CLPX-Ground: Ground Based Passive Microwave Radiometer (GBMR-7) Data, Version 1

USER GUIDE

How to Cite These Data

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

Graf, T., T. Koike, H. Fujii, M. J. Brodzik, and R. Armstrong. 2003. *CLPX-Ground: Ground Based Passive Microwave Radiometer (GBMR-7) 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/RP8KSSYM8TT2. [Date Accessed].

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National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

The data set contains brightness temperature observations of the snow pack at the LSOS in Fraser, Colorado, USA. Measurements were taken at 18.7, 23.8, 36.5, and 89 GHz (vertical/horizontal polarization) using a ground-based passive microwave radiometer (GBMR-7). Three different measurement techniques or physical characteristics of the surface are presented:

- **Undisturbed snow cover (Azimuth 140 to 210 degrees; scans designated fraser03 and fraser07; see Figure 1).** The snow cover in this area was undisturbed during the winter season, and therefore the total accumulated snow was observed.
- **Angular scans (Azimuth 180 degrees; scan designated fraser10; see Figure 1).** A single 'direction' was selected for the angular scans, but was observed with different incident angles, which ranged from 30 to 70 degrees
- **Bare soil and new snow accumulation (Azimuth 270 to 290 degrees; scans designated fraser09 and frzr09b9; see Figure 1).** During the winter season, all snow accumulated in this scan area was completely removed, twice.

In addition to observed snow brightness temperatures, snow pit characteristics snow density, snow temperature, snow stratigraphy, snow grain size, and snow water equivalent) and meteorological forcing data observations (wind speed, wind direction, air temperature, relative humidity, downward long-wave radiation, downward short-wave radiation and precipitation) are available. Photos of the sectors cleared of snow are also included.

TB values of -999.999: indicate a missing TB measurement. This occurred in the 23 GHz channel after it was disabled during a field repair in November, 2002. This affected all 23 GHz measurements after that date.

Negative TB values (not equal to -999.999): occurred occasionally in all channels, usually when the radiometer was observing the sky. Cold sky temperatures are normally outside the instrument's calibration range, and are therefore not reliable; negative values are not included in averages in the `.csv.stats` files.

1.1 Radiometer Observations

Radiometer data are presented in three forms:

- Raw Data (binary and comma-delimited ASCII)
- Processed Data (tab-delimited ASCII)
- Graphs of Processed Data (.png graphs)

1.2 Meteorological, Soil, and Snow Pit Data

Additional data include meteorological and soil data (.csv; comma-separated ASCII) and snow pit data (.csv; comma-separated ASCII files and GIS-compatible shapefile spatial data format). Double quotes are used to delimit text within fields, and commas contained within the double quotes do not indicate a new field. Please see the CLPX Snow Pit Measurements document for more detailed information on the GBMR snow pits.

1.3 Format

The GBMR-7 is controlled by an ASCII "scan file" that defines operational parameters for a given measurement session. Controllable features include antenna elevation, azimuth, dwell time, number of samples and channels to record. Five scan files were used during the CLPX experiments, for scan definitions named fraser03, fraser07, fraser09, fraser10 and frzr09b9 (see Figure 1). Data files collected during the experiment are ordered in scan file directories, with data file names determined by date and time the scanfile was executed.

Scan data files are in binary, comma-delimited, and tab-delimited ASCII format. Snow pit data files are in ASCII format. Graphs are in PNG format, and photos of the study site are in JPG format.

GBMR snow pit files include four comma-separated ASCII files (containing summary, density profile, temperature profile, and stratigraphy profile information), and six shapefiles each (with various extensions) for summary, density profile, temperature profile, and stratigraphy profile data. Shapefiles contain everything included in the text files, except for general pit comments, which were too verbose for import into shape format. Please see the CLPX Snow Pit Measurements document for more detailed information on the GBMR snow pits.

1.4 File and Directory Structure

The radiometer data are provided as a compressed (tarred and zipped) file, `gbmr7-radiometer.tgz`, which when uncompressed yields binary data files (`.dat`), ASCII files (`.cvs`), processed radiometer data in ASCII (`.cvs.stats`), and graphs (`.png`).

Snow pit data are provided as a compressed (tarred and zipped) file, `pit_gbmr_v2.tgz`, which extracts into two directories: "`ascii/`" contains the .csv version of the data, and "`shape_files/`" contains the GIS-compatible shapefiles.

Meteorology and soil data are provided as ASCII files: `gbmr7-met.csv` and `gbmr7-soil.csv`.

Photos are provided as JPEG (`.jpg`) files.

1.5 File Naming Convention

Radiometer scan files are named `MMDDhhmm.dat`, `MMDDhhmm.csv`, and `MMDDhhmm.csv.stats`, where MMDDhhmm is month (MM), day (DD) hour (hh), and minute (mm). E.g., `01201615.dat` is the binary radiometer file for 20 January 2002 at 1615 hours local time. There are three files for each date/time combination: .dat, .csv, and .csv.stats.

Radiometer graph files are named `MMDDhhmm_h-v.png` (e.g., `01201615_h-v.png` is the radiometer graph file for 20 January 2002 at 1615 hours local time).

January and December files contain data from 2002. February and March files contain data from 2003.

Meteorology and soil files are named `gbmr7-met.csv` and `gbmr7-soil.csv`.

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

`pit_gbmr_v#_density.csv` = processed snowpit data - Density
`pit_gbmr_v#_strat.csv` = processed snowpit data - Stratigraphy
`pit_gbmr_v#_summary.csv` = processed snowpit data - Summary
`pit_gbmr_v#_temperature.csv` = processed snowpit data - Temperature

Snow pit shapefile names are `pit_gbmr_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.

1.6 Snow Pit ID's

```
GBMR Pit IDs: gbmr##x
        gbmr = pit taken near GBMR instrument
        ## = 2-digit pit number, indicates same location throughout the winter

        x = letter {a,b,c, etc} indicating sequence of pit
                measurements throughout the winter
```

1.7 File Size

Scan files range from 1 to 43 KB, snow pit files are 8 to 17 KB, graphs are 5 KB, and the meteorology/soil files range from 1.6 to 3.7 MB.

1.8 Spatial Coverage

Measurements were taken at the LSOS at Fraser, Colorado, US. This is a 100 m x 100 m study site located within the Fraser ISA, near the Fraser Experimental Forest Headquarters Facility.

1.8.1 Spatial Resolution

The following map provides an overview of the observation site, and is included in the data set. This map contains the location of all scan fields observed with the radiometer, the snow pit areas, and the locations of the met station, the precipitation gauge, and the soil sensors.

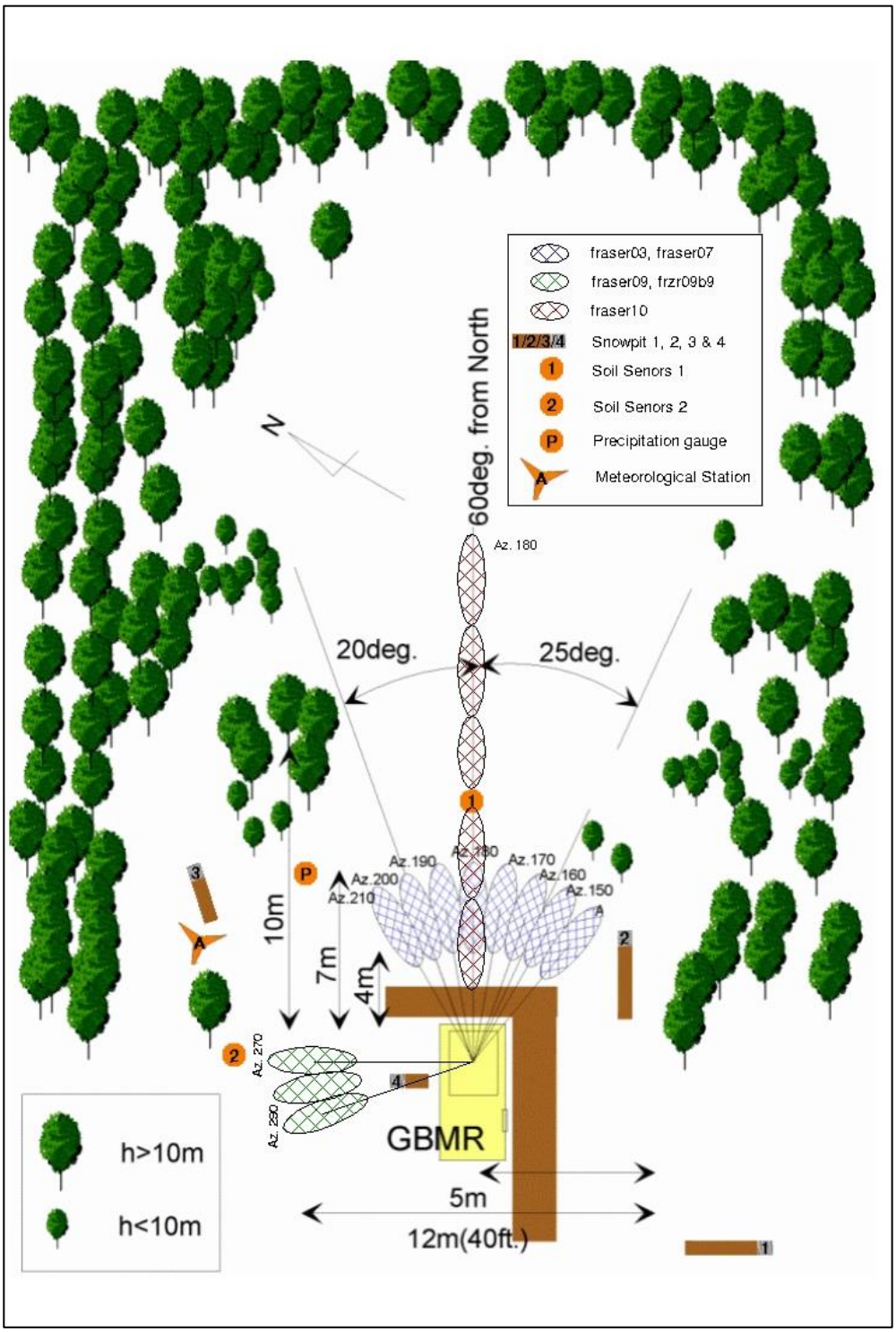


Figure 1. Overview of the observation site

1.9 Temporal Coverage

1.9.1 Radiometer Data

Radiometer data were collected on the following dates, with 0.2 sec integration times:

Pre-IOP1:

19-21 January 2002: fraser03

Pre-IOP3:

10-13 December 2002: fraser07, fraser09

IOP3:

18 February 2003: fraser07, fraser09
19 February 2003: fraser07, fraser09, fraser10
20 February 2003: fraser07, frzr09b9, fraser10
21 February 2003: fraser07, frzr09b9, fraser10
22 February 2003: fraser07, fraser09, frzr09b9, fraser10
23 February 2003: fraser07, fraser09, frzr09b9
24 February 2003: fraser07, frzr09b9, fraser10
25 February 2003: fraser07, frzr09b9, fraser10
26 February 2003: fraser07, frzr09b9, fraser10

IOP4:

25 March 2003: fraser07, frzr09b9, fraser10

1.9.2 Meteorological Data

Meteorological data were collected between 1 October 2002 and 29 March 2003, with an average resolution of 10 min.

1.9.3 Soil Temperature and Soil Moisture Data

Soil temperature and soil moisture data were collected as follows (see Figure 1) for the location of the both soil sensors):

Soil Temperature Location 1: 8 October 2002 - 29 March 2003
Soil Moisture Location 1: 8 October 2002 - 29 March 2003
Soil Temperature Location 2: 15 October 2002 - 29 March 2003
Soil Moisture Location 2: 5 October 2002 - 29 March 2003

1.9.4 Snow Pit Data

Snow pit data were collected between 13 November and 15 December 2002, and between 4 January and 11 March 2003.

1.10 Parameter or Variable

Parameters presented in this data set are brightness temperatures (Kelvin), snow parameters, and meteorological parameters. Snow pit parameters include snow density, snow temperature, snow stratigraphy, and snow grain size. Meteorological parameters include maximum wind speed (m/s), average wind speed (m/s), wind direction (degrees), air temperature (degrees Celsius), relative humidity (%), downward longwave radiation (W/m2), downward shortwave radiation (W/m2), and precipitation (mm).

1.10.1 File Header Descriptions

1.10.1.1 Raw Data (comma-delimited ASCII)

These files contain all samples that were observed during the execution of one scanfile. Note, a scan file can have more than one footprint, and one footprint comprises multiple samples.

```
Row 1: Header: Number of Samples - "#  Number of samples, INTEGER"
Row 2: Header: Integration Time - "# Integration time [sec], FLOAT"
Row 3: Header:
        Time of Observation. - "# Time of measurement, YYYY/MM/DD hh:mm:ss"
       YYYY = Year (4-digit)
       MM   = Month (2-digit, 01 - 12)
       DD   = Day (2-digit, 01-31)
Row 4-5: Header
Row 6 - Row: NumberOfSamples+5 (comma separated values)
Col. 1: Sample Number (first value = 0), INTEGER
Col. 2: 18,7 GHz - v (FLOAT, 3 digits after decimal point)
Col. 3: 18.7 GHz - h (float, 3 digits after decimal point)
Col. 4: 23.8 GHz - v (FLOAT, 3 digits after decimal point)
        (This channel was not in service after 20 January 2002)
Col. 5: 36.5 GHz - v (FLOAT, 3 digits after decimal point)
Col. 6: 36.5 GHz - h (FLOAT, 3 digits after decimal point)
Col. 7: 89.0 GHz - v (FLOAT, 3 digits after decimal point)
Col. 8: 89.0 GHz - h (FLOAT, 3 digits after decimal point)
```

1.10.1.2 Processed Data (tab-delimited ASCII)

These data files contain an average of all samples that belong to one footprint. In addition, the following polarization differences and spectral gradients were calculated: 18V-18H, 36V-36H, 89V-89H, 18H-36H.

```
Row 1 - Row 6: Header - Comments
Row 7: Header - Input File Name  "#   Reading File:   STRING"
Row 8: Header - Output File Name  "#  Result File:   STRING"
Row 9: Header -
   Space-delimited list of sample numbers that are averaged into one value.
   These sample numbers correspond to one footprint of a scan file.
   "# Sample Numbers:   0-49 50-99 100-149 150-199 200-249"
```

```
   This means the first entry represents the average of sample 0-49.
Row 10 - Row 12: Header
Row 13 - Row 12+NumberOfSampleRanges: (tab-delimited values)
Col. 1: Average (Footprint) Number (first value = 0),INTEGER
Col. 2: 18,7 GHz - v (FLOAT, 3 digits after decimal point)
Col. 3: 18.7 GHz - h (float, 3 digits after decimal point)
Col. 4: 23.8 GHz - v (FLOAT, 3 digits after decimal point)
       (This channel was not in service after  20 January 2002)
Col. 5: 36.5 GHz - v (FLOAT, 3 digits after decimal point)
Col. 6: 36.5 GHz - h (FLOAT, 3 digits after decimal point)
Col. 7: 89.0 GHz - v (FLOAT, 3 digits after decimal point)
Col. 8: 89.0 GHz - h (FLOAT, 3 digits after decimal point)
Col. 9: 18.7V - 18.7H (FLOAT, 3 digits after decimal point)
Col.10: 36.5V - 36.5H (FLOAT, 3 digits after decimal point)
Col.11: 89.0V - 89.0H (FLOAT, 3 digits after decimal point)
Col.12: 18.7H - 36.5H (FLOAT, 3 digits after decimal point)
Col.13: QC (INTEGER, 3 digits)
             100 = Data are OK
             101 = Interference at 18.7 GHz
             102 = Interference at 36.5 GHz
             103 = Interference at 89.0 GHz
             104 = Sensor at 18.7 GHz broke
             105 = Sensor at 36.5 GHz broke
             106 = Sensor at 89.0 GHz broke
```

1.10.1.3 Meteorological Data:

```
Row 1 - 2: Header
Row 3 - ..: Data, 1 row per 10 min.
Col. 1: Date - YYYY/MM/HH
Col. 2: Time - hh:mm (24 hour format, MST)
Col. 3: Maximum Windspeed
        (FLOAT, 2 digits after decimal point)
Col. 4: Average Windspeed [m/s]
        (FLOAT, 2 digits after decimal point)
Col. 5: Wind Direction [0..360 deg]
        (FLOAT, 2 digits after decimal point)
Col. 6: Air Temperature
        (FLOAT, 2 digits after decimal point)
Col. 7: relative Humidity
        (FLOAT, 2 digits after decimal point)
Col. 8: Shortwave Downward Radiation [W/m2]
        (FLOAT, 2 digits after decimal point)
Col. 9: Longwave Downward Radiation [W/m2]
        (FLOAT, 2 digits after decimal point)
Col.10: Precipitation [mm], (FLOAT, 3 digits after decimal point)
Col.11: Quality Flag (this column is empty, if no changes were made):
        TA100: Problems with temperature sensor
        (All values before 3 Feb 2003 are flagged, because the recorded
        temperatures seemed too low. The relative pattern seems to be OK.)
```

1.10.1.4 Soil Temperature and Moisture Data

Location 1: The probes were installed close to fraser07 (azimuth=180 degrees), 2 m behind the footprint).

Location 2: The probes were installed close to fraser09 and frzr09b9 (right side of the footprint).

```
Row 1 - 2: Header
Row 3 - ..: Data, 1 row per 10 min
Col. 1: Date - YYYY/MM/HH
Col. 2: Time - hh:mm (24 hour format)
Col. 3: Soil Temperature - Location 1 - Surface
        (FLOAT, 2 digits after decimal point)
Col. 4: Soil Temperature - Location 1 -  1.5 cm
        (FLOAT, 2 digits after decimal point)
Col. 5: Soil Temperature - Location 1 -  5.0 cm
        (FLOAT, 2 digits after decimal point)
Col. 6: Soil Temperature - Location 1 - 10.0 cm
        (FLOAT, 2 digits after decimal point)
Col. 7: Soil Temperature - Location 1 - 20.0 cm
        (FLOAT, 2 digits after decimal point)
Col. 8: Soil Temperature - Location 2 - Surface
        (FLOAT, 2 digits after decimal point)
Col. 9: Soil Temperature - Location 2 -  3.0 cm
        (FLOAT, 2 digits after decimal point)
Col.10: Soil Temperature - Location 2 -  5.0 cm
        (FLOAT, 2 digits after decimal point)
Col.11: Soil Temperature - Location 2 - 10.0 cm
        (FLOAT, 2 digits after decimal point)
Col.12: Soil Temperature - Location 2 - 20.0 cm
        (FLOAT, 2 digits after decimal point)
Col.13: Soil Moisture - Location 1 -  1.5 cm
        (FLOAT, 2 digits after decimal point)
Col.14: Soil Moisture - Location 1 - 10.0 cm
        (FLOAT, 2 digits after decimal point)
Col.15: Soil Moisture - Location 1 - 20.0 cm
        (FLOAT, 2 digits after decimal point)
Col.16: Soil Moisture - Location 2 -  3.0 cm
        (FLOAT, 2 digits after decimal point)
Col.17: Soil Moisture - Location 2 - 10.0 cm
        (FLOAT, 2 digits after decimal point)
Col.18: Soil Moisture - Location 2 - 20.0 cm
        (FLOAT, 2 digits after decimal point)
Col.19: Flag:
        For each replaced value ('6999'), a flag is set.
        Flags are separated by '/'.
        If nothing was changed, this column is empty.
        Format of Flag:
        'SensorTyp'_'Location'-'SensorNumber'#'ErrorNr.
        SensorTyp = 'M' (SoilMoisture) or 'T' (SoilTemperature)
         Location = 'L1' (location 1) or 'L2' (location2)
        SensorNumber = '1' to '5' (for T) or '1' to '3' (for M)
        ErrorNr = 101 (SM lower then 5%) or 102 (SM higher then 50%)
```

```
ErrorNr = 201 (Temperature values of L1_3, L1_4 and L1_5 after
               2002/10/13 removed because of malfunction of sensors)
```

1.10.1.5 Snow Pit Summary, Density, Temperature, and Stratigraphy Data

The snow pit summary, density profile, temperature profile, and stratigraphy files are described in the CLPX Snow Pit Measurements document.

2 DATA ACQUISITION AND PROCESSING

2.1 Scan Data

2.1.1 Radiometer Specifications

Frequencies: 18.7, 23.8, 36.5, 89.0 GHz
Measurement Range: 0 K to 350 K
Absolute Accuracy: 0.5 K, 0.4 K (RMS) over 10 minutes/ea
Resolution: 0.3 K min
Antenna Beam Width: 10 deg. (FWHM)
Antenna Sequent: 0.1 deg. max
Beam Efficiency: 98% min
Cross Polarization: 0.1% max
Sidelobe level: -40 dBi max
Polarization: V & H (23.8 GHz only V)
Positioner: Azimuth (360 deg), Elevation (90 deg), fully motorized
IF Bandwidth: 200 MHz

For further information on calibration, see:

Kazama, S, T. Rose, and R. Zimmerman.1999. A Precision Autocalibrating 7ch Radiometer for Environmental Research Applications. Journal of the Remote Sensing Society of Japan 19(3): 37-45.

The radiometer was set up as in the following photo:

Figure 2. Radiometer setup

2.1.2 Scan Files

The GBMR-7 is controlled by an ASCII "scan file" that defines operational parameters for a given measurement session. Controllable features include antenna elevation, azimuth, dwell time, number of samples and channels to record. Five scan files were used during the CLPX experiments, for scan definitions named fraser03, fraser07, fraser09, fraser10 and frzr09b9 (see Figure 1).

Position: Azimuth (Az.) = 0 and Elevation (El.) = -87 represents the "home" position of the sensor; the sensor is looking at the lift table. In some scan files, the measurement finished with a short observation of sky brightness temperature (Az = 180 deg, El = 55 deg).

```
fraser03:

Footp.-#|    Az.   |   El.    | # Samples | Integration. Time
--------+---------+----------+-----------+-----------------
 1.     | 210 deg | -35 deg |     50    |   0.2 s
 2.     | 200 deg | -35 deg |     50    |   0.2 s
 3.     | 190 deg | -35 deg |     50    |   0.2 s
 4.     | 180 deg | -35 deg |     50    |   0.2 s
 5.     | 170 deg | -35 deg |     50    |   0.2 s
```

6.	160 deg	-35 deg	50	0.2 s
7.	150 deg	-35 deg	50	0.2 s
8.	140 deg	-35 deg	101	0.2 s

fraser07:

Footp.-#	Az.	El.	# Samples	Integration. Time
1.	190 deg	-35 deg	50	0.2 s
2.	185 deg	-35 deg	50	0.2 s
3.	180 deg	-35 deg	50	0.2 s
4.	175 deg	-35 deg	50	0.2 s
5.	170 deg	-35 deg	50	0.2 s
6.	180 deg	55 deg	50	0.2 s
7.	0 deg	-87 deg	5	0.2 s

fraser09:

Footp.-#	Az.	El.	# Samples	Integration. Time
1.	290 deg	-35 deg	50	0.2 s
2.	285 deg	-35 deg	50	0.2 s
3.	280 deg	-35 deg	50	0.2 s
4.	275 deg	-35 deg	50	0.2 s
5.	270 deg	-35 deg	50	0.2 s
6.	180 deg	55 deg	50	0.2 s
7.	0 deg	-87 deg	5	0.2 s

frzr09b9:

Footp.-#	Az.	El.	# Samples	Integration. Time
1.	290.0 d	-35 deg	50	0.2 s
2.	287.5 d	-35 deg	50	0.2 s
3.	285.0 d	-35 deg	50	0.2 s
4.	282.5 d	-35 deg	50	0.2 s
5.	280.0 d	-35 deg	50	0.2 s
6.	277.5 d	-35 deg	50	0.2 s
7.	275.0 d	-35 deg	50	0.2 s
8.	272.5 d	-35 deg	50	0.2 s
9.	270.0 d	-35 deg	50	0.2 s
10.	180.0 d	55 deg	50	0.2 s
11.	0.0 d	-87 deg	5	0.2 s

fraser10:

Footp.-#	Az.	El.	# Samples	Integration. Time

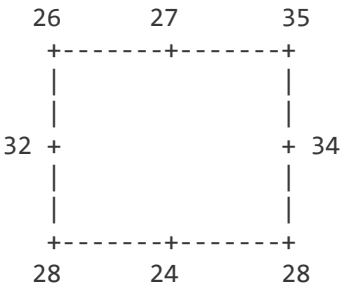
1.	180 deg	-20 deg	50	0.2 s
2.	180 deg	-25 deg	50	0.2 s
3.	180 deg	-30 deg	50	0.2 s
4.	180 deg	-35 deg	50	0.2 s
5.	180 deg	-40 deg	50	0.2 s
6.	180 deg	-45 deg	50	0.2 s
7.	180 deg	-50 deg	50	0.2 s
8.	180 deg	-55 deg	50	0.2 s
9.	180 deg	-60 deg	50	0.2 s
10.	0 deg	-87 deg	5	0.2 s

2.1.3 Fraser09/frzr09b9: Snow Depth

At these two scan file targets, the snow was removed several times during the winter (photos were taken of this procedure, and are included here and in the data set).

Dec. 13, 2002:

Scan of the complete snow cover.
Around 20 cm of snow was removed (depth in cm)



The following scan files are available:

Complete Snow Cover - Fraser09: 12130607.dat, 12130622.dat
Partial Removal - Fraser09: 12130706.dat, 12130736.dat

Figure 3. Dec. 13, 2002: Beginning of partial removal

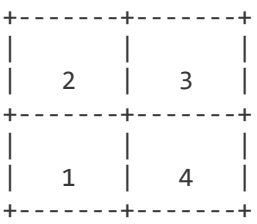
Figure 4. Dec. 13, 2002: Partial removal complete

Figure 5. Dec. 14, 2002: Next day, scene recovered with snow

Afterwards the snow was removed completely; unfortunately the radiometer positioner was damaged and no additional scans were executed.

Feb. 21, 2003:

The snow was removed in 4 steps, in the following order:



After one sector was removed, the scanfiles frzr09b9 and fraser07 were executed:

a) Complete Snow Cover - frzr09b9: 02211040, 02211108
b) Sector 1 removed - frzr09b9: 02211137, 02211156
c) Sector 2 removed: - frzr09b9: 02211213, 02211220
d) Sector 3 removed - frzr09b9: 02211244, 02211254
e) Sector 4 removed - frzr09b9: 02211133

Figure 6. Feb. 22, 2003: First sector removed

Figure 7. Feb. 22, 2003: Second sector removed

Figure 8. Feb. 22, 2003: Third sector removed

Figure 9. Feb. 22, 2003: Last sector removed

The layout of the measurement site for IOP3 and IOP4, in relation to other LSOS measurements, is shown in the following figure:

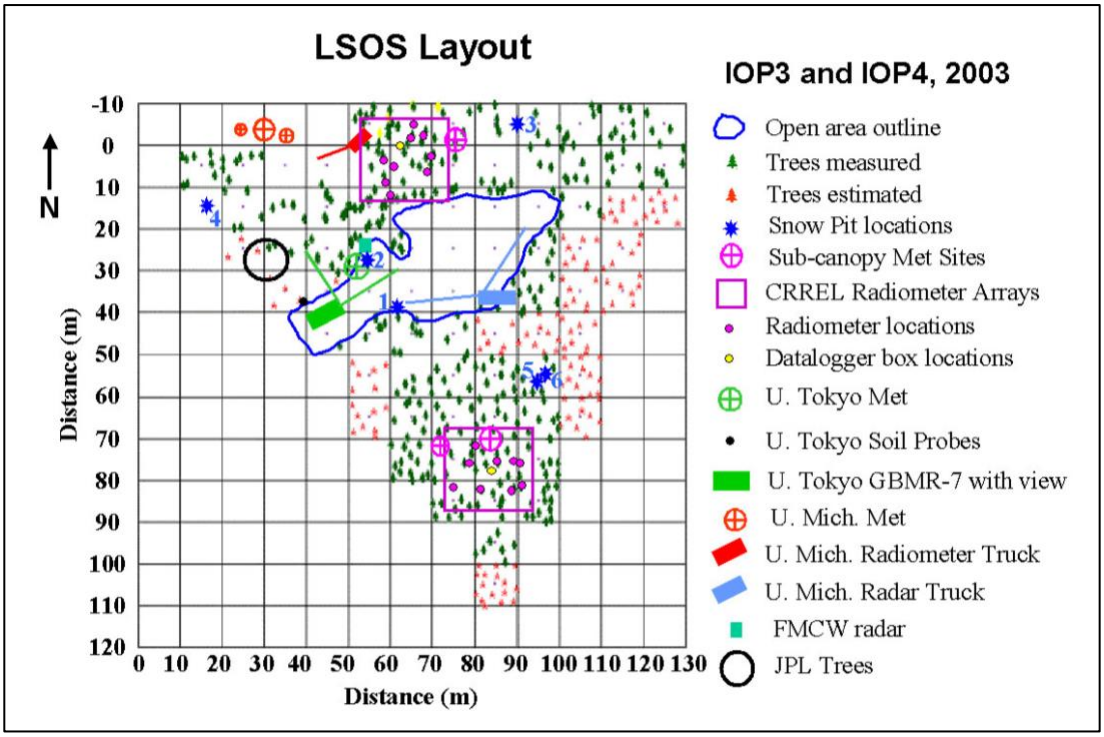


Figure 10. Layout of the measurement site for IOP3 and IOP4

2.2 Meteorological Data

Meteorological data were collected between 1 Oct 2002 and 29 Mar 2003, with a temporal resolution of 10 min (average).

Instrumentation:

Data Logger: Campbell Scientific, CR23X
Data Logger Support Software: Campbell Scientific, PC208W
Humidity & Temperature Probe: Vaisala, HMP45A & HMP45D
Windspeed & Wind Direction: Young, Model 05103
Pyrometer - Longwave Downward Radiation: EKO, MS-202F
Pyrometer - Shortwave Downward Radiation: EKO, MS-802F

Note: The air temperature sensor was not working correctly until 3 Feb 2003. The observed temperature values are too low, and often no value was recorded. As a counter-measure, the metal cover of the temperature sensor was replaced with a plastic cover. After 3 Feb the data seem to be better, but some of the values are still suspiciously low.

2.3 Soil Temperature & Soil Moisture Data

Instrumentation:

Soil Moisture: IMKO, TRIME-IT
Soil Temperature: Platinum Type Temperature Sensor (self-made)

Five soil temperature [deg. Celsius] and three soil moisture [%] sensors were installed at each of two different locations. Soil temperature depths were: surface, 1.5 cm, 5.0 cm, 10.0 cm, and 20.0 cm. Soil moisture was measured at 1.5 cm, 5.0 cm, 10.0 cm, and 20.0 cm.

2.4 Snow Pits

Several snow pits were surveyed throughout the winter. The data are quality controlled and follow the same format as the standard snow pit data (CLPX Snow Pit Measurements).

The snow pits are available for the following days:

2002: 3, 27 Nov, 11-15 Dec
2003: 4, 22 Jan, 2, 3, 6, 7, 9, 10, 21, 25 Feb, 11 Mar

Four different snow pit locations were selected. GPS location was recorded for each individual pit, but because of GPS inaccuracy, the location of the snow pits shown in Figure 1 is more accurate than the GPS data.

2.5 Quality Assessment

The following files were influenced by interference. They have been identified because unusual peaks in the data were observed during the measurement. Other investigators were working in the study area at the same time, operating active and passive microwave instruments. Discussions with these investigators about their measurements at these times confirm the interference.

```
Observed Interference at 18.7 GHz:
_________________________________
fraser10:
 Feb. 19 2003 - 15:15 (02191515.*)
 Feb. 19 2003 - 15:23 (02191523.*)
 Mar. 25 2003 - 10:56 (03251056.*)

frzr09b9:
 Feb. 21 2003 - 12:54 (02211254.*)

fraser07:
 Feb. 21 2003 - 13:03 (02211303.*)
 Mar. 25 2003 - 10:40 (03251040.*)

Observed Interference at 89 GHz:
_______________________________
fraser07:
 Feb. 23 2003 - 10:00 (02231000.*)
```

The air temperature sensor was not working correctly until 3 Feb 2003. The observed temperature values are too low, and often no value was recorded. As a counter-measure, the metal cover of the temperature sensor was replaced with a plastic cover. After 3 Feb the data seem to be better, but some of the values are still suspiciously low.

3 REFERENCES AND RELATED PUBLICATIONS

Kazama, S, T. Rose, and R. Zimmerman.1999. A Precision Autocalibrating 7ch Radiometer for Environmental Research Applications. Journal of The Remote Sensing Society of Japan 19(3): 37-45.

3.1 Related Data Collections

All CLPX Data Sets

4 CONTACTS AND ACKNOWLEDGMENTS

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