Local Energy-budget Measurement Stations Developed by the University of Utah EFD Lab

LEMS

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1.0 Data Set Overview

1.1 Time period covered by the data

Approximately September - October 2012 and May 2013. For specific times please refer to individual file names.

1.2 Physical location (latitude, longitude, elevation)

See separate file (LEMS_coordinates.txt) with coordinates, 0, 0

1.3 Instrument type

MesoNET

1.4 Data provider

University of Utah

1.5 Web address references

http://www3.nd.edu/~dynamics/materhorn/

https://www.eol.ucar.edu/field_projects/materhorn-x

2.0 Instrument Description

LEMS are solar powered, low-cost Energy-budget Measurement Stations, which have been designed and assembled at the University of Utah EFD lab. LEMS monitor incoming solar radiation (LI-200), 2-m air temperature and relative humidity (Sensirion SHT 15, Humidity +/- 2-5% Temperature +/- 0.5K), air pressure (Bosch BMP085), surface temperature (Zytemp TN9), as well as soil temperature and moisture (Decagon 5TM) at two levels below ground. Data are logged using an Arduino-based open source controller with a data logger that can store up to 2 GB of data.

2.1 Instrument website

http://www.mech.utah.edu/~pardyjak/Instruments.php

https://www.licor.com/env/products/light/pyranometer.html

https://www.sensirion.com/en/products/humidity-sensors/digital-humidity-sensors-for-accurate-measurements/

https://cdn-shop.adafruit.com/datasheets/BST-BMP085-DS000-06.pdf

http://www.zytemp.com/products/tn901.asp

http://www.decagon.com/en/soils/volumetric-water-content-sensors/5tm-vwc-temp/

2.2 Table of specifications

Accuracy	Range	Frequency	Resolution
Consult the manufacturer specifications.	Consult the manufacturer specifications.	Consult the manufacturer specifications.	Consult the manufacturer specifications.

3.0 Data Collection and Processing

3.1 Description of data collection

3.2 Description of derived parameters and processing techniques used

Original data files are provided.

3.3 Description of quality assurance and control procedures

This dataset was not subject to any quality control or processing it has been provided in its original form.

3.4 Data intercomparisons

4.0 Data Format

4.1 Data file structure

TXT files for each 10 second averaged values. The text files are in ASCII, CSV format and have a header line.

4.2 File naming convention

dataProvider_instrument_identifier_instrumentType_startDateAndTime_endDateAndTime.extension

4.3 Data format

comma delimited ASCII

4.4 Data layout

Each file has a line provides the column headers for all subsequent rows of data contained within the file.

4.5 List of parameters with units, sampling intervals, frequency, range

Millis - milliseconds of recording,

Month - month of recording,

Day - day of recording,

Year - year of recording,

Hour - hour of recording,

Minute - minutes of recording,

Second - second of recording,

SHT Amb - air temperature measured at 2m with Sensirion SHT15, °C,

Rel Hum - relative humidity measured at 2m with Sensirion SHT15, %,

Pressure - air pressure measured with Bosch BMP085, hPa,

BMP Amb - air temperature measured with Bosch BMP085, °C,

IR - Zytemp TN9 IR data,

TN9 Amb - surface temperature measured with Zytemp TN9, °C,

Soil Lower Temp - soil temperature measured at 5cm below the surface with Decagon 5TM, °C,

Soil Lower Mois - soil moisture measured at 5cm below the surface with Decagon 5TM, VWC(m^3/m^3),

Soil Upper Temp - soil temperature measured at 25cm below the surface with Decagon 5TM, °C,

Soil Upper Mois - soil moisture measured at 25cm below the surface with Decagon 5TM, VWC(m^3/m^3),

Sunlight - incoming solar radiation measured with LI-200, SR (W/m^2)

4.6 Data version number and date

raw, v1.0, October 2016

4.7 Description of flags, codes used in the data, and definitions

4.8 Data sample

```
Millis,Month,Day,Year,Hour,Minute,Second,SHT Amb,Rel Hum,Pressure,BMP
Amb,IR,TN9 Amb,Soil Lower Temp,Soil Lower Mois,Soil Upper Temp,Soil
Upper Mois,Sunlight
5071,10,13,2012,14,58,25,20.2500,45.01,87290.00,24.00,21.98,21.04,17.
50,0.12989,14.70,0.28072,379.21
15276,10,13,2012,14,58,35,20.0900,45.33,87288.00,23.90,21.98,21.10,17
.50,0.12989,14.70,0.28041,378.48
25479,10,13,2012,14,58,45,20.0400,44.44,87317.00,23.90,21.66,21.16,17
.50,0.12989,14.70,0.28072,379.21
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35698,10,13,2012,14,58,55,20.0200,46.03,87316.00,24.00,21.66,21.16,17
.50,0.12989,14.70,0.28041,379.21
45911,10,13,2012,14,59,5,19.9600,46.47,87318.00,24.00,21.66,21.23,17.
50,0.12989,14.70,0.28072,377.75
56116,10,13,2012,14,59,16,19.7900,45.15,87317.00,24.10,21.29,21.23,17
.50,0.12989,14.70,0.28010,376.79
66339,10,13,2012,14,59,26,19.6400,44.81,87315.00,24.10,21.29,21.29,17
.50,0.12989,14.70,0.28072,374.85
76545,10,13,2012,14,59,36,19.6600,44.56,87313.00,24.20,20.91,21.29,17
.50,0.12989,14.70,0.28041,372.67
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5.0 Data Remarks

5.1 PI's assessment of the data

5.2 Missing data periods

5.3 Software compatibility

6.0 References

[1] Fernando, H. J. S., E. R. Pardyjak, S. Di Sabatino, F. K. Chow, S. F. J. DeWekker, S. W. Hoch, J. Hacker, J. C. Pace, T. Pratt, Z. Pu, J. W. Steenburgh, C. D. Whiteman, Y. Wang, D. Zajic, B. Balsley, R. Dimitrova, G. D. Emmitt, C. W. Higgins, J. C. R. Hunt, J. G. Knievel, D. Lawrence, Y. Liu, D. F. Nadeau, E. Kit, B. W. Blomquist, P. Conry, R. S. Coppersmith, E. Creegan, M. Felton, A. Grachev, N. Gunawardena, C. Hang, C. M. Hocut, G. Huynh, M. E. Jeglum, D. Jensen, V. Kulandaivelu , M. Lehner, L. S. Leo, D. Liberzon, J. D. Massey, K. McEnerney, S. Pal, T. Price, M. Sghiatti, Z. Silver, M. Thompson, H. Zhang, T. Zsedrovits, 2015: The MATERHORN – Unraveling the Intricacies of Mountain Weather, BAMS, doi: http://dx.doi.org/10.1175/BAMS-D-13-00131.1.

[2] http://www.mech.utah.edu/~pardyjak/Instruments.php