Sub-canopy Energetics at the CLPX Local Scale Observation Site (LSOS)

1 SUMMARY

This data set consists of data from two pine sites at the Local Scale Observation Site (LSOS) of the Cold Land Processes Experiment (CLPX) in northern Colorado. The LSOS is a 100 x 100-m study site located within the Fraser Intensive Study Area (ISA). The study area has flat topography with both a dense pine forest and an open pine forest. Parameters measured include sub-canopy incoming solar and longwave radiation, air temperature, relative humidity, wind speed, snow depth, and snow wetness. Data were collected during February and March, 2002 and 2003.

The NASA Cold Land Processes Experiment (CLPX) is a multi-sensor, multi-scale experiment that focuses on extending a local-scale understanding of water fluxes, storage, and transformations to regional and global scales. Within a framework of nested study areas in the central Rocky Mountains of the western United States, ranging from 1-ha to 160,000 km2, intensive ground, airborne, and spaceborne observations are collected. Data collection focuses on two seasons: mid-winter, when conditions are generally frozen and dry, and early spring, a transitional period when both frozen and thawed, dry and wet conditions are widespread.

2 CITING THESE DATA

Hardy, J., G. Koenig, D. Cline, K. Elder, R. Davis. 2002. Sub-canopy energetics at the CLPX Local Scale Observation Site (LSOS). Boulder, CO: National Snow and Ice Data Center.

3 OVERVIEW TABLE

Category	**Description**
data format	Microsoft Excel Spreadsheet
spatial coverage	100 x 100m in northern Colorado, US
temporal coverage and resolution	Midwinter and spring seasons, 2002
file size	20 to 4,500 KB
parameter(s)	Sub-canopy incoming solar radiation, longwave radiation, air temperature, relative humidity and wind speed. Snow wetness and snow depth surveys.

4 CONTACTS

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5 DETAILED DATA DESCRIPTION

5.1 Format

Data are stored in Microsoft Excel files.

Missing data are identified by "-999".

5.1.1 Sub-canopy meteorological data:

Meteorological data are available in Excel spreadsheet files, with a file extension of .xls. There are three met files (IOP1, March 2002, and IOP2) for the LSOS, with filenames of *met_iop1lsos.xls* and *met_200203lsos.xls*, and *met_iop2lsos.xls*, respectively.

Files named *met_iop1lsos.xls* and met_iop2lsos.xls contain three worksheets each, labeled **Dense Pine**, **Open Pine**, **Tree 21**. The *met_iop* files contain the following fields in the **Dense Pine** worksheet:

```
Column 1: YEAR, 4 digit year
Column 2: DOY - Day of Year
Column 3: TIME - hhmm
Column 4: WS - Mean Horizontal Wind Speed, averaged over previous time step.
               Units in meters per second.
Column 5: WD - Mean Wind Direction, averaged over previous time step.
               Units in degrees.
Column 6: PSP1.adj - Mean incoming solar radiation averaged over previous time
                     step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 7: PSP2.adj - Mean incoming solar radiation averaged over previous time
                     step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 8: PSP3.adj - Mean incoming solar radiation averaged over previous time
                     step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 9: PSP4.adj - Mean incoming solar radiation averaged over previous time
                     step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 10: PSP5.adj - Mean incoming solar radiation averaged over previous time
                      step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 11: PSP6.adj - Mean incoming solar radiation averaged over previous time
                      step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 12: PSP7.adj - Mean incoming solar radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 13: PSP8.adj - Mean incoming solar radiation averaged over previous time
                      step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 14: PSP9.adj - Mean incoming solar radiation averaged over previous time
                      step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 15: PSP10.adj - Mean incoming solar radiation averaged over previous
                       time step and adjusted for recalibrated radiometer in July 2002.
                       Units are Watts per meter squared.
Column 16: PIR2.adj - Mean incoming longwave radiation averaged over previous time
                      step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 17: PIR3.adj - Mean incoming longwave radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 18: Mean Air Temperature averaged over previous time step. Units in degrees Celsius.
Column 19: Mean Relative Humidity averaged over previous time step. Units are percent.
Column 20: Battery Voltage sampled at time step. Units are voltage.
```

The *met_iop* files contain the following fields in the **Open Pine** worksheet:

```
Column 1: YEAR, 4 digit year
Column 2: DOY - Day of Year
Column 3: TIME - hhmm
Column 4: PSP1.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 5: PSP2.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 6: PSP3.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 7: PSP4.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 8: PSP5.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 9: PSP6.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 10: PSP7.adj - Mean incoming solar radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 11: PSP8.adj - Mean incoming solar radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 12: PSP9.adj - Mean incoming solar radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 13: PSP10.adj - Mean incoming solar radiation averaged over previous
                       time step and adjusted for recalibrated radiometer in July 2002.
                       Units are Watts per meter squared.
Column 14: PIR1.adj - Mean incoming longwave radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 15: PIR2.adj - Mean incoming longwave radiation averaged over previous
                      time step and adjusted for recalibrated radiometer in July 2002.
                      Units are Watts per meter squared.
Column 16: Battery Voltage sampled at time step. Units are voltage.
```

The *met_iop* files contain the following fields in the **Tree 21** worksheet:

```
Column 1: YEAR, 4 digit year
Column 2: DOY - Day of Year
Column 3: TIME - hhm
Column 4: Battery Voltage sampled at time step. Units are voltage.
Column 5: Matrix0 - Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 6: Matrix1- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 7: Matrix2- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 8: Matrix3- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 9: Matrix4- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 10: Matrix5- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 11: Matrix6- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 12: Matrix7- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 13: Matrix8- Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 14: Matrix9 Mean incoming solar radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 15: K&Z 1 - Mean incoming longwave radiation averaged over previous
                    time step. Units are Watts per meter squared.
Column 16: K&Z 2 - Mean incoming longwave radiation averaged over
                    previous time step. Units are Watts per meter squared.
```

The file named *met_200203lsos.xls* contains one worksheet labeled **Dense Pine**. The data provided in column 6 (PSP 1.adj) are NOT quality controlled in terms of deleting (or flagging) data when the pyranometer is snow-covered as no-one was on site during this period to keep the pyranometers clear of snow.

```
Column 1: YEAR, 4-digit year
Column 2: DOY - Day of Year
Column 3: TIME - hhmm
Column 4: WS - Mean Horizontal Wind Speed, averaged over previous
               time step. Units in meters per second.
Column 5: WD - Mean Wind Direction, averaged over previous time step. Units in degrees.
Column 6: PSP1.adj - Mean incoming solar radiation averaged over previous
                     time step and adjusted for recalibrated radiometer in July 2002.
                     Units are Watts per meter squared.
Column 7: Mean Air Temperature averaged over previous time step. Units in degrees Celsius.
Column 8: Mean Relative Humidity averaged over previous time step. Units are percent.
Column 9: Battery Voltage sampled at time step. Units are voltage.
```

5.1.2 Snow Depth Survey Data

Snow depth data are available in Microsoft Excel files, with a file extension of .xls. There are three snow survey files for IOP1 and IOP2 with filenames *depth_DATElsos.xls*, where:

DATE = date in YYYY_MM_DD
.xls = Excel extension

Each file has three "worksheets" labeled: **Dense Pine**, **Open Pine**, and **Snow Pits**.

All three surveys were conducted by walking along established paths in the same order each time. In the dense pine site, the snow survey begins at the met tower and radiates out to each radiometer in approximately 1 m intervals. After measuring snow depths along the path to each radiometer, then we measured depth along a west to east traverse and a north to south traverse. In the open pine site we measured snow depths radial from the central datalogger box, along the paths to each radiometer. Finally, measures of snow depth were made along the path toward Tree 21. At each of the six snow pit locations a measure of at least ten snow depths were made during each survey.

Snow Depth Transect Files

Snow depth transect files contain measures of snow depth in centimeters with column headings identifying the path where measurements were made.

5.1.3 Snow Wetness Data

Snow wetness data are available in a Microsoft Excel files, with a file extension of *.xls*. There is one snow wetness file, with separate workbooks for IOP1 and IOP2, with a filename of *wetness_2002lsos.xls*

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.

Snow Wetness File:

```
Column A: Location of measurement (pit #). Letter next to pit number refers to the
          date the snow pit was measured and corresponds to submitted snow pit data.
Column B: Date in MM/DD/YYYY format
Column C: Time of measurement in 2400-hour time.
Column D: Depth the moisture sensing plate was inserted into the snow pit wall.
          Depth in centimeters. The Denoth moisture meter senses snow moisture 3 cm
          above and below sensor plate so a measurement at a depth of 10 cm provides
          information on the snow moisture between 7-13 cm.
Column E: Measured snow density in grams per cubic centimeter.
Column F: Snow wetness as measured and calculated from the Denoth snow wetness
          meter. Snow wetness is in percent.
```

5.2 Spatial Coverage

Schematic diagram of the nested study areas for the CPLX

Study area map

Location of MSAs

The LSOS study site is a single, 1-ha study site located within the Fraser ISA, near the Fraser Experimental Forest Headquarters Facility. At this 100 m x 100 m site, intensive ground observations of snow, soil, and vegetation are made in conjunction with stationary, ground-based

microwave remote sensing (active and passive) and micrometeorological observations. The site consists of two open meadows separated by a stand of short trees. Ground-based remote sensors will have an opportunity to view both a homogeneous area of open snow cover, and a homogenous stand of forest cover. At this scale, where spatial variability is relatively low, microwave remote sensing data, radiative-transfer models, detailed physical models of energy and mass balance of snow and the underlying soil, and ground observations can be most easily related to each other. Here, physical models and remote sensing retrieval algorithms can be evaluated with little ambiguity, and confidence levels can be established at the scale of our current understanding of important physical processes.

5.3 Temporal Coverage

The experiment is being conducted between the Fall of 2001 and the Spring of 2003. Two intensive observation periods (IOPs) will be conducted each year: one during a dry period (February) and one during a wet period (March). The IOPs will be conducted on the same day-of-year (DOY) schedule each year.

IOP1 took place between February 19 and February 24, 2002.

MSA	Scheduled Observation Period	Actual Observation Period
Fraser	19-20 February 2002	Snow depth data collected 19-20 Feb. Snow pit data collected 20 Feb
North Park	21-22 February 2002	Snow depth and snow pit data collected 21 Feb. Additional snow pit data across the MSA (coincident with the Gamma overflights) were collected 22 Feb.
Rabbit Ears	23-24 February 2002	Snow depth data collected 23 Feb. Snow pit data collected 24 Feb.

IOP2 took place 25 March through 30 March 2002.

MSA	Scheduled Observation Period	Actual Observation Period
Fraser	25-26 March 2002	Snow depth data collected 25-26 March. Snow pit data collected 26 March
North Park	27-28 March 2002	Snow depth and snow pit data collected 27 March. Additional snow pit data across the MSA were collected 28 March
Rabbit Ears	29-30 March 2002	Snow depth data collected 29 March. Snow pit data collected 30 March.

5.4 Parameter or Variable

5.4.1 Parameter Description

Measurements at the LSOS include daily in-situ sampling of snow, soil, and vegetation characteristics at several locations within a fenced area. Snow and soil measurements include snow and soil pits, snow depth probing, and snow/soil interface temperature probing. The stem and canopy temperature, and xylem flux of several trees within the area is also monitored. Two micrometeorological towers, one located in the open snow area and the other in the forested area, monitor ambient conditions and provide forcing data sets for 1-D snow/soil models. These measurements, together with the ground-based remote sensing, will provide the framework for evaluating and improving microwave radiative transfer models and coupling them to land surface models.

For a complete description of parameters and measurements, please refer to the Measurements section of the CLPX Plan
at http://www.nohrsc.noaa.gov/~cline/clp/field_exp/clpx_plan/chapters/CLPX_plan_chap4.htm

6 DATA ACCESS AND TOOLS

6.1 Data Access

Data are available via FTP to CLPX investigators.

7 DATA ACQUISITION AND PROCESSING

For complete information about data acquisition and processing, please see the Cold Land Processes Field Experiment (CLPX) Plan Web Site.

8 REFERENCES AND RELATED PUBLICATIONS

Please see the References section of the CLPX Plan.

9 DOCUMENT INFORMATION

9.1 Document Creation Date

2002-11-15