CLPX-Ground: Sub-Canopy Energetics 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., T. Link, D. Marks, R. A. Melloh, G. Koenig, and K. Elder. 2002. *CLPX-Ground: Sub-Canopy Energetics 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/10.5067/5E0JEZFRBBIO. [Date Accessed].

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

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National Snow and Ice Data Center

TABLE OF CONTENTS

1 DETAILED DATA DESCRIPTION

This work addresses two of the overall CLPX questions: (1) How do the extent and evolution of snow and frozen landscapes affect fluxes, storage, and transformations of water, energy, and carbon? (2) At what scales does spatial variability of key state variables in the cryosphere (including snow characteristics, soil moisture, the extent of frozen soils, and the transition between frozen and thawed conditions) control fluxes and transformations of water, energy, and carbon, and can remote sensing resolve this variability at these scales?

1.1 Format

Radiation and tree data are stored as tab-delimited ASCII files (missing data are identified by "-999").

Photos are provided as JPEG and GIF files.

Meteorological data are provided as comma-separated ASCII files for 2003 (missing data are "-99"), and tab-delimited ASCII files for 2002 (missing data are "0").

1.1.1 Tree Data

There is one ASCII text file containing tree characteristics, including individual tree locations and structure data from the uniform and discontinuous pine sites (`LSOS_TreeCharacteristics_Hardy.txt`). This file has the following column headers:

Quadrant
GROUP_NUMB
MARKED (x or yes)
Species (llp, es, sf, or qas)
Location X
Location Y
Tree Height (m)
DBH - diameter at breast height (m)
Height of crown base (m)
Crown Diameter (m)

The list of 358 trees (November and March data) has been sorted by Quadrant (Figure 2), and then by x-location within the Quadrant. The following abbreviations are used for tree species:

LPP = Lodgepole Pine (Pinus contorta)
ES = Englemann Spruce (Picia engelmanni)
SF = Subalpine Fir (Abies lasiocarpa)
QAS = Quaking Aspen (Populus tremuloides)

The following figure shows the tree characteristics for this study. Not every tree parameter was measured and recorded in November 2001. Instead, the characteristics of a tree were measured and the researchers either lumped the tree with a previously measured tree with similar characteristics, or marked the tree as unique in characteristics. For example, if an LLP was 13 m tall, had a crown diameter of 3.8 m, and a DBH of 0.2 m, and was within approximately 5% of a previously measured tree, then this LLP was recorded as having the same characteristics of the previously measured tree. This resulted in some trees having identical characteristics and other trees only showing partially measured parameters. In March 2002, characteristics were measured for all trees.

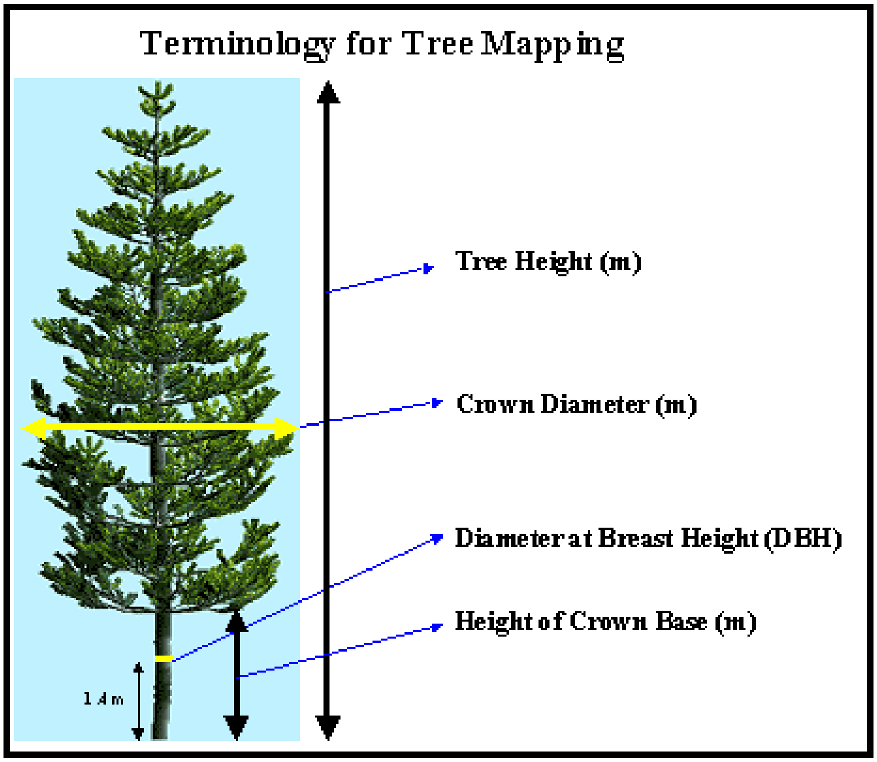

Figure 1. Tree Characteristics

Photo files include 51 digital images of pine trees taken from unique locations in the study area, at a 45-degree zenith angle (in JPEG format), and 54 hemispherical photographs of pines taken looking up from unique locations (in GIF format). Locations are identified in the filenames.

1.1.2 Radiation Data

There are three radiation files each for IOP1 and IOP2: one each for the dense (uniform) pine stand, the open (discontinuous) pine stand, and for Tree 21. Tree 21 is a specific tree sampled during both IOP1 and IOP2, but not sampled during IOP3 or IOP4. There are two files each for IOP3 and IOP4: one each for the uniform pine stand and the discontinuous pine stand.

The **Uniform** canopy files contain the following fields:

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 (W/m2)
Column 5: PSP2.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 6: PSP3.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 7: PSP4.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 8: PSP5.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 9: PSP6.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 10: PSP7.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 11: PSP8.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 12: PSP9.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 13: PSP10.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 14: PIR2.adj – Mean incoming longwave radiation averaged over previous time step(W/m2).
Column 15: PIR3.adj – Mean incoming longwave radiation averaged over previous time step (W/m2)
Column 16: Battery Voltage sampled at time step. Units are voltage (in IOP3 and IOP4 data files only)

The **Discontinuous** canopy files contain the following fields:

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 (W/m2)
Column 5: PSP2.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 6: PSP3.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 7: PSP4.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 8: PSP5.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 9: PSP6.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 10: PSP7.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 11: PSP8.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 12: PSP9.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 13: PSP10.adj – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 14: PIR1.adj – Mean incoming longwave radiation averaged over previous time step (W/m2)
Column 15: PIR2.adj – Mean incoming longwave radiation averaged over previous time step (W/m2)
Column 16: Battery Voltage sampled at time step. Units are voltage

The **Tree 21** files contain the following fields:

Column 1: YEAR, 4-digit year
Column 2: DOY – Day of Year
Column 3: TIME – hhmm

Column 4: Battery Voltage sampled at time step. Units are voltage
Column 5: Matrix 0 – Mean incoming solar radiation averaged over previous time step (W/m2)
Column 6: Matrix 1 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 7: Matrix 2 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 8: Matrix 3 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 9: Matrix 4 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 10: Matrix 5 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 11: Matrix 6 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 12: Matrix 7 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 13: Matrix 8 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 14: Matrix 9 – Mean incoming solar radiation averaged over previous time step(W/m2)
Column 15: K&Z 1 – Mean incoming longwave radiation averaged over previous time step(W/m2)
Column 16: K&Z 2 – Mean incoming longwave radiation averaged over previous time step(W/m2)

1.1.3 Meteorological Data

There are five meteorological files. The two comma-separated (.csv) files contain data collected at meteorology towers within the LSOS (one in the open pine area, and one in the dense pine area) between February and May 2003. These data include snow depth; snow temperature; soil temperature; soil heat flux; infrared temperatures of the snow surface, tree trunk surface, and forest canopy; hypodermic thermocouple temperatures of four sides of tree trunks (N,S,E, & W); and air temperature, relative humitidy, wind speed, and wind direction.

The comma-separated meteorological files contain the following fields:

year = 4-digit year
month = 2-digit month
day = 2-digit day of month
hour = 2-digt (24-hr) hour
minute = 2-digit minute
snowdepth = Judd sensor snowdepth (cm)
rft = Thermocouple reference junction temperature (C)
wnd2s = 2-D Sonic anemometer resultant wind speed at 2 m, averaged (m/s)
wnd2d = 2-D Sonic anemometer resultant wind direction at 2 m, instantaneous (deg. N)
wnd0_5s = 2-D Sonic anemometer resultant wnd speed at 0.5 m, averaged (m/s)
wnd0_5d = 2-D Sonic anemometer resultant wind direction at 0.5 m, instantaneous (deg. N)
tmp2a = Vaisala air temperature at 2 m, averaged (C)
hum2a = Vaisala relative humidity at 2 m, averaged (%)
tmp0_5a = Vaisala air temperature at 0.5 m, averaged (C)
hum0_5a = Vaisala relative humidity at 0.5 m, averaged (%)
tmp2ij = Judd sensor air temperature (C)
irt1 = Exergen infrared temperature of tree trunk surface (C)
irt2 = Exergen infrared temperature of snow surface (C)
irt3 = Exergen infrared temperature of forest canopy (C) (not used in open pine area)
hypN = Type T hypodermic thermocouple temperature, north side of tree trunk (C)
hypE = Type T hypodermic thermocouple temperature, east side of tree trunk (C)

hypS = Type T hypodermic thermocouple temperature, south side of tree trunk (C)
hypW = Type T hypodermic thermocouple temperature, west side of tree trunk (C)
shf1 = HFT 3.1 soil heat flux plate at 2 cm (Wm-2)
shf2 = HFT 3.1 soil heat flux plate at 2 cm (Wm-2)
stm015 = CS107 soil temperature at 15 cm (C)
stm030 = CS107 soil temperature at 30 cm (C)
vltd = Voltage of DAS battery (V)
snt020 = Type T thermocouple snowpack temperature at 20 cm above soil surface (C)
snt040 = Type T thermocouple snowpack temperature at 40 cm above soil surface (C)
snt060 = Type T thermocouple snowpack temperature at 60 cm above soil surface (C)
wnd2dd = 2-D Sonic anemometer resultant wind direction at 2 m, standard deviation (deg. N)

The three tab-delimited ASCII files contain wind speed, wind direction, air temperature, and relative humidity data collected within the LSOS during February and March 2002.

Additional meteorological data are in preparation. Please contact Danny Marks at the USDA Agricultural Research Service for information about, and access to, these data.

1.2 File and Directory Structure

Tree characteristics data, radiation data, and meteorological data are provided in one compressed (tarred and zipped) file, lsos_energetics_data.tgz. When uncompressed, this file yields

1. Tree data in one ASCII file: `LSOS_TreeCharacteristics_Hardy.txt.`
2. Radiation files in ASCII for the uniform and discontinuous pine areas for each IOP, and for Tree 21 in IOP1 and IOP2 only
3. Meteorological data in ASCII from meteorology towers in the LSOS.

Photos are in two directories: one for digital photos (`45_Photos/`) and one for hemispherical photos (`Hemi_Photos/`).

1.3 File Naming Convention

Tree data are in one ASCII file, named `LSOS_TreeCharacteristics_Hardy.txt`.

Digital photo files are named `LSOS_45_ XXXXXX_Hardy.jpg`, where 45 represents the zenith angle of the photo, and XXXXXX is a unique position location in the study area (e.g., E50S70).

Hemispherical photos are named `LSOS_Hem_XXXXXX_Hardy.gif`, where XXXXXX is a unique position location in the study area (e.g., E50S70).

Radiation files are named `Rad_discont_IOP#_Hardy.txt, Rad_uniform_IOP#_Hardy.txt`, and `Rad_tree21_IOP#_Hardy.txt`, where # is the IOP number.

Meteorological files are named *densepine.csv* and *openpine.csv*, and `Met_uniform_IOP1_Hardy.txt`, `Met_uniform_IOP2_Hardy.txt`, and `Met_uniform_March02_Hardy.txt`.

1.4 File Size

Photo files range in size from 18 to 126 KB. Radiation data files range in size from 79 to 209 KB. The tree characteristics file is 15 KB. Meteorological files range in size from 54 KB to 1.43 MB.

1.5 Spatial Coverage

Radiation and meteorological measurements were conducted at the CLPX LSOS study site, a 100 x 100 m site located within the Fraser Intensive Study Area (ISA). The triangular LSOS consists of a small clearing, a managed uniform pine canopy, and a discontinuous, mixed age canopy. The LSOS was divided into 78 plots, each 10 x 10 m, and in 62 of the plots, the individual tree locations were mapped and linked to measurements of their structure.

The uniform pine site consists of lodgepole pine trees with an average height of 12.4 m (standard deviation = 2.5 m; n = 88) and relatively uniform spacing between trees. Trees in the discontinuous site are of mixed species [predominantly lodgepole pine with some Englemann Spruce (*Picia engelmannii*) and Subalpine Fir (*Abies lasiocarpa*) with an average tree height of 7.8 m (standard deviation = 4.8 m; *n* = 88) and heterogeneous spacing between trees.

Ten pyranometers (PSPs) and two pyrgeometers (PIRs) were positioned in each pine stand. Pyranometer locations within each canopy type were different for 2002 and 2003, allowing for 40 unique radiometer locations. The locations of the pyranometers represented the variability of solar receipt, in that some were placed adjacent to a tree stem in different cardinal directions, while others were located beneath small canopy gaps.

Meteorological measurements were taken at three meteorology towers: one in the discontinuous pine area and two in the uniform pine area.

1.5.1 Spatial Coverage Map

The following map shows the 78 numbered quadrants in the LSOS. Green marks represent the location of measured trees, and the red marks represent the estimated location of trees.

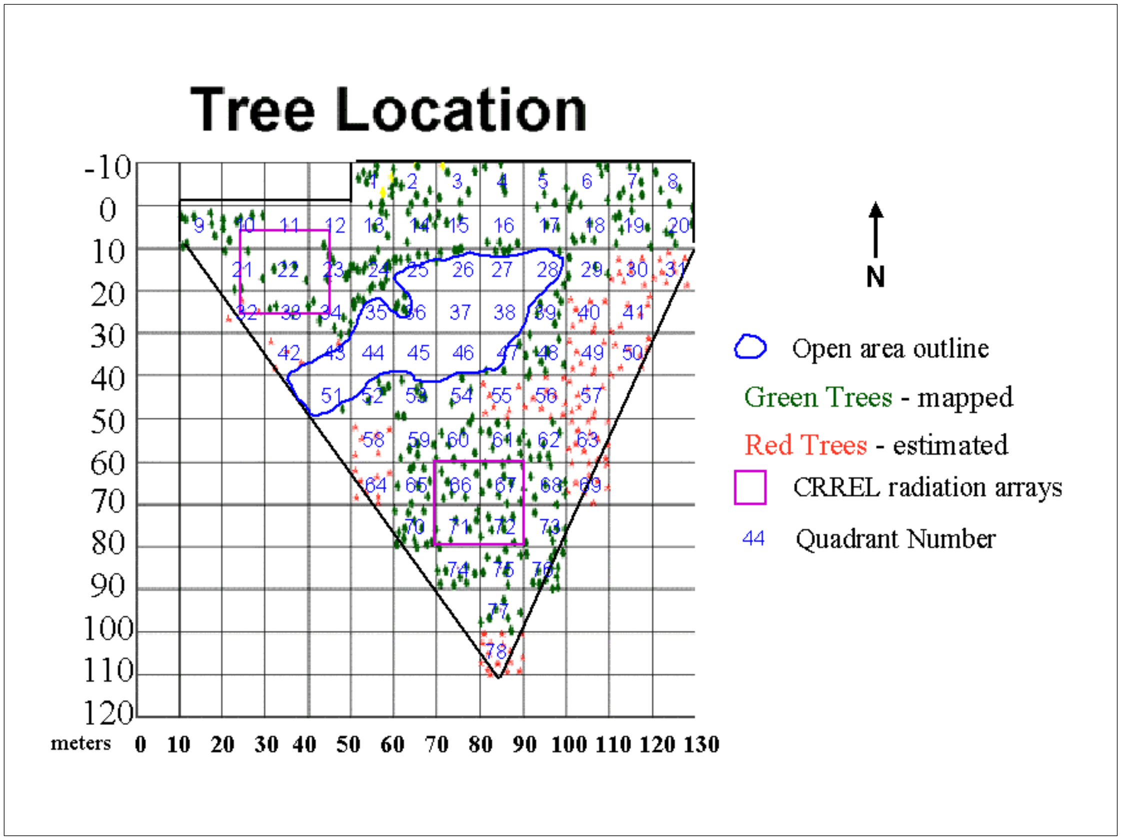

Figure 2. LSOS Tree Locations

The general layout of the LSOS during IOP3 and IOP4 (2003) is shown below.

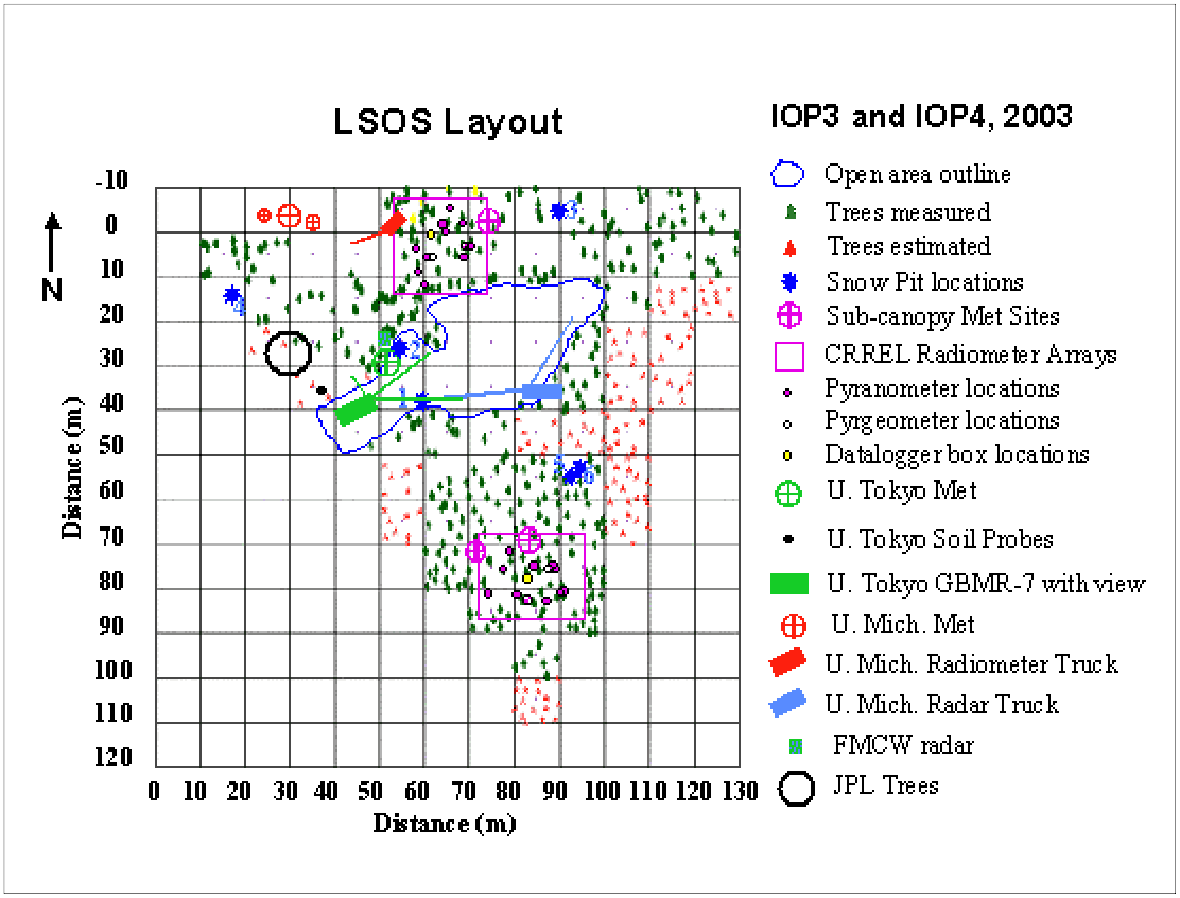

Figure 3. LSOS Layout in IOP3 and IOP4 (2003)

The following are two expanded views of radiometer locations in the discontinuous (Figure 4) and uniform (Figure 5) pine sites. Black numbers next to the pyranometers (purple circles) refer to the PSP# identifier. Purple numbers next to the pyrgeometers (purple & white circles) refer to the PIR# identifier. Each plot has 10 PSPs and 2 PIRs. The met towers are shown by purple circles with crosshairs. The comma-separated meteorological data files contain data that were collected at the right (eastern) tower in Figure 5, and the tab-delimited meteorological data files contain data collected at the left (western) tower in Figure 5.

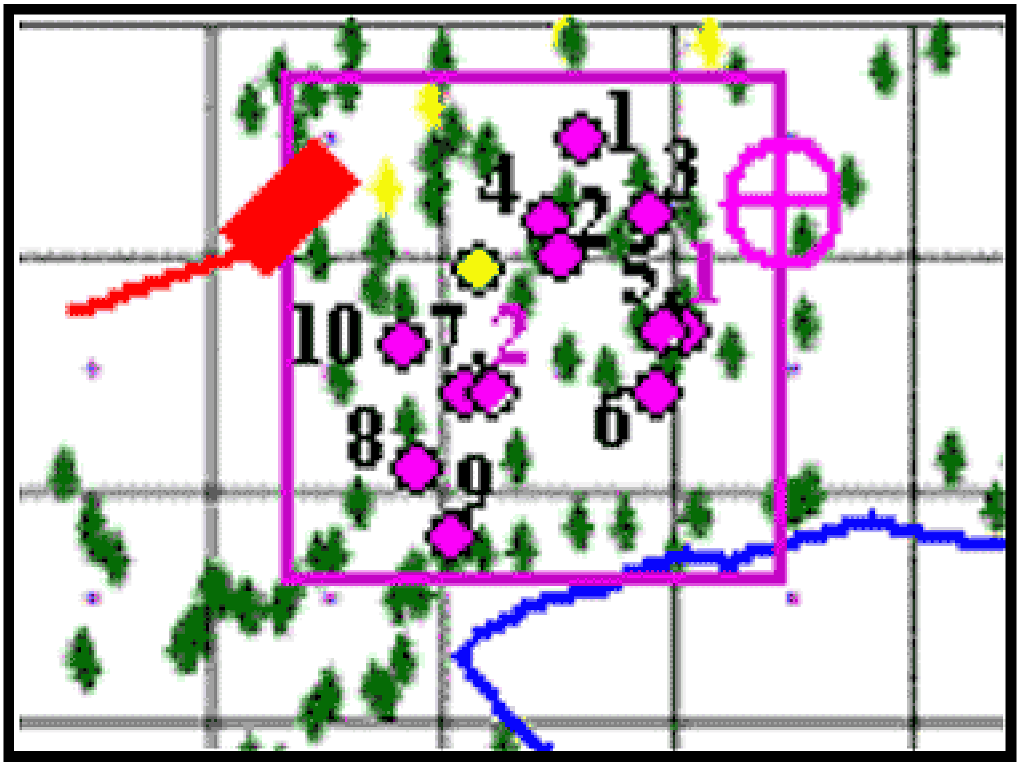

Figure 4. Radiometer locations in the discontinuous pine sites.

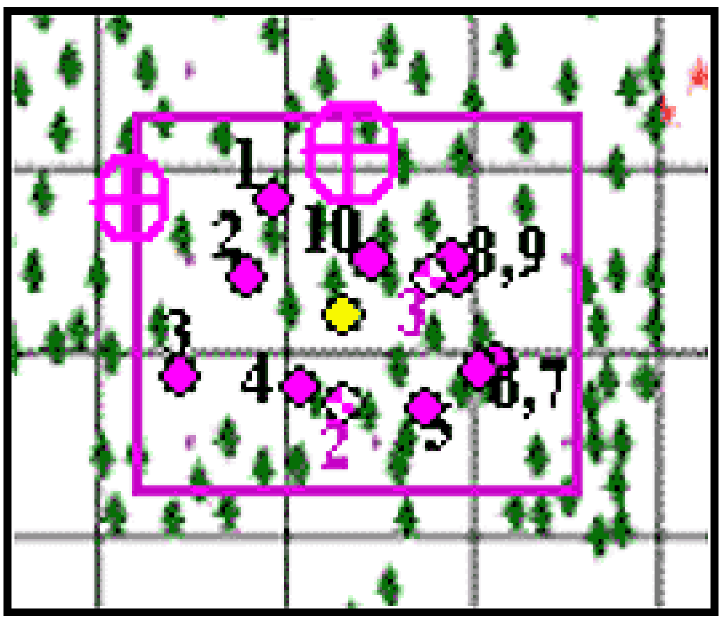

Figure 5. Radiometer locations in the uniform pine sites.

1.6 Temporal Coverage

Measurements of tree characteristics were made in November 2001 and March 2002, but data represent tree characteristics for the entire CLPX. Hemispherical and digital photographs were taken in November 2001.

Radiometer measurements were taken during IOPs 1, 2, 3, and 4 in 2002 and 2003:

IOP1: 17-23 February 2002
IOP2: 23-31 March 2002
IOP3: 17-24 February 2003
IOP4: 25-31March 2003

Meteorological data were collected 17-23 February and 22-29 March 2002 (IOP1 and IOP2), and 2 February to 26 May 2003 (including IOP3 and IOP4).

1.7 Parameter or Variable

Tree measurements include characteristics of individual trees [location, species, height, diameter at breast height (DBH), maximum diameter of the crown, and height of lowest part of the canopy].

Radiation measurements at the LSOS include sub-canopy incoming solar radiation and longwave radiation.

Meteorological parameters include snow depth; snow temperature; soil temperature; soil heat flux; infrared temperatures of the snow surface, tree trunk surface, and forest canopy; hypodermic thermocouple temperatures of four sides of tree trunks (N,S,E, and W); and air temperature, relative humidity, wind speed, and wind direction.

1.8 Quality Assessment

1.8.1 Radiation Data

The following lists give actions taken during data collection to ensure the quality of the radiation data, by date (such as clearing the radiometers of accumulated snow).

IOP1 Uniform Pine (formerly “Dense Pine”)
Day 49 at 1135 radiometers cleared of about 2 cm new snow
Day 50 at 0830 radiometers cleared of about 5 cm new snow
Day 51 at 0830 radiometers cleared of about 7 cm new snow
Day 51 at 0915 radiometers cleared of new snow
Day 52 at 0830 radiometers cleared of frost
Day 53 at 0840 radiometers cleared of frost
Day 54 at 0830 radiometers cleared of frost

IOP1 Discontinuous Pine (formerly “Open Pine”)
Day 50 at 0840 radiometers cleared of about 5 cm new snow
Day 51 at 0830 radiometers cleared of about 7 cm new snow
Day 51 at 1000 radiometers cleared of new snow
Day 52 at 0815 radiometers cleared of frost

Day 53 at 0835 radiometers cleared of frost
Day 54 at 0830 radiometers cleared of frost

IOP1 Tree 21
Day 50 at 1525 radiometers leveled and cleared of snow
Day 51 at 0830 radiometers cleared of about 7 cm new snow
Day 51 at 0930 radiometers cleared of new snow
Day 52 at 0820 radiometers cleared of frost
Day 53 at 0850 radiometers cleared of frost

IOP2 Uniform Pine
Day 84 at 0800 radiometers cleared of snow
Day 85 at 0755 radiometers cleared of 2 cm snow
Day 86 at 0800 radiometers cleared of 1.5 cm snow

IOP2 Discontinuous Pine
Day 84 at 0800 radiometers cleared of snow
Day 85 at 0745 radiometers cleared of 2 cm snow
Day 86 at 0750 radiometers cleared of 1.5 cm snow

IOP2 Tree 21
Day 84 at 0945 radiometers cleared of snow
Day 85 at 0750 radiometers cleared of 2 cm snow
Day 86 at 0755 radiometers cleared of 1.5 cm snow

IOP3 Uniform Pine
Day 48 at 0855 radiometers cleared of about 10 cm new snow
Day 48 at 0920 PIR batteries changed
Day 48 at 1120 radiometers cleared of dusting new snow
Day 50 at 0855 radiometers cleared of some frost
Day 51 at 0815 radiometers cleared of some frost
Day 51 at 1125 program change on P2 instruction, line 2
Day 52 at 0900 radiometers cleared of ~ 4 cm snow
Day 52 at 1220 radiometers cleared of dusting snow
Day 53 at 0830 radiometers cleared of ~15 cm snow
Day 53 at 1030 radiometers cleared of snow
Day 53 at 1510 radiometers cleared of snow
Day 54 at 0815 radiometers cleared of ~10 cm snow
Day 55 at 0910 radiometers cleared of ~10 cm snow
Day 55 at 1230 radiometers cleared of dusting snow
Day 55 at 1645 end data collection

IOP3 Discontinuous Pine
Day 50 at 0830 radiometers cleared of some frost
Day 51 at 0800 radiometers cleared of some frost
Day 51 at 0945 program change on P2 instruction, line 2
Day 52 at 0850 radiometers cleared of ~ 4 cm snow
Day 52 at 1210 radiometers cleared of dusting snow

Day 53 at 0815 radiometers cleared of ~15 cm new snow
Day 53 at 1020 radiometers cleared of new snow
Day 54 at 0805 radiometers cleared of ~10 cm new snow
Day 55 at 0855 radiometers cleared of ~10 cm new snow
Day 55 at 1230 radiometers cleared of dusting snow
Day 55 at 1735 end data collection

IOP4 Uniform Pine
Day 84 at 0930 first set of complete measurements
Day 86 at 0900 radiometers cleared of ~10 cm snow
Day 87 at 0820 radiometers cleared of ~1 cm snow
Day 88 at 0825 radiometers cleared of dusting of snow and a touch of frost
Day 89 at 0820 radiometers cleared of ~2cm snow
Day 90 at 1220 end data collection

IOP4 Discontinuous Pine
Day 84 at 0830 first set of complete measurements
Day 86 at 0845 radiometers cleared of ~10 cm snow
Day 87 at 0810 radiometers cleared of ~1 cm snow - domes not covered
Day 88 at 0815 radiometers cleared of a dusting of snow and a touch of frost
Day 89 at 0835 radiometers cleared of ~2cm snow
Day 89 at 1800 end data collection for most radiometers
Day 90 at 1125 end data collection for all radiometers

1.8.2 Meteorological Data

1.8.2.1 Open Pine Site, Fraser (openpine.csv)

All numeric values that were ±6999 were set to missing.

Wind direction, wind speed and standard deviation of wind speed were treated as follows:

- When standard deviation of wind speed was 0 (a good diagnostic that the sonic anemometer was not properly functioning),
- then the wind direction, wind speed, and standard deviation of wind speed values were set to missing
- When the wind direction was 0, the value was set to missing
- When wind speed was < 0, then both wind speed and direction were set to missing
- When the absolute difference of the 0.5 m and 2 m wind speed was > 5, then the 2 m wind speed was set to missing
- The last valid values for the 0.5 m wind speed and direction was before 31Mar03:11:30 MST

Snow depth was set to missing if it was > 125 cm or < -5 cm. The last valid value for snow depth was before 22Feb03:12:45. A single lag difference of a 15-point, centered, moving average was calculated and if greater than 2 cm, then snow depth was set to missing. These values were all chosen by inspecting the record and determining which values would best filter erroneous records while mostly preserving the integrity of the original record.

All of the other measured parameters were evaluated, but no modifications were required.

1.8.2.2 Dense Pine Site, Fraser (densepine.csv)

All numeric values that were ±6999 were set to missing.

Wind direction, wind speed and standard deviation of wind speed were treated as follows:

- When standard deviation of wind speed was 0 (a good diagnostic that the sonic anemometer was not properly functioning),
- then the wind direction, wind speed, and standard deviation of wind speed values were set to missing
- When the wind direction was 0, the value was set to missing
- When wind speed was < 0, then both wind speed and direction were set to missing
- When the absolute difference of the 0.5 m and 2 m wind speed was > 5, then the 2 m wind speed was set to missing

Snow depth was set to missing if it was > 150 cm or < -5 cm. The last valid value for snow depth was before 22Feb03:12:45. A single lag difference of a 15-point, centered, moving average was calculated and if greater than 2 cm, then snow depth was set to missing. These values were all chosen by inspecting the record and determining which values would best filter erroneous records while mostly preserving the integrity of the original record. There were three additional records that the above method failed to capture, which were determined to be erroneous and were set to missing. They occurred on 22Feb03:0115, 27Feb03:0000 and 27Mar03:1250 MST.

All of the other measured parameters were evaluated, but no modifications were required.

2 DATA ACQUISITION AND PROCESSING

Tree height and the height of crown base were measured using a Laser Technology, Inc. Impulse Laser Rangefinder with a range accuracy of 3 cm. Crown diameter and DBH were measured using a measurement tape according to standard forestry practices.

Digital photos were taken were taken over the grid at a staggered 20 m interval, looking south, using a Kodak DC240 Zoom camera. An inclinometer was used to approximate the 45-degree zenith angle position of the camera. The camera was mounted on a tripod at approximately 1 m height. The photographs were taken over a period of several days in early November 2001 during which sky conditions were clear. The purpose of these photos was to visualize the canopy interception of the sun track to the south.

Hemispherical photographs were taken approximately 1 m above each of the 40 different radiometer locations at a staggered 20 m interval with a Nikkor 8-mm f/2.8 hemispherical lens (180° field of view) with an integral red filter and were analyzed with Gap Light Analyzer (GLA) software, developed by Frazer. The lens was mounted on a Nikon FM2 35-mm camera body with data back for recording print numbers on the film. The camera was mounted on a tripod at an approximate height of 1 m and oriented such that north corresponded to the top of the photograph. The photographs were taken over a period of several days in early November 2001 during which sky conditions were clear. Photographs were taken at dusk and dawn to avoid light reflections of direct sunlight from the canopy that could be confused with sky. The top of the camera was oriented north and black and white TMAX 400 ASA film was used. The negatives were digitized with a Noritzu scanner. Once digitized, the images were “flipped” east-west to account for real versus camera orientation. The investigators found good agreement between measured and GLA-predicted transmissivities (r2 = 0.86) when all data from both years were considered. Transmission factors derived from hemispheric photos and GLA software can be used to specify the distribution of solar flux under a canopy, instead of direct solar flux measurements, without degradation in snow model melt predictions.

Incoming global solar radiation was measured at the snow surface beneath the discontinuous and the uniform canopies using arrays of 10 upward looking pyranometers at each site. The arrays consisted of Eppley Precision Spectral Pyranometers (PSP, 0.3- to 3.0- m m wavelength, 160 ° sky view, 5% accuracy), placed on the snow surface in the forest stand. A Campbell Scientific CR10 datalogger was programmed to measure irradiance every 10 seconds and output 5-minute averages. Pyranometers were labeled PSP1 through PSP10. Each pyranometer sat on a small piece of 0.06-m-thick foam to provide stability on the snow surface; the instrument level was checked daily. Every morning, and throughout the day, as necessary, all pyranometers were cleared of any accumulated snow or frost, and the time of clearing noted. An Eppley Precision Infrared Radiometer (pyrgeometer, PIR) was also deployed in the LSOS.

A meteorological tower was erected in a small clearing near the LSOS. Data collection was on-going starting in February 2002. Standard meteorological data (air temperature, relative humidity, wind speed) were measured at this site at several heights and stored on a Campbell Scientific datalogger. Additionally, incoming global solar radiation and incoming longwave radiation were measured at the top of the tower at heights greater than the surrounding trees. Precipitation (water equivalent) and snow depth were continuously monitored. During the experiment's observation periods, the investigators measured detailed snow properties (depth, density, grain size and shape, temperature, and stratigraphy) at three sites each day at the LSOS.

3 REFERENCES AND RELATED PUBLICATIONS

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5 DOCUMENT INFORMATION

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