SMEX03 Watershed Ground Soil Moisture Data: Oklahoma, Version 1

USER GUIDE

How to Cite These Data

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

Jackson, T. and M. Cosh. 2006. *SMEX03 Watershed Ground Soil Moisture Data: Oklahoma, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/MDA5IC8S3LBM. [Date Accessed].

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National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

The data are formatted as tab-delimited ASCII text. The column headings for each data file are described in Tables 1 through 4.

Note: Missing data are represented by -99.

Table 1. Column Headings and Definitions for the `LW_GVSM_Raw.txt` File

Column Heading	Definition
Date	Date of measurements, month/day/year
Field_ID	Watershed field number
Site_ID	Site location identifier number
Start Time	Start time of sampling, Central Daylight Time (CDT)
Stop Time	Stop time, CDT
Latitude	Latitude of sample, World Geodetic System 1984 (WGS84) degrees
Longitude	Longitude of sample site, WGS84 degrees
UTM_Easting	Easting of sample site in meters, WGS84 Universal Transverse Mercator (UTM), Zone 14
UTM_Northing	Northing of sample site in meters, WGS84 UTM, Zone 14
TP_mV A	ThetaProbe millivolt reading at position A, volts
TP_mV B	ThetaProbe millivolt reading at position B, volts
TP_mV C	ThetaProbe millivolt reading at position C, volts
TP_VSM_gc A	ThetaProbe volumetric soil moisture (VSM) from general calibration at position A, cubic meters/cubic meters
TP_VSM_gc B	ThetaProbe VSM from general calibration at position B, cubic meters/cubic meters
TP_VSM_gc C	ThetaProbe VSM from general calibration at position C, cubic meters/cubic meters
TP_VSM_scc A	ThetaProbe VSM from site-specific calibration at position A, cubic meters/cubic meters
TP_VSM_scc B	ThetaProbe VSM from site-specific calibration at position B, cubic meters/cubic meters
TP_VSM_scc C	ThetaProbe VSM from site-specific calibration at position C, cubic meters/cubic meters
Can_ID 0-3 cm	Can identification number for 0-3 cm sample
Can_Wgt 0-3 cm	Can weight for 0-3 cm sample, grams
Wet_Wgt 0-3 cm	Wet weight for 0-3 cm sample, grams

Column Heading	Definition
Dry_Wgt 0-3 cm	Dry weight for 0-3 cm sample, grams
GSM 0-3 cm	Gravimetric soil moisture (GSM) for 0-3 cm sample, grams water/grams dry soil
Bulk_Density 0-3 cm	Bulk density for 0-3 cm sample, grams/cubic meters
VSM 0-3 cm	VSM for 0-3 cm sample, cubic meters/cubic meters
Can_ID 3-6 cm	Can identification number of 3-6 cm sample
Can_Wgt 3-6 cm	Can weight of 3-6 cm sample, grams
Wet_Wgt 3-6 cm	Wet weight of 3-6 cm sample, grams
Dry_Wgt 3-6 cm	Dry weight of 3-6 cm sample, grams
GSM 3-6 cm	GSM of 3-6 cm sample, grams water/grams dry soil
Bulk_Density 3-6 cm	Bulk density of 3-6 cm sample, grams/cubic meters
VSM 3-6 cm	VSM of 3-6 cm sample, cubic meters/cubic meters
Total VSM 0-6 cm	Total VSM of 0-6 cm, cubic meters/cubic meters
Scoop?	Was a scoop tool used for this sample? If so, an average bulk density was used for the calculation of VSM.

Table 2. Column Headings and Definitions for the `LW_GVSM_Sum.txt` File

Column Heading	Definition
Date	Date of measurements, month/day/year
Field_ID	Watershed field number
Start_Time	Start time of sampling, Central Daylight Time (CDT)
Stop_Time	Stop time, CDT
Latitude	Latitude of sample, World Geodetic System 1984 (WGS84) degrees
Longitude	Longitude of sample site, WGS84 degrees
UTM_Easting	Easting of sample site in meters, WGS84 Universal Transverse Mercator (UTM), Zone 14
UTM_Northing	Northing of sample site in meters, WGS84 UTM, Zone 14
Bulk_Density avg	Average bulk density, kilograms/cubic meters
Bulk_Density stdev	Standard deviation for bulk density, kilograms/cubic meters
VSM 0-3 cm, avg	Average VSM of 0-3 sample, cubic meters/cubic meters
VSM 0-3 cm, stdev	Standard deviation of 0-3 sample, cubic meters/cubic meters
VSM 3-6 cm, avg	Average VSM of 3-6 sample, cubic meters/cubic meters

Column Heading	Definition
VSM 3-6 cm, stdev	Standard deviation of 3-6 sample, cubic meters/cubic meters
VSM 0-6 avg	Average VSM of 0-6 sample, cubic meters/cubic meters
VSM 0-6 stdev	Standard deviation of 0-6 sample, cubic meters/cubic meters
V avg	Average ThetaProbe millivolt reading, volts
V stdev	Standard deviation ThetaProbe millivolt reading, volts
VSM-gc avg	Average ThetaProbe VSM from general calibration, square meters/square meters
VSM-gc stdev	Standard deviation ThetaProbe VSM from general calibration, square meters/square meters
VSM-ssc avg	Average ThetaProbe VSM from site specific calibration, square meters/square meters
VSM-ssc stdev	Standard deviation ThetaProbe VSM from site specific calibration, square meters/square meters

Table 3. Column Headings and Definitions for the `LW_Temp_Raw.txt` File

Column Heading	Description
Date	Date of measurements, month/day/year
Field_ID	Watershed field number
Site_ID	Site location identifier number
Start Time	Sampling start time, CDT
Stop Time	Sampling stop time, CDT
Latitude	Latitude of sample site, WGS84 degrees
Longitude	Longitude of sample site, WGS84 degrees
UTM_Easting	Easting of sample site in meters, WGS84, Zone 14
UTM_Northing	Northing of sample site in meters, WGS84, Zone 14
Apogee IRT	Infrared thermometer reading, degrees Celsius
Temp 1 cm	Temperature probe reading at 1 cm, degrees Celsius
Temp 5 cm	Temperature probe reading at 5 cm, degrees Celsius
Temp 10 cm	Temperature probe reading at 10 cm, degrees Celsius

Table 4. Column Headings and Definitions for the `LW_Temp_Sum.txt` File

Column Heading	Description
Date	Date of measurements, month/day/year
Field_ID	Watershed field number
Start Time	Sampling start time, CDT

Column Heading	Description
Stop Time	Sampling stop time, CDT
Latitude	Latitude of sample site, WGS84 degrees
Longitude	Longitude of sample site, WGS84 degrees
UTM_Easting	Easting of sample site in meters, WGS84, Zone 14
UTM_Northing	Northing of sample site in meters, WGS84, Zone 14
Temp 1 cm avg	Average temperature probe reading at 1 cm depth, degrees Celsius
Temp 1 cm stdev	Standard deviation temperature probe reading at 1 cm depth, degrees Celsius
Temp 5 cm avg	Average temperature probe reading at 5 cm depth, degrees Celsius
Temp 5 cm stdev	standard deviation temperature probe reading at 5 cm depth, degrees Celsius
Temp 10 cm avg	Average temperature probe reading at 10 cm depth, degrees Celsius
Temp 10 cm stdev	Standard deviation temperature probe reading at 10 cm depth, degrees Celsius

1.2 File and Directory Structure

Table 5 lists the files contained in this data set.

Table 5. Files Contained in this Data Set

File Name	Description	File Size
LW_GVSM_Raw.txt	Little Washita, OK gravimetric and volumetric soil moisture (GVSM) files for raw data.	470 KB
LW_GVSM_Sum.txt	Little Washita, OK gravimetric and volumetric soil moisture (GVSM) files for summary data.	33 KB
LW_Temp_Raw.txt	Little Washita, OK soil temperature and surface temperature (Temp) files for raw data.	214 KB
LW_Temp_Sum.txt	Little Washita, OK soil temperature and surface temperature (Temp) files for summary data.	22 KB

1.3 Volume

The total volume is approximately 740 KB.

1.4 Spatial Coverage

Southernmost Latitude: 34.90º N
Northernmost Latitude: 34.96º N

Westernmost Longitude: 98.30º W
Easternmost Longitude: 97.95º W

1.5 Temporal Coverage

Data were collected from 2 July 2003 to 17 July 2003.

1.5.1 Temporal Resolution

All parameters were collected daily. Surface soil moisture was sampled between 9:00 A.M. and 12:00 P.M. CDT.

1.6 Parameter or Variable

1.6.1 Parameter Description

Table 6 lists parameters of this data set, the sensor/method of measurement, and their units of measure.

Table 6. Parameters in this Data Set

Parameter	Units of Measurement	Source/Sensor(s)
Gravimetric soil moisture	Grams of water per grams of dry soil (g/g) * 100	Manual soil collection
Volumetric soil moisture	Grams water per grams dry soil (g/g)	Computed from bulk density
Volumetric soil moisture	Cubic meters per cubic meters (m3/m3)	Impedance probes
Bulk density	Grams per cubic centimeter (g/cm3)	Manual soil collection
Surface and subsurface soil temperature	Degrees Celsius	Infrared pyrometers and temperature probes
Surface soil moisture	Water fraction volume cubic meters per cubic meters (m3/m3) * 100	Impedance probes

1.6.2 Sample Data Record

For each file of this data set, the first four and last four columns are displayed in the samples below.

The following sample shows the first five rows from LW_GVSM_Raw.txt. The value -99 is a fill value for missing values, and the entries for the column titled Scoop? are often left blank.

Table 7. Sample Data Record from LW_GVSM_Raw.txt

Date	Field ID	Site ID	Start Time	...	Bulk_Density 3-6 cm	VSM 3-6 cm	Total_VSM 0-6cm	Scoop?
7/2/2003	LW02	1	13:45	...	-99	-99	-99	
7/3/2003	LW02	2	13:45	...	1.547	0.272	0.274	
7/4/2003	LW02	3	13:45	...	-99	-99	-99	
7/5/2003	LW02	4	13:45	...	-99	-99	-99	

The following sample shows the first five rows of the LW_GVSM_Sum.txt file. Some fields may contain fill values of -99:99 and other missing parameters are denoted by -99.

Table 8. Sample Data Record from LW_GVSM_Sum.txt

Date	Field ID	Start Time CDT	Stop_Time CDT	...	VSM-gc avg	VSM-gc stdev	VSM-ssc avg	VSM-ssc stdev
7/2/2003	LW02	13:45	15:10	...	0.21	0.05	0.187	0.023
7/2/2003	LW03	9:55	10:45	...	0.11	0.051	0.128	0.038
7/2/2003	LW04	10:50	12:20	...	0.089	0.041	0.087	0.029
7/2/2003	LW11	-99:99	-99:99	...	-99	-99	-99	-99

The following sample shows the first five rows of the LW_Temp_Raw.txt file. Missing parameters are denoted by -99.

Table 9. Sample Data Record from LW_Temp_Raw.txt

Date	Field ID	Site ID	Start Time	...	Apogee IRT in Celsius	Temp 1 cm	Temp 5 cm	Temp 10 cm
7/2/2003	LW02	1	13:45	...	-99	40.2	34.1	31.7
7/3/2003	LW02	2	13:45	...	-99	36.5	31.3	31.3
7/4/2003	LW02	3	13:45	...	-99	38.3	31.3	31.3
7/5/2003	LW02	4	13:45	...	-99	35.5	31.3	31.3

The following sample shows the first five rows of file LW_Temp_Sum.txt. Some time fields contain fill values of -99:99, and other missing parameters are denoted by -99.

Table 10. Sample Data Record from LW_Temp_Sum.txt

Date	Field ID	Start Time CDT	Stop Time CDT	...	Temp 5 cm avg	Temp 5 cm stdev	Temp 10 cm avg	Temp 10 cm stdev
7/2/2003	LW02	13:45	15:10	...	31.4	2.3	31.3	2.2
7/2/2003	LW03	9:55	10:45	...	32.8	4.3	29.7	2.5
7/2/2003	LW04	10:50	12:20	...	32.3	2.1	29.3	1.3
7/2/2003	LW11	-99:99	-99:99	...	32.1	3.5	30.2	3

2 DATA ACQUISITION AND PROCESSING

2.1 Theory of Measurements

2.1.1 Sampling

Sampling was performed on sites approximately one-quarter section, 0.8 km by 0.8 km, in size. Soil samples were collected and soil temperature, surface temperature, soil dielectric constants, and flux tower measurements were taken at 14 points in these sites. Figure 1 illustrates the sampling locations within the one-quarter section sites.

Gravimetric soil samples were taken with a coring tool at sites marked All on Figure 1. Four samples per field were retrieved.

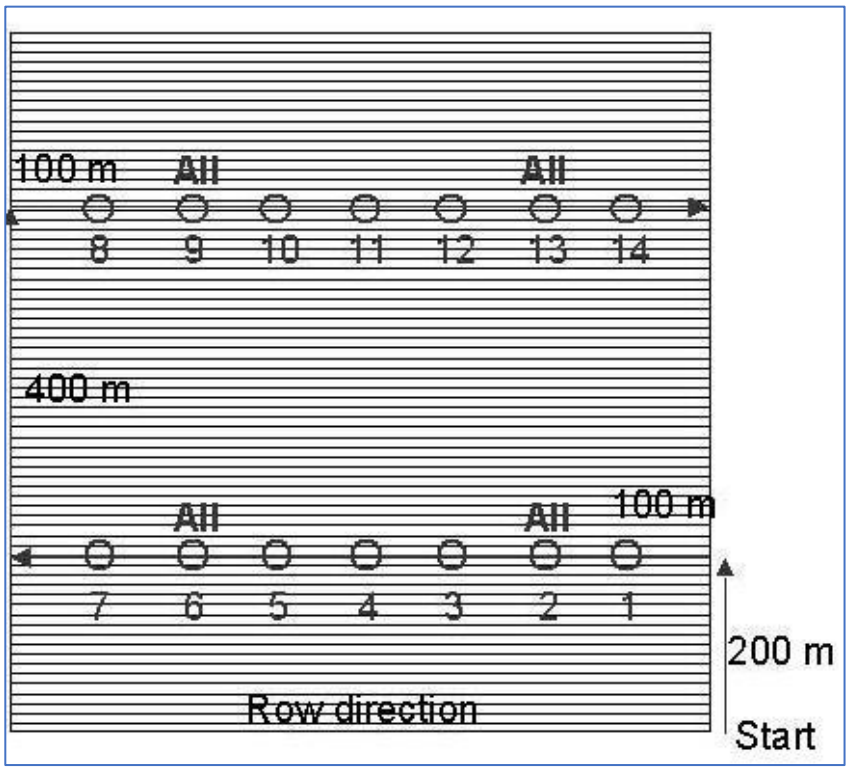

Figure 1. Sampling locations for the SMEX03 watershed soil moisture data.

2.1.2 Determining Gravimetric Soil Moisture

Gravimetric soil moisture was determined in the laboratory by weighing, drying, and weighing again soil samples collected with the coring tool.

2.1.3 Computing Bulk Density and Volumetric Soil Moisture

Bulk density was computed by dividing the dry soil mass by the volume of the coring tool, either 1 cm or 5 cm. The bulk density value computed from the 3-6 cm soil sample was deemed more reliable, and this value was used in the calculation of volumetric soil moisture:

VSM = GSM * BD

Note: For samples collected with the scoop tool, the average bulk density from all coring tool samples was used for computation of volumetric soil moisture.

2.2 Error Sources

2.2.1 Volumetric Soil Moisture

Soil dielectric constants measured with impedance probes (ThetaProbes) were used in volumetric soil moisture computations. For various reasons, including extremely dry conditions, severe

weather restrictions, miscommunication among personnel, and cultivation, some sites were not sampled on particular days. Occasionally, a ThetaProbe rod was broken because of very hard and dry soil conditions. When possible, the broken rod was replaced. When it was not possible to replace the rod, a new instrument was used.

2.2.2 Bulk Density

The coring tool used extracts a known volume of soil that was used to compute a bulk density. There is potential for compaction with this tool, resulting in higher bulk densities when compared to other methods. Occasionally, a scoop tool was used to retrieve a soil sample when soil was excessively dry. This scoop tool does not allow for a bulk density estimate. In these situations, the average bulk density from all coring tool samples was used for computation of volumetric soil moisture for scoop samples.

The bulk density value from the 0-3 cm sample was considered less reliable than the 3-6 cm sample; therefore, the 3-6 cm bulk density value was used for volumetric soil moisture calculations.

2.3 Sensor or Instrument Description

2.3.1 Manual Soil Collection

Samples were collected manually in the field using coring tools, rectangular shaped scoop tools, and soil cans.

2.3.2 Infrared Thermometer (Pyrometer) and Temperature Probe

The surface temperature was sampled using handheld infrared thermometers such as the OMEGA OS643-LS Infrared Pyrometer. This instrument has an emissivity of 0.95, accuracy of ± 3%, and temperature range of 0 to 260°C (32 to 500°F). Refer to OMEGA Engineering for more information. Soil temperature was obtained using a temperature probe inserted to depths of 1 cm, 5 cm, and 10 cm. Several different temperature probes were used, but all have a metal rod, plastic top, and digital readout.

2.3.3 Impedance Probes (ThetaProbes)

Investigators used impedance probes to measure surface volumetric soil moisture. The probes were Type ML2 manually-operated impedance instruments manufactured by Delta-T Devices, Ltd. The ThetaProbes have four separate 6-cm stainless steel rods that were inserted vertically into the soil. Each instrument was connected to a handheld reader that delivered the electrical pulse, detected the return signal, and converted the period to voltage between 0 and about 1 V.

The software provided by the probe manufacturer calibrates the ThetaProbes by calculating an estimate of volumetric soil moisture according to the following equation:

$$\text{Theta} = \frac{1.07 + 6.4V - 6.4V2 + 4.7V3 - a0}{a1}$$

where a0 and a1 are 1.6 and 8.4, respectively. These estimates are provided in the data files.

Researchers also performed site-specific calibration for each field of sampling. ThetaProbe voltage readings from a row sampling point were compared to the volumetric soil moisture measured at the same point. A regression relationship was developed and new volumetric soil moisture values were estimated.

Field averages were calculated by counting each row reading twice for a total of four data points per sampling site. Field averages and standard deviations were calculated by computing the sampling site average, and then computing the average amongst the 14 field sampling sites. Finally, standard deviations were calculated.

3 REFERENCES AND RELATED PUBLICATIONS

3.1 Related Data Collections

AMSR-E Validation Data Sets

4 CONTACTS AND ACKNOWLEDGMENTS

Thomas J. Jackson
Hydrology and Remote Sensing Laboratory
US Department of Agriculture (USDA) - Agricultural Research Service (ARS)
Beltsville, MD 20705
USA

Michael H. Cosh
Hydrology and Remote Sensing Laboratory
US Department of Agriculture (USDA) - Agricultural Research Service (ARS)
Beltsville, MD 20705
USA

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5 DOCUMENT INFORMATION

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5.2 Date Last Updated

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