SMEX02 Soil Moisture and Temperature Profiles, Walnut Creek, Iowa, Version 1

USER GUIDE

How to Cite These Data

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

Crosson, W. and C. Laymon. 2003. *SMEX02 Soil Moisture and Temperature Profiles, Walnut Creek, Iowa, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/J98J79QGJROA. [Date Accessed].

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FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0185

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

Data are provided in a Microsoft Excel file with multiple sheets and as text files for each field. The text files contain the same data as the Excel file. In the text files, data are in tab-delimited format.

1.2 File Naming Convention

The Excel file is named "soil_profile_data.xls" and contains worksheets labeled by field number. The text files are named "soil_profile_fieldxx.txt," where xx corresponds to the field ID number.

1.3 Spatial Coverage

Southernmost Latitude: 41.934

Northernmost Latitude: 41.992

Westernmost Longitude: -93.664

Easternmost Longitude: -93.529

1.4 Temporal Coverage

Measurements for fields 15 and 16 were taken daily between 23 June 2002 and 23 July 2002. Measurements for fields 23 and 24 were taken daily between 24 June 2002 and 23 July 2002.

1.4.1 Temporal Resolution

Measurements were recorded at 10-second intervals and averaged over 15-minute output intervals. The data files contain only the 15-minute averages.

1.5 Parameter or Variable

1.5.1 Parameter Description

Parameters in this data set are soil moisture, soil temperature, and rainfall.

1.5.2 Parameter Range

The following table details the column headings for the data files. Where the column is a parameter, the description includes the sensor and unit of measurement.

Column Heading	Description
DOY	Numerical day of the year (Julian date)
Time	Time in the form HHMM (Central Daylight Time)
Elapsed Time	Elapsed time in hours since DOY 174, hour 0
Field ID	The number of the field: 15, 16, 23, or 24 (also indicated by the worksheet or file name)
Batt_V	The voltage of the battery supplying power to the data system (nominally 12 V)
Rain	Rainfall amount (in mm) from tipping bucket gauge
WCR Per (pit ID, depth)	Period (msec) measured by the WCR in pit A or B, at depths of 2, 5, 10, 15, 20, and 30 cm
VWC Per (pit ID, depth)	Volumetric water content (VWC) (percentage) measured in pit A or B, at depths of 2, 5, 10, 15, 20, and 30 cm
Soil T (pit ID, depth)	Soil temperature (in °C) measured in pit A or B, at depths of 2, 5, 10, 15, 20, and 30 cm
Mux Temp	Multiplexer temperature (in °C)
TCAV	Average temperature (in °C) of upper 5 cm soil layer

1.5.3 Sample Data Record

The following sample shows a small number of the actual columns in the data tables. The sample contains one column of each kind of measurement that exists in the data. The actual data tables contain measurements for multiple sites, where the sample below shows data for only one site, including the multiplexer reading and the average soil temperature for the upper 5 cm.

DOY	Time	Elapsed Time	Field ID	Rain	WCR Per A2	VWC A2	Soil T A2	Mux Temp	TCAV
All Times CDT				mm	msec	%	C	C	C
175	1415	38.25	23	0	0.965	9.6	36.52	38.01	27.48
175	1430	38.5	23	0	0.964	9.5	36.82	37.98	29.52
175	1445	38.75	23	0	0.964	9.49	37.03	38.16	32.84
175	1500	39	23	0	0.963	9.4	37.18	37.05	33.66
175	1515	39.25	23	0	0.962	9.32	37.39	36.36	33.87

2 SOFTWARE AND TOOLS

No special tools are required to view the text files. A spreadsheet program, text viewer, or Web browser will display the Microsoft Excel file.

3 DATA ACQUISITION AND PROCESSING

The data collection stations were located at four fields in the Walnut Creek watershed. Fields 15 and 24 were corn fields; 16 and 23 were soybean fields. The schematic below illustrates how the pits were arranged at the study fields. At each field, two pits were dug within 5 m of each other to a depth of 30 cm. For corn fields, pit A was dug between the rows perpendicular to rows. Pit B was adjacent to a row, 15 cm from the stems of the plants. For soybean fields, the two profiles were established with no regard to row structure.

In each pit, soil moisture and temperature measurements were made at six depths: 2, 5, 10, 15, 20, and 30 cm. Soil moisture was measured at each depth using a WCR, a device based on time domain reflectometry. WCRs were installed with both rods in the horizontal plane. The WCR rods in pit A were installed parallel to and equidistant from the rows. The rods in pit B were installed perpendicular to and under the crop row. Soil temperature was measured at the six depths in pit A using soil temperature probes (STPs). In addition, the mean 0-5 cm temperature was measured in pit A using 4-sensor averaging thermocouple (TCAV) probes installed at 1, 2, 3, and 4 cm depths. A tipping bucket rain gauge having 0.1 mm resolution was deployed above the vegetation at each plot.

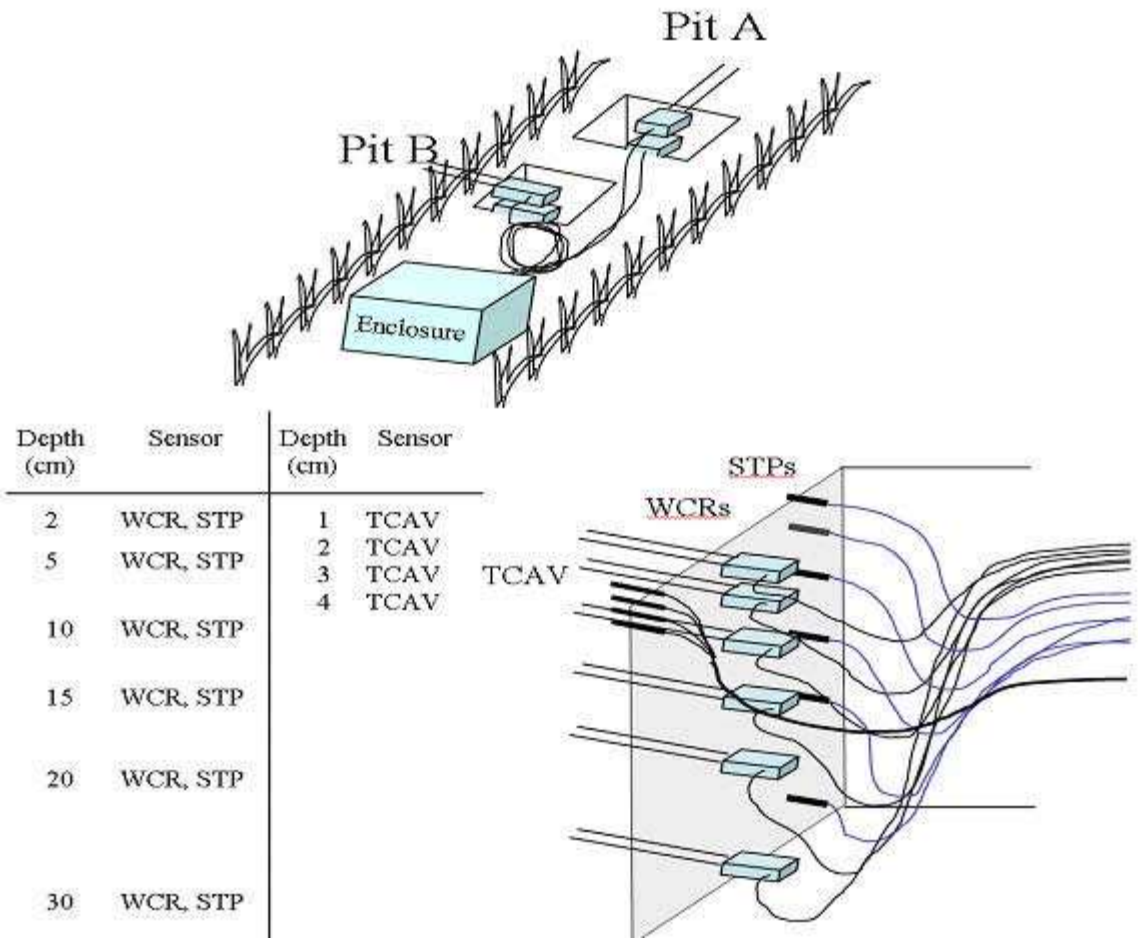

Figure 1. Schematic drawing of the pit configurations, courtesy of Alabama A&M University

3.1 Derivation Techniques and Algorithms

3.1.1 Processing Steps

Conversion of WCR periods to volumetric water content (VWC) is a two-step process. The period is corrected for temperature effects, and then the temperature-corrected period is used to obtain VWC.

Temperature-corrected period (tcor) is calculated from measured period (tmeas) and soil temperature (T) at the same depth using:

$$tcor = tmeas - (T-22)[tmeas(1 - c1) - co]/15$$

where co = 0.80 and c1 = 0.1824.

3.1.2 Error Sources

Missing and erroneous data were identified based on field notes and post-experiment examination of output. Missing periods of brief duration (approximately one hour or less) were filled using linear interpolation. The following tables indicate dates and times of missing or bad data and what action was used to correct them.

Site 15

Data begins 174/1715, ends 193/1115

Sensor	Date/time	Explanation	Data Correction
WCR Per B15	180/1115	Checking sensor wiring	Interpolated
WCR Per B20	180/1100-1115	Checking sensor wiring	Interpolated
WCR Per B20	183/1000	Connecting storage module	Interpolated
Soil T A5	Before 183/1015	Bad sensor	Set to missing value
All WCRs	187/1230-1630	Intermittent battery problem	Interpolated periods

Site 16

Data begins 174/1615, ends 193/1145

Sensor	Date/time	Explanation	Data Correction
Soil T A2	All	Sensor improperly deployed	Set to missing value
Rain	191/1945-2030	Unknown	Set to Field 15 value

Field 23

Data begins 175/1415, ends 204/1345

Sensor	Date/time	Explanation	Data Correction
WCR B10, B15	All	All Data indicates sensors were too shallow	None; data are suspect

Field 24

Data begins 175/1515, ends 204/1345. No missing or bad data.

3.2 Sensor or Instrument Description

The WCRs were calibrated post-experiment using data from soil cores taken daily at each field. This was done to improve the fit (relative to the default Campbell equation) between WCR gravimetric water content (GWC) estimates and GWC measured at each site. VWC is computed from the calibrated WCRs. Temperature-corrected periods for the WCRs were compared at each

site with GWC values from the sliced cores for the corresponding depths, 2 cm and 5 cm. WCR measurements at these depths were compared with sliced core data for 0-4 cm and 4-6 cm layers. Soil core data were not available for greater depths. The following table summarizes the linear regression analysis for each field and sensor. Columns labeled A sites, B sites, and All sites contain coefficients derived by pooling the indicated data. The A2 and B2 columns refer to the 2 cm measurements for each site. The A5 and B5 columns refer to the 5 cm measurements for each site. The linear regression equations shown in the tables below were applied to each sensor as follows.

Note: Values in italics were not applied in computing the final calibrated VWC values.

Field 15

Sensor	A2	B2	A5	B5	A sites	B sites	All sites
Correlation	0.94	0.97	0.90	0.96	0.89	0.94	*0.70*
Slope	62.45	84.76	48.70	62.75	52.80	72.43	*35.58*
Intercept	-58.24	-69.90	-45.02	-50.22	-48.81	-58.95	*-25.75*

Field 16

Sensor	A2	B2	A5	B5	A sites	B sites	All sites
Correlation	*0.90*	0.93	*0.81*	0.89	*0.85*	0.81	0.81
Slope	*120.86*	94.79	*76.73*	56.95	*99.54*	60.96	71.80
Intercept	*-12.12*	-80.37	*-66.37*	-47.43	*-90.0*	-49.44	*-60.94*

Field 23

Sensor	A2	B2	A5	B5	A sites	B sites	All sites
Correlation	0.87	0.93	0.83	0.87	0.48	0.78	*0.55*
Slope	75.07	81.17	86.09	69.60	21.26	53.87	*27.21*
Intercept	-63.99	-68.99	-93.54	-63.45	-12.51	-44.37	*-18.03*

Field 24

Sensor	A2	B2	A5	B5	A sites	B sites	All sites
Correlation	0.90	0.91	0.81	0.92	0.65	0.76	*0.63*
Slope	72.33	51.37	53.03	52.72	32.35	32.97	*26.09*
Intercept	-68.44	-38.14	-54.28	-47.34	-24.93	-21.62	*-15.63*

For sensors at 2 cm and 5 cm, the equation for the specific sensor was applied. For sensors at depths of 10, 15, 20 and 30 cm, the equation for A sites or B sites was applied. The exception was at Field 16 for the A sensors. The large slope and intercept values in the A2 and A sites equations resulted in some negative moisture contents. Therefore, the All sites equation was applied for all A sensors at Field 16. For other sites, the All sites equations were not used, but are shown here for completeness.

The regression model is of the form

GWC = Slope* t_{cor} + Intercept

For example, for Field 15, sensor A2, if t_{cor} = 1.0 msec, then:

GWC = 62.45*1.0 - 58.24 = 4.21 (%)

GWC was then converted to VWC using the following bulk densities for each field:

Field	Bulk density (g/cm^3)
15	1.20
16	1.15
23	1.25
24	1.15

4 REFERENCES AND RELATED PUBLICATIONS

Please see the SMEX02 site for more information, and the AMSR-E site to access data.

5 CONTACTS AND ACKNOWLEDGMENTS

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6 DOCUMENT INFORMATION

6.1 Publication Date

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6.2 Date Last Updated

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