SMEX02 Iowa Regional Ground Soil Moisture Data, Version 1

USER GUIDE

How to Cite These Data

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

Jackson, T., M. Cosh, and J. Famiglietti. 2003. *SMEX02 Iowa Regional Ground Soil Moisture Data, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/602254K8XDBX. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0182

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DETAILED DATA DESCRIPTION

1.1 Format

ASCII tab-delimited text files. The following tables detail the column headings for each data file.

`IA_GSM_Raw_V2.txt` - Gravimetric Soil Moisture Raw Data Columns

Column Heading	Description
Date	month/day/year
DOY	Numerical day of the year
IA Site	Site location identification number
CanID	Can identification number
Depth	Depth (cm)
WetWgt	Wet weight (g)
DryWgt	Dry weight (g)
GSM	Gravimetric soil moisture in grams of water per grams of dry soil
CanWgt (g)in grams	
Bulk_Density	Bulk density (g/cm^3)
VSM	Volumetric soil moisture (m^3/m^3)

`IA_TEMP_RAW.txt` - Soil and Surface Temperature Raw Data Columns

Column Heading	Description
Date	Month/day/year
DOY	Numerical day of the year (Julian date)
IA Site	Site location identification number
Latitude	Latitude in decimal degrees
Longitude	Longitude in decimal degrees
Easting	UTM Easting in meters (Zone 15)
Northing	UTM Northing in meters (Zone 15)
Time	Local daylight saving time
surface	Surface temperature in °C
1cm	Soil temperature at 1 cm depth in °C
5 cm	Soil temperature at 5 cm depth in °C
10cm	Soil temperature at 10 cm depth in °C

`IA_TP_RAW.txt and IA_TP_SUM.txt` - Theta Probe Raw and Summary Data Columns

Column Heading	Description
Date	Month/day/year
DOY	Numerical day of the year (Julian date)
SiteID	Site location identification number
Latitude	Latitude in decimal degrees

Longitude	Longitude in decimal degrees
Easting	UTM Easting in meters (Zone 15)
Northing	UTM Northing in meters (Zone 15)
Row	Location in tilled row: 0=in row; for example, in line with planted corn or soybeans 0.5=midpoint between two rows
mV	Theta probe output in volts (V)
Stdev (in IA_TP_SUM.txt only)	Standard deviation of voltage output in V
VSM_gc	Volumetric soil moisture content from generalized calibration of voltage data
Stdev (in IA_TP_SUM.txt only)	Standard deviation of VSM_gc
VSM_ssc	Volumetric soil moisture content from specific calibration of voltage data
Stdev (in IA_TP_SUM.txt only)	Standard deviation of VSM_ssc

1.2 File and Directory Structure

Directory structure is set up according to the type of data:

- gravimetric
- soil_and_surface_temp
- theta_probe
- theta_probe_avg

1.3 File Naming Convention

Most file names contain the letters IA to designate the Iowa regional soil moisture site. Raw data files in each directory contain the word RAW, summary data files contain the word SUM. Some files also contain a version number (such as V2 for version 2) if the file has been revised.

1.4 Spatial Coverage

Southernmost Latitude: 41.7º N

Northernmost Latitude: 42.7º N

Westernmost Longitude: 93.8º W

Easternmost Longitude: 93.2º W

1.5 Temporal Coverage

25 June 2002 to 12 July 2002

1.5.1 Temporal Resolution

All data were collected daily at multiple sites.

1.6 Parameter or Variable

Parameters in this data set are: gravimetric and volumetric soil moisture, bulk density, and soil and surface temperatures. The following table describes the units of measurement and sources of each parameter.

Parameter	Unit of Measurement	Sensor
Gravimetric soil moisture	grams of water per grams of dry soil	manual soil collection
Volumetric soil moisture	grams of water per grams of dry soil	manual soil collection
Bulk density	grams per cubic centimeter (g/cm^3)	manual soil collection
Surface and soil temperature	degrees Celsius	OS643-LS Infrared
Surface and soil temperature (volumetric)	degrees Celsius	Theta Probes
Soil Moisture	Water Fraction Volume (m^3/m^3)	Theta Probes

1.6.1 Sample Data Record

The following is a sample from the gravimetric data file "IA_GSM_Raw_V2.txt":

Date	DOY	IA Site	CanID	Depth	WetWgt	DryWgt	GSM	CanWgt	Bulk_Density		VSM
6/25/2002		176	1	961	1	66.6	65	0.061	38.69	1.149	0.055
6/25/2002		176	1	962	2	162.7	140.9	0.213	38.43	0.895	0.191
6/25/2002		176	2	963	1	81.3	79.1	0.054	38.62	1.768	0.053
6/25/2002		176	2	964	2	174.7	151.7	0.204	38.85	0.985	0.201
6/25/2002		176	3	965	1	58.6	58.1	0.026	38.75	0.845	0.026
6/25/2002		176	3	966	2	174.1	151.4	0.201	38.69	0.984	0.198
6/25/2002		176	4	967	1	74.3	72.9	0.04	38.13	1.518	0.060

The following sample is taken from the soil and surface temperature average data file "IA_TEMP_RAW.txt":

Date	DOY	IA Site	LatitudeLongitude		Easting	NorthingTime		surface	1cm	5 cm	10cm
6/25/2002	176	1	42.6599	-93.7174	441207	4723296	11:50	35.0	27.0	25.5	23.3
6/25/2002	176	2	42.5872	-93.7058	442086	4715215	12:25	40.0	37.3	30.6	27.2
6/25/2002	176	3	42.5066	-93.7192	440911	4706278	13:00	42.0	38.3	33.0	27.9
6/25/2002	176	4	42.4122	-93.7280	440099	4695803	13:35	36.0	31.0	29.4	27.6
6/25/2002	176	5	42.3417	-93.7287	439977	4687974	14:10	39.0	29.0	27.1	25.5
6/25/2002	176	6	42.2555	-93.6991	442333	4678376	14:40	45.0	48.7	32.5	28.4

2 DATA ACQUISITION AND PROCESSING

2.1 Theory of Measurements

The regional soil moisture site is within a single satellite passive microwave footprint (approximately 50 km), and measurements were taken around the time of the Aqua AMSR overpass (13:30 local time). The goal of soil moisture sampling in these regional sites is to provide a reliable estimate of volumetric soil moisture and variance within the AMSR-E footprint.

2.1.1 Section Sampling

Sampling was performed on sites approximately a quarter section (0.8 km by 0.8 km) in size. A grid of 47 individual sites was sampled, covering approximately 50 km by 100 km (4 by 12 sites). One location in each of the 47 sites was sampled. The sampling was conducted between 12:00 and 15:00 local time.

2.1.2 Gravimetric and Volumetric Sampling

The primary measurement was the 0-6 cm dielectric constant at a single location in each site using Theta Probes. The dielectric constant is converted to volumetric soil moisture using a calibration equation. Volunteers used a coring tool to extract a single soil moisture sample of the 0-1 cm and 1-6 cm soil layers.

2.1.3 Computing Volumetric Soil Moisture and Bulk Density

Samplers used the following steps to compute volumetric soil moisture and bulk density:

- Compute the gravimetric soil moisture (GSM) and dry mass
- Divide the dry mass of the soil by the volume of the cylinder (1 or 5 cm) to obtain the bulk density (BD)
- Compute volumetric soil moisture (VSM):
  VSM=GSM*BD
  Note: for the 0-1 cm samples, the 1-6 cm BD was used because of the unreliability of the 0-1 cm samples

2.2 Derivation Techniques and Algorithms

2.2.1 Theta Probe

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 probe 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 theta probe was used.

2.3 Sensor or Instrument Description

2.3.1 Gravimetric and Soil Moisture

Samples were collected manually. In the laboratory they were weighed, dried, then weighed again.

2.3.2 Theta Probes

Investigators also used theta probes to measure surface volumetric soil moisture. The probes were Type ML2 manually-operated impedance instruments manufactured by Delta-T Devices, Ltd. The theta probes have 4 separate 6-cm stainless steel rods that were inserted vertically into the soil. Each instrument was connected to a handheld reader, which delivers the electrical pulse, detects the return signal, and converts the period to voltage between 0 and about 1 V.

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

$$\text{Theta} = \frac{1.07 + 6.4V - 6.4V^2 + 4.7V^3 - a_0}{a_1}$$

where a_0 and a_1 are 1.6 and 8.4, respectively. These estimates are provided in the data files.

Researchers also performed soil specific calibration for each field of sampling. Theta probe 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 VSM values were estimated.

3 REFERENCES AND RELATED PUBLICATIONS

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

4 CONTACTS AND ACKNOWLEDGMENTS

Thomas J. Jackson, Hydrologist, Mike Cosh, General Physical Scientist, USDA ARS Hydrology Lab; and Jay Famiglietti, Associate Professor, Earth System Science, University of California.

Acknowledgments:

Many graduate students and volunteers worked to collect the field data.

5 DOCUMENT INFORMATION

5.1 Publication Date

July 2003

5.2 Date Last Updated

14 April 2021