Daily Soil Temperature and Meteorological Data for Sites at Toolik Lake Alaska, Version 1

USER GUIDE

How to Cite These Data

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

Gus Shaver, Jim Laundre 2003. *Daily Soil Temperature and Meteorological Data for Sites at Toolik Lake Alaska, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. https://doi.org/10.7265/yyzc-sx85. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/GGD906

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 File Information

1.1.1 Format

Tables in comma-delimited text format

1.1.2 File and Directory Structure

There is one directory for each data collection site: main and tussock

1.1.3 Naming Convention

File names consist of the following elements:

YYYY = four-digit year
dltld = Main LTER site
dltud - Tussock site

Example data file names:

2002dltld.txt
1998dltld.txt
2002dltud.txt
1998dltud.txt

1.1.4 File Size

File sizes range from 43 to 95 KB.

1.2 Spatial Information

1.2.1 Coverage

Data were collected in the Toolik Lake area of Alaska, coordinates 68.63 N, 149.60 W

1.3 Temporal Information

1.3.1 Coverage

Readings were taken between 1988 and 2002.

1.3.2 Resolution

Measurements were recorded daily.

1.4 Parameter or Variable

1.4.1 Parameter Description

Soil, lake, and air temperature, wind speed, precipitation, vapor pressure, rainfall, quantum radiation.

1.4.2 Unit of Measurement

All temperature measurements are given in degrees Celsius.

1.4.3 Parameter Source

For both data collection sites, a Campbell 21x datalogger measured all weather variables in this data set. Various sensors were used to gauge the data, as follows:

- Pyranometer: Model LI-200SB- calibrated to detect most the daylight spectrum (sunlight and PAR)
- Net Radiation: WeatherMeasure Weathertronics, Fritschen Type - Measures the difference between incoming and outgoing radiation of wavelengths from 0.3 - 60 microns. Range ±980 Watts m-2. Sensitivity ± 3.5mV/Watts/m-2. Temperature compensation for 10-54°C.
- Rain gauge: Tipping Bucket Electric Rain Gauge. A complex spun collector funnel with a knife edge that diverts the water to a tipping bucket mechanism. Each alternate tip occurs for each 0.01 inch of rainfall. Accuracy 1% at 2 inches per hour or less. Accurate Temperature Range: 0 - 37°C.
- Relative humidity/temperature: Model 207 Temperature and Relative Humidity Probe. Temperature sensor is a Fenwall electronics thermistor. Relative humidity sensor is a Physical-chemical research sensor. Temperature accuracy over the range -40 to 56°C is 1.0°C. Relative humidity for a range of 12 - 100%, the percentage error is 3. Upper temperature limit is 79°C.
- Wind speed: MET-ONE wind speed sensor Model 014A. Sensor uses a 3-cup anemometer assembly and simple magnet-read switch assembly to produce a series of contact closures whose frequency is proportional to wind speed. Operating range is 0 to 125 mph or 0-60 m/s. Accuracy ±1.5% or 0.25 mph. Working temperature range is -50 to 85°C.

- Quantum: Li-Cor, Quantum, Model LI-190SB. Measures photosynthetically active radiation (PAR) in mEinsteins S-1 m-2. Range is 400-700nm wavelength. Sensitivity is 8mA/1000 mE s-1 m-2. Relative error is less then ±10% for plant canopies or less then ±5% for growth chambers.

1.4.4 Parameter Range

The tables below for each site describe each parameter and the units of measurement used. These table columns correspond to the columns in the data tables.

Table 1. Main LTER Site

Variable	Variable	Units
YEAR	Year	yyyy
DATE	Date	dd-mmm-yyyy
MONTH	Month of collection	integer
ID	Datalogger program step	integer
JULIAN	Julian date	ddd
RAIN	Total daily rain	mm
AT 1M	Daily average Air temperature at 1 meter	Celsius
AT 5M	Daily average Air temperature at 5 meters	Celsius
ATMAX 1M	Maximum temperature at 1 meter	Celsius
ATMAX HR 1M	Time of maximum air temperature at 1 meters	2400
ATMAX 5M	Maximum air temperature at 5 meters	Celsius
ATMAX HR 5M	Time of maximum air temperature at 5 meters	2400
ATMIN 1M	Minimum air temperature at 1 meter	Celsius
ATMIN HR 1M	Time of minimum air temperature at 1 meter	2400
ATMIN 5M	Minimum air temperature at 5 meters	Celsius
ATMIN HR 5M	Time of minimum air temperature at 5 meters	2400
WSMAX 1M	Wind Speed Maximum at 1 meter	meters/sec
WSMAX HR 1M	Time of wind speed Max at 1M	2400 time
WSMAX 5M	Wind Speed Maximum at 5 meter	meters/sec
WSMAX HR 5M	Time of wind speed Max at 5M	2400 time
WIND SP 1M	Daily average wind speed at 1 meter	meters/sec
WIND SP 5M	Daily average wind speed at 5 meter	meters/sec
Vapor Press	Avg. Vapor Pressure at 5 meters	millibars
Pyr j/cm2	Total joules per sq cm per day	joules/cm2/day
Quantum Mol/m2/day	Photosynthetical Active Radiation	(Mol/m2/day)
Moss1 Temp	Avg.Soil moss layer temperature - set 1	Celsius

Variable	Variable	Units
Soil1 5cm	Avg. Soil temperature at 5 cm - set 1	Celsius
Soil1 10cm	Avg. Soil temperature at 10 cm - set 1	Celsius
Soil1 20cm	Avg. Soil temperature at 20 cm - set 1	Celsius
Soil1 50cm	Avg. Soil temperature at 50 cm - set 1	Celsius
Soil1 100cm	Avg. Soil temperature at 100 cm - set 1	Celsius
Soil1 150cm	Avg. Soil temperature at 150 cm - set 1	Celsius
Lake Temp	Avg. Lake water temperature at approx. 2 meters (see notes)	Celsius
Comment	Notes on data	

Table 2. Tussock site

Variable Name	>Variable description	Units
YEAR	Year	YYYY
DATE	Date	DD-MMM-YYYY
MONTH	Month	
ID	Program step that output the data	
JULIAN	Julian Date	ddd
Rain	Total daily unfrozen rain	mm
CT TEMP 3M	Daily average air temperature at 3 meters	Celsius
MAX CT TEMP 3M	Maximum temperature at 3 meters	Celsius
MAX HOUR CT TEMP 3M	Time of air temperature max at 3 meters	2400
MAX WIND SPEED 3M	Wind Speed Maximum at 3 meter	meters/sec
MAX HOUR WIND SP	Time of wind speed Max at 3M	2400
MIN CT TEMP 3M	Minimum air temperature at 3 meters	Celsius
MIN HOUR CT TEMP 3M	Time of air temperature min at 3 meters	2400
WIND SPEED 3M m/s	Daily average wind speed at 3 meters	meters/sec
GH TEMP	Daily greenhouse air temperature	Celsius
SH TEMP	Daily shade house air temperature	Celsius
CT Quantum mol/m2/day	Control Quantum radiation per meter sq. per day	moles
GH Quantum mol/m2/day	Greenhouse Quantum radiation per meter sq. per day	moles
SH Quantum mol/m2/day	Shade house Quantum radiation per meter sq. per day	moles
VAPOR PRES	Avg. Vapor Pressure at 3 meters	millibars

Variable Name	>Variable description	Units
PYR J CM2 HR	Total joules per sq cm per day	joules/cm2/day
CT1 10cm	Set 1 daily average soil temperature at 10cm	Celsius
CT1 20cm	Set 1 daily average soil temperature at 20cm	Celsius
CT1 40cm	Set 1 daily average soil temperature at 39cm	Celsius
CT2 10cm	Set 2 daily average soil temperature at 10cm	Celsius
CT2 20cm	Set 2 daily average soil temperature at 20cm	Celsius
CT2 40cm	Set 2 daily average soil temperature at 40cm	Celsius
COMMENTS	Comments about individual datum points	

1.4.5 Sample Data Record

Data are in tables. The following table is a sample of a data table from the Main LTER site. Note that this sample shows only a portion of the columns in the actual data.

Table 3. Sample of a data table from the Main LTER site

DATE	Rain	AT 1M	AT 5M	ATMAX 1M	ATMAX 5M	ATMAX HR 5M	ATMIN HR 1M	Moss 1 Temp	Soil 1 5cm	Soil1 150cm
30-Apr-02	2.794	1.2	1.7	3.9	5	1934	434	-1	-1	-6
1-May-02	3.556	-4.9	-4.8	1.4	2	44	2025	0	0	-6
2-May-02	1.778	-8.8	-8.6	-3.2	-2	1835	2314	-1	-1	-5
3-May-02	0	-14.5	-14.3	-7.5	-7.5	847	2339	-3	-3	-5
4-May-02	0	-8.1	-7.9	-3.8	-3.7	1502	153	-4	-4	-5

DATE	Rain	AT 1M	AT 5M	ATMAX 1M	ATMAX 5M	ATMAX HR 5M	ATMIN HR 1M	Moss 1 Temp	Soil 1 5cm	Soil1 150cm
5-May-02	0	-3.5	-3.2	1.5	1.6	1622	246	-4	-4	-5
6-May-02	0	-0.1	0.1	2.9	3	1539	106	-2	-2	-5
7-May-02	0.254	-0.9	-0.9	3	2.7	1619	316	-1	-1	-4
8-May-02	0	1.3	1.4	4.9	4.6	1550	16	0	-1	-4
9-May-02	0.254	2	1.9	5.4	4.6	1025	2301	2	0	-4
10-May-02	1.524	-0.9	-1.1	0.3	0.1	836	2247	1	0	-4
11-May-02	2.286	-0.8	-1.1	3	2.7	1816	2303	2	0	-3
12-May-02	0.508	-0.4	-0.5	3	2.6	812	301	2	0	-3
13-May-02	0	-3.2	-3.2	4.2	3.8	941	0	1	0	-3

2 DATA ACQUISITION AND PROCESSING

2.1 Quality, Errors, and Limitations

2.1.1 Error Sources

Missing data indicated with N/A.

2.1.1.1 Main LTER Site Notes and Comments:

Wind speed less than .447 is considered calm. For most years, radiation data were not totaled for the winter months since no attempt was made to keep sensors snow and frost-free. Lake temperature is measured near the lake depth sensor.

The following table details specific errors and comments for each year, which correspond to the Main LTER site data file for the same year.

Table 4. Specific errors and comments for each year

Year	Comments
1988	From June 1 to August 24 the 5 meter sensor was only at 3 meters. On August 24th the 3 meter temperature/ RH sensor was moved up to 5 meters for better separation for the possibility of calculating energy balance using Bowen ratio approach. For the winter, only the 5 meter temperature/RH, wind speed and direction, soil temperature, and lake temperature were recorded. For 5 meter air temperatures less then -40, a regression of 5 meter air temperature verse air TC (only used 0 to -35 for regression) was used to correct the air temperatures. The 5 meter air thermistor is only accurate to -40 Celsius. Missing data for air temperature and rain were estimated when possible. For small gaps the in the hourly data before and after were averaged. For larger gaps regressions were made with the Imnaviat data set (a weather station maintained by Hinzman and Kane, Water Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775-5860, which is about 12 kilometers away and 200 meters higher).
1989	The precipitation tipping rain bucket has an Alter-type wind screen. For the winter of 88-89, only the 5 meter temperature/RH, wind speed and direction, soil temperature, and lake temperature were recorded. For 5 meter air temperatures less then -40, a regression of 5 meter air temperature verse air TC (only used 0 to -35 for regression) was used to correct the air temperatures. The 5 meter air thermistor is only accurate to -40 Celsius. Missing data for air temperature and rain were estimated when possible. For small gaps the in the hourly data before and after were averaged. For larger gaps regressions were made with the Imnaviat data set (a weather station maintained by Hinzman and Kane, Water Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775-5860, which is about 12 kilometers to the east and 200 meters higher).
1990	The datalogger stopped collecting data during winter of 1990-91. This file has data from January through August of 1990. Tussock Station was used to estimate using regressions between the two sites for missing data values.
1991	The datalogger stopped collecting data during winter of 1990-91. Data from January to April are estimated from the Tussock station.

Year	Comments
1992	Data is missing for the following periods: 92160 to 92175 - Data not saved before changing memory allocations in logger. 92189 to 92248 - Data logger not set in logging mode after trying to fix the lake quantum sensor. 92174 TO 92366 - AIR TC 1M is not working. Missing data for air temperature and rain were estimated when possible. For small gaps the in the hourly data before and after were averaged. For larger gaps regressions were made with the either Toolik Tussock site or Imnaviat data set (a weather station maintained by Hinzman and Kane, Water Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775-5860, which is about 12 kilometers to the east and 200 meters higher).
1993	Data is missing for the following periods: 93014 to 93166 - Top tower blew off; 5 Meter - Temp, RH, Wind direction and Wind speed no good. Also caused 1 meter Temp, RH to be erratic from 93130-93166. Soil temperature for set 2 were out of range during the winter. Missing data for air temperature and rain were estimated when possible. For small gaps the in the hourly data before and after were averaged. For larger gaps regressions were made with the either Toolik Tussock site or Imnaviat data set (a weather station maintained by Hinzman and Kane, Water Research Center, University of Alaska Fairbanks, Fairbanks, AK 99775-5860, which is about 12 kilometers to the east and 200 meters higher).
1994	
1995	Quantum mol/m2 was corrected for negative readings by adding 400 to the daily quantum sum.
1996	Lake and 50 and 100 cm soil thermocouples stopped working during the winter of 1996 because of a loose wire. Quantum mol/m2 was corrected for negative readings by adding 500 to the daily quantum sum.
1997	Data was lost from 168 to 176 when logger memory filled. Late August soil profile #1 at 50 and 100 cm could not be reset. They were put in at 20 cm shallower. Using set 2 for daily temperature.
1998	Maximum and minimum values are from minute readings and not from hourly averages except for TC 5M min which is from hourly averages.
1999	
2000	Data logger stopped during winter, 24 Nov 2000 to 2 Jun 2001; using Wet sedge data logger to estimate 1 and 5 meter temperatures (regressed available 1 and 5 meter temperatures with wet sedge 3 meter temperatures). Imnavait rain gage used for precipitation.
2001	Battery lost connection with logger and no data was collected from 24 Nov 2000 to June 2001; The StowAway sensor was used to estimate the 1 meter air temperature and a regression between 1 m and 5m to estimate the 5 meter air temp. Where StowAway was missing or temperatures dropped below -37.2 the Wet Sedge air temperature was used.
2002	Battery lost connection with logger and no data was collected from 24 Nov 2000 to June 2001; The StowAway sensor was used to estimate the 1 meter air temperature and a regression between 1 m and 5m to estimate the 5 meter air temp. Where StowAway was missing or temperatures dropped below -37.2 the Wet Sedge air temperature was used. From 4 Jun 02 through 23 Aug 02 replaced 5 meter vapor pressure calculation with 1 meter. The 5 meter RH sensor was not working.

2.1.1.2 Tussock Site Notes and Comments

For all years: Wind speeds less then .447 are considered calm. Only unfrozen precipitation is reported. The global solar radiation sensor data is not corrected for frost or snow on the sensors during the winter months, so use this only qualitatively. The quantum sensor data are also not corrected for a small negative offset. In the spring months, soil temperatures are problematic since frost heaving of the probes caused depth of measurements to change.

The following table details specific errors and comments for each year, which correspond to the Tussock site data file for the same year.

Table 5. Specific errors and comments for each year

Year	Comments
1990	Data collection for this site began 24 June 1990.
1991	Missing days:16 June hour 1600 to 21 June hour 1400 (Bad connection); 16 August hour 1100 to 19 August hour 1900; 9 November hour 0500 to end of year (Battery volts dropped below 9.7). Pyranometer had an offset of -0.008; data was not corrected. Quantum sensors would go negative during low light/darkness. Most of the time the offset was -2.236 but occasionally one would read >-44. The control RH sensor was faulty, never getting above 82%. Data are reported but not used in vapor pressure calculation.
1992	The data logger failed in winter 91-92. Battery voltage dropped below 9 volts. Last day collected was 9 November 1991. A new 21x was installed and the old one sent to be serviced. An error was made when setting up the new program - minute readings was averaged every minute. As a result data overflowed the memory and only one day worth of data was saved. The problem was corrected 11 July 1992. The control and shade RH sensor are faulty, never getting above 82%. Data are reported but not used in vapor pressure calculation.
1993	Data is missing between 1 January through 31 May 1993.
1995	Wind direction sensor stopped working in December Wind speeds less then .447 are considered calm. Due to a vole hole in one of the multiplexer snow melt water caused data lost from 23 May to 10 June. The multiplexer was remove and number of sensors reduced in the green and shade houses.
1996	Data was lost on 3 Jan to 20 Jan when a storage module became full and on 7 Jun to 15 Jun and 19 Aug to 23 Aug when the datalogger stopped recording .The soil probes are checked every August and adjusted if possible. The depth is indicated in the variable name. Control RH sensor was not working from Jan to Aug when the sensor was replaced.
1997	The soil probes are checked every August and adjusted if possible.
1998	In August 1998 all profiles were reset using a white fiberglass pole anchored approximately 75 cm in to the permafrost. Replicates were installed in average non-tussock microsites. In January, February and December there are some erratic soil temperatures that are unexplained. From late June to late July the connection to the multiplexer failed resulting in no soil temperatures for that period.

3 CONTACTS AND ACKNOWLEDGMENTS

Gus Shaver, Principal Investigator at the Marine Biological Laboratory, and Jim Laundre, Marine Biological Laboratory

4 REFERENCES

See the Arctic LTER site for the hourly data and other weather data (http://ecosystems.mbl.edu/arc/default.htm)

5 DOCUMENT INFORMATION

5.1 Publication Date

14 May 2003

5.2 Date Last Updated

14 May 2003