CLPX-Ground: ISA Snow Pit Measurements, Version 2

USER GUIDE

How to Cite These Data

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

Cline, D., R. Armstrong, R. Davis, K. Elder, and G. E. Liston. 2003, updated 2004. *CLPX-Ground: ISA Snow Pit Measurements, Version 2*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5060/D4H41PBP. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0176

National Snow and Ice Data Center

TABLE OF CONTENTS

1   DATA DESCRIPTION

1.1 File Information

1.1.1   Format

Snow pit data are available in comma-separated ASCII text files, with a file extension of .csv, and in shapefile spatial data format shapefiles, with various extensions. There are four types of files: summary, density profile, temperature, and stratigraphy. Shapefiles contain everything included in the text files, except for general pit comments, which were too verbose for import into shape format.

During all Intensive Study Periods (IOPs), extra pits were dug across the entire North Park MSA, to coincide with simultaneous airborne gamma measurements. These pits have non-standard pit IDs.

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. In the shapefiles, missing dates are designated 9999-99-99, missing text fields are designated "NoData", and missing numeric fields are designated -999.

For detailed information about snow pit data format, please see the CLPX Snow Pit Measurements documentation.

1.1.2   Directory Structure

Data are organized in the following structure:

pit_iop_v2.tgz

photos/
   iop1/
     alpine/
          other/
               roughness/
               terrain/
          buffalo_pass/
          fool_creek/
          gamma/
          illinois_river/
          michigan_river/
          potter_creek/

        spring_creek/

        st_louis_creek/

  iop2/

   alpine/

        other/

                roughness/

                templates/

                terrain/

        buffalo_pass/

        fool_creek/

        illinois_river/

        michigan_river/

        no_isa/

        potter_creek/

        spring_creek

        st_louis_creek/

        walton_creek/

  iop3/

   alpine/

        other/

        pitwall/

        roughness/

        terrain/

        buffalo_pass/

        fool_creek/

        illinois_river/

        michigan_river/

        potter_creek/

        spring_creek/

        st_louis_creek/

  iop4/

The compressed (tarred and zipped) file "pit_iop_v2.tgz" will extract into two directories: ascii/ contains the .csv version of the data, and shape_files/ contains the GIS-compatible shapefiles. The shapefiles are organized as:

`pit_iop_v#_density.dbf` (and .prj, .sbn, .sbx, .shp, .shx)

`pit_iop_v#_strat.dbf` (and .prj, .sbn, .sbx, .shp, .shx)

`pit_iop_v#_summary.dbf` (and .prj, .sbn, .sbx, .shp, .shx)

`pit_iop_v#_temperature.dbf` (and .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 (v#).

1.1.3   Naming Convention

Snow pit filenames are named `pit_GROUP_v#_DATA.csv`, where:

pit indicates snow pit data
GROUP = pit group (iop1, iop2, iop3, iop4)
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

shapefile names are pit_GROUP_v#_DATA.ext, where:

pit = indicates snow pit data
GROUP = pit group (iop)
note that all IOP pits are included in a single shape file
v# = Data release number (e.g., version 2)
DATA = type of data in the file: "summary," "density," "temperature," or "strat"
.ext = shape file extenstions {.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.

The following codes are used in filenames (and for site names in the raw data):

MSA Code
    F = Fraser
    N = North Park
    R = Rabbit Ears

ISA Code
    A = Alpine
    B = Buffalo Pass
    F = Fool Creek
    I = Illinois River
    M = Michigan River
    P = Potter Creek
    S = Spring Creek (if MSA Code = R) or

St. Louis Creek (if MSA Code = F)

W = Walton Creek

ISA Sector

A = Lower Left Quadrant – SW

B = Upper Left Quadrant – NW

C = Upper Right Quadrant – NE

D = Lower Right Quadrant - SE

1.2 Spatial Information

1.2.1 Coverage

Fraser, North Park, and Rabbit Ears MSAs in northern Colorado, USA.

Schematic diagram of the nested study areas for the CPLX

Study area map

Location of MSAs

Location and characteristics of ISAs

1.2.1.1 IOP1 Snow Pits Measured

MSA	Planned number of pits	Actual number of pits
Fraser	48	47
LSOS (18 pits)	0	0
North Park	48	48 plus 118 "gamma" pits
Rabbit Ears	48	48

1.2.1.2 IOP2 Snow Pits Measured:

MSA	Planned number of pits	Actual number of pits
Fraser	48	48
LSOS (18 pits)	0	0
North Park	48	48 plus 160 "gamma" pits
Rabbit Ears	48	48

1.2.1.3 IOP3 Snow Pits Measured:

MSA	Planned number of pits	Actual number of pits
Fraser	48	48
North Park	48	48 plus 92 "gamma" pits

MSA		
Rabbit Ears	48	18

1.2.1.4 IOP4 Snow Pits Measured:

MSA	Planned number of pits	Actual number of pits
Fraser	48	48
North Park	48	48 plus 43 "gamma" pits
Rabbit Ears	48	44

1.3 Temporal Information

1.3.1 Coverage

IOP1 took place 19-24 February 2002.

IOP2 took place 25-30 March 2002.

IOP3 took place 20-25 February 2003.

IOP4 took place 26-31 March 2003.

Because of the general lack of snow in North Park, all pit data were collected on the first day of ground observations. The second day, teams collected pits at sites across the entire MSA to coincide with the gamma overflights.

1.4 Parameter Description

Parameters include snow density, snow temperature, snow stratigraphy, snow grain size, snow water equivalent, snow wetness, surface roughness, and various averages and statistics.

For a complete description of parameters and measurements, please refer to the Measurements section of the CLPX Plan.

2 DATA ACQUISITION AND PROCESSING

For detailed information about snow pit data, please see the CLPX Snow Pit Measurements documentation.

2.1 Quality Assessment

The pit data were collected with the strictest levels of quality control, including QC performed in the field, usually within a day of the measurement (this includes the so-called "gamma pits" taken along roadsides in North Park, to coincide with simulataneous airborne gamma overflights).

Sources of measurement error in the snow pit density data include debris/vegetative matter embedded in the snow pit wall, particularly at or near the bottom of the snow pit, and the practice of "carrying down" the last measured density to the bottom of the pit, when the density cutter could not be used for the lowest measurements. This usually affected the last 10 cm or so, but could affect more, and is indicated in the density profile records with QC code "001". Surveyors did their best to avoid debris in the density cutters, but this situation was not always avoidable, and, where possible, was noted in the surveyors' comments.

Detailed Explanations of Snow Pit QC Codes:

In general:

codes from   are reserved for QC performed on

001-099	snow density measurements
100-199	snow mass measurements ("shallow" pits)
200-299	snow temperature measurements
300-399	snow stratigraphy measurements
400-899	unused
900-999	general pit information, i.e. header values

Code   Description (what was reset/set/estimated: the reason why)

000   QC OK: all tests passed

001   Density value estimated: Surveyor did not measure densities to the ground.

002   Density value calculated from sipre mass: Surveyor used sipre tube instead of density cutter.

003   Reset recorded layer top heights: recorded layer overlapped with layer above.

004   Interpolated layer density: gap in recorded densities.

005   Surveyor entered trace, will be treated as measurement of 0.

105   Surveyor entered trace, will be treated as measurement of 0.

301   Reordered grain sizes from LargeMedSmall: Relative grain sizes appeared out of expected order.

302   Reordered grain sizes from LargeSmallMed: Relative grain sizes appeared out of expected order.

303   Reordered grain sizes from MedSmallLarge: Relative grain sizes appeared out of expected order.

304   Reordered grain sizes from MedLargeSmall: Relative grain sizes appeared out of expected order.

305   Reordered grain sizes from SmallLargeMed: Relative grain sizes appeared out of expected order.

310   Reordered grain dimensions from LongShort: Relative dimensions appeared out of expected order.

311   Reordered grain dims/sizes from LongShort and LargeMedSmall: Relative grains appeared out of expected order.

312   Reordered grain dims/sizes from LongShort and LargeSmallMed: Relative grains appeared out of expected order.

313   Reordered grain dims/sizes from LongShort and MedSmallLarge: Relative grains appeared out of expected order.

314   Reordered grain dims/sizes from LongShort and MedLargeSmall: Relative grains appeared out of expected order.

315   Reordered grain dims/sizes from LongShort and SmallLargeMed: Relative grains appeared out of expected order.

320   Grain dims/sizes are ambiguous.

901   Snow pit depth estimated from first density measurement: Surveyor did not enter pit depth.

902   Snow pit depth estimated from mass measurement depths: Surveyor did not enter pit depth.

903   Snow pit depth estimated from first stratigraphy depth: Surveyor did not enter pit depth.

904   Snow pit depth set to 0: Surveyor did not enter pit depth, no snow measurement taken, but soil samples taken.

905   Warning: Snow pit depth does not match top of density profile.

906   Warning: Snow pit depth does not match top of temperature profile.

907   Warning: Snow pit depth does not match top of stratigraphy profile.

914   Canopy reset to missing value: Snow depth is 0.

915   Surface roughness reset to n: Snow depth is 0.

916   Surface wetness reset to missing value: Snow depth is 0.

917   Canopy height reset to missing value: Snow depth is 0.

950   Warning: Shallow pit form used, but pit depth > 15 cm.

951   Warning: Deep pit form used, but pit depth < 15 cm.

990   Warning: One or both UTM coordinates are missing.

991   Warning: Missing date and/or time field.

999   No data collected for this pit.

Detailed Explanations:

000   QC OK: all tests passed

      No problems were detected, values have not been changed from the original forms.

Density QC codes

001   Density value estimated: Surveyor did not measure densities to the ground.

      The density cutter was 10 cm high, so the final density profile was generally not measured all the way to the ground, especially in cases where vegetation was present. This density measurement was estimated by carrying the last actual measurement to the ground.

002   Density value calculated from sipre mass: Surveyor used sipre tube instead of density cutter.

> In some cases, the surveyor used the density profile sheet (normally used for density cutter measurements) to record SIPRE tube (mass) measurments. The original measurement is assumed to be a mass and has been used to calculate this density.

003   Reset recorded layer top heights: recorded layer overlapped with layer above.

> The recorded density layer overlapped with the layer above it. In order to assure non-overlapping measurements for pit average density and SWE, the top height of this layer was reset to the bottom height of the layer above it.

004   Interpolated layer density: gap in recorded densities.

> There was a gap in the recorded density layers. In order to assure a continuous set of density measurements for pit average density and SWE, this layer was inserted, with a density interpolated from the densities of the immediately surrounding layers.

005   Surveyor entered trace, will be treated as measurement of 0.

> During IOP3 and IOP4, snow on the ground that was not measurable was recorded as a trace, and trace values were included in calculated values as zeroes.

Mass QC codes

105   Surveyor entered trace, will be treated as measurement of 0.

> During IOP3 and IOP4, snow on the ground that was not measurable was recorded as a trace, and trace values were included in calculated values as zeroes.

Stratigraphy QC codes

301   Reordered grain sizes from LargeMedSmall: Relative grain sizes appeared out of expected order.

> The expected order of grain dimensions was short dimension Small, Medium, Large followed by long dimension Small, Medium, Large. However, when the QC software compared the areas (i.e. ShortSmall times LongSmall, etc.) the original values in this stratigraphy layer appeared to be reversed (Large, Medium, Small) and have been reordered.

302   Reordered grain sizes from LargeSmallMed: Relative grain sizes appeared out of expected order.

> The expected order of grain dimensions was short dimension Small, Medium, Large followed by long dimension Small, Medium, Large. However, when the QC software compared the areas (i.e. ShortSmall times LongSmall, etc.) the original values in this

stratigraphy layer appeared to be out of order (Large, Small, Medium) and have been reordered.

303   Reordered grain sizes from MedSmallLarge: Relative grain sizes appeared out of expected order.

The expected order of grain dimensions was short dimension Small, Medium, Large followed by long dimension Small, Medium, Large. However, when the QC software compared the areas (i.e. ShortSmall times LongSmall, etc.) the original values in this stratigraphy layer appeared to be out of order (Medium, Small, Large) and have been reordered.

304   Reordered grain sizes from MedLargeSmall: Relative grain sizes appeared out of expected order.

The expected order of grain dimensions was short dimension Small, Medium, Large followed by long dimension Small, Medium, Large. However, when the QC software compared the areas (i.e. ShortSmall times LongSmall, etc.) the original values in this stratigraphy layer appeared to be out of order (Medium, Large, Small) and have been reordered.

305   Reordered grain sizes from SmallLargeMed: Relative grain sizes appeared out of expected order.

The expected order of grain dimensions was short dimension Small, Medium, Large qfollowed by long dimension Small, Medium, Large. However, when the QC software compared the areas (i.e. ShortSmall times LongSmall, etc.) the original values in this stratigraphy layer appeared to be out of order (Small, Large, Medium) and have been reordered.

310   Reordered grain dimensions from LongShort: Relative dimensions appeared out of expected order.

The expected order of grain dimensions was 3 short dimensions followed by 3 long dimensions, however, original values in this stratigraphy layer appeared swapped, and have been reordered.

311   Reordered grain dims/sizes from LongShort and LargeMedSmall: Relative grains appeared out of expected order.

A combination of 301 and 310.

312   Reordered grain dims/sizes from LongShort and LargeSmallMed: Relative grains appeared out of expected order.

A combination of 302 and 310.

313   Reordered grain dims/sizes from LongShort and MedSmallLarge: Relative grains appeared out of expected order.

> A combination of 303 and 310.

314   Reordered grain dims/sizes from LongShort and MedLargeSmall: Relative grains appeared out of expected order.

> A combination of 304 and 310.

315   Reordered grain dims/sizes from LongShort and SmallLargeMed: Relative grains appeared out of expected order.

> A combination of 305 and 310.

320   Grain dims/sizes are ambiguous.

> The combination of dimensions and grain sizes was ambiguous. These grain sizes were left in the order that they were recorded, but should probably be treated with care before assuming dimension and or size order.

Pit Summary (general mismatches across various fields) QC codes

901   Snow pit depth estimated from first density measurement: Surveyor did not enter pit depth.

> The pit depth field on the original data sheet was left blank. It has been estimated using the top height of the uppermost density measurement.

902   Snow pit depth estimated from mass measurement depths: Surveyor did not enter pit depth.

> The pit depth field on the original data sheet was left blank, and there was no density or stratigraphy profile information. The pit depth has been estimated using the maximum height of the mass measurements taken.

903   Snow pit depth estimated from first stratigraphy depth: Surveyor did not enter pit depth.

> The pit depth field on the original data sheet was left blank, and there was no density profile information. The pit depth has been estimated using the top height of the uppermost stratigraphy measurement.

904   Snow pit depth set to 0: Surveyor did not enter pit depth, no snow measurement taken, but soil samples taken.

> The pit depth field on the original data sheet was left blank, and there was no density, temperature or stratigraphy profile information, but soil samples were taken. The location is assumed to have no snow, and depth has been set to 0.

905   Warning: Snow pit depth does not match top of density profile.

The pit depth value on the original data sheet is different from the top height of the density profile.

906   Warning: Snow pit depth does not match top of temperature profile.

The pit depth value on the original data sheet is different from the top height of the temperature profile.

907   Warning: Snow pit depth does not match top of stratigraphy profile.

The pit depth value on the original data sheet is different from the top height of the stratigraphy profile.

914   Canopy reset to missing value: Snow depth is 0.

Measurement protocol was to record canopy only when snow depth was greater than 0. In this case a recorded canopy was reset to missing because the snow depth was 0.

915   Surface roughness reset to n: Snow depth is 0.

Measurement protocol was to take a surface roughness photo only when snow depth was qgreater than 0. In this case a photo was taken, but this field was reset to "n" (no) because the snow depth was 0. The roughness photograph at this pit was not deleted, however.

916   Surface wetness reset to missing value: Snow depth is 0.

Measurement protocol was to record surface wetness only when snow depth was greater than 0. In this case a recorded surface wetness was reset to missing because the snow depth was 0.

917   Canopy height reset to missing value: Snow depth is 0.

Canopy height field was introduced (in North Park only) during IOP2. Measurement protocol was to record canopy height only when snow depth was greater than 0. In this case a recorded canopy height was reset to missing because the snow depth was 0.

950   Warning: Shallow pit form used, but pit depth > 15 cm.

Measurement protocol was to use the "shallow" pit form when the snow depth was less than 15 cm.

951   Warning: Deep pit form used, but pit depth < 15 cm.

Measurement protocol was to use the "deep" pit form when the snow depth was more than 15 cm.

990   Warning: One or both UTM coordinates are missing.

Pit coordinates are incomplete or missing.

991   Warning: Missing date and/or time field.

Date and/or time field are missing.

999   No data collected for this pit.

Data were not collected at this pit location, due to safety hazard, weather conditions, or lack of time.

3   CONTACTS AND ACKNOWLEDGMENTS

Kelly Elder

Research Hydrologist

Rocky Mountain Research Station

USDA Forest Service

240 W. Prospect Road

Fort Collins, CO USA 80526

Don Cline

National Weather Service

National Operational Hydrologic Remote Sensing Center

1735 Lake Drive W.

Chanhassen, MN 55317

4   REFERENCES

Please see the References section of the CLPX Plan.

ESRI Shapefile Technical Description (http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf)

CLPX-Ground: ISA Snow Depth Transects and Related Measurements, Version 2

5   DOCUMENT INFORMATION

5.1 Publication Date

15 August 2003

5.2 Date Last Updated

2 May 2021