. Davis, J. Pomeroy, G. Koh, R. Armstrong, T. Koike, and K. McDonald (2002). The Cold Land Processes Field Experiment (CLPX) Local Scale Observation Site (LSOS). American Geophysical Union Fall Meeting 6-10 December 2002, San Francisco, California. *Eos Transactions*, 83 (47), pp. F537.

## 3.1 Related Data Collections

---

[All CLPX Data Sets](#)

[CLPX-Ground: ISA Snow Pit Measurements](#)

[Sub-Canopy Energetics at the CLPX Local Scale Observation Site \(LSOS\)](#)

[CLPX-Ground: Micrometeorological Data at the Local Scale Observation Site \(LSOS\)](#)

[CLPX-Ground: Ground-based L and Ku Band Polarimetric Scatterometry at the LSOS](#)

[CLPX-Ground: Ground Based Passive Microwave Radiometer \(GBMR-7\) Data at the LSOS](#)

## 4 CONTACTS AND ACKNOWLEDGMENTS

Janet P. Hardy

CLPX - LSOS Coordinator

ERDC-CRREL

72 Lyme Road

Hanover, NH 03744-1290

## 5 DOCUMENT INFORMATION

### 5.1 Publication Date

---

19 July 2004

### 5.2 Date Last Updated

---

11 May 2021