SMEX04 Regional Soil Moisture Data: Sonora

Summary

This data set combines data for several parameters measured for the Soil Moisture Experiment 2004 (SMEX04) in Sonora, Mexico. SMEX04 was conducted during August of 2004 to coincide with the North American Monsoon Experiment in the Southwestern U.S. and Northwestern Mexico. The parameters include volumetric soil moisture estimated from the Theta Probe, soil temperature and gravimetric soil moisture from soil sampling. The data were obtained from a group of regional sampling teams in sites within six regional boxes (25-km by 25-km). One text file containing the manually-recorded data set is provided for simplicity. Data provided here span from August 4, 2004 through August 15, 2004, where available. Data is provided in one ASCII text file available via FTP.

The Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) is a mission instrument launched aboard NASA's Aqua Satellite on 4 May 2002. AMSR-E validation studies linked to SMEX are designed to evaluate the accuracy of AMSR-E soil moisture data. Specific validation objectives include assessing and refining soil moisture algorithm performance, verifying soil moisture estimation accuracy, investigating the effects of vegetation, surface temperature, topography, and soil texture on soil moisture accuracy, and determining the regions that are useful for AMSR-E soil moisture measurements.

Citing These Data:

Vivoni, E. R., C. J. Watts, J. C. Rodríguez, and L. A. Méndez-Barroso. 2009. *SMEX04 Regional Soil Moisture Data: Sonora*. Boulder, Colorado USA: NASA DAAC at the National Snow and Ice Data Center.

Overview Table

Category	Description
Data format	ASCII tab-delimited text
Spatial coverage	29.03° N to 31.28° N, 109.73° W to 111.07° W
Temporal coverage	4 August 2004 to 15 August 2004
File naming convention	A single file contains all of the manual measurements for the Sonora region.
File size 272	KB
Parameter(s)	Volumetric soil moisture, soil temperature, gravimetric soil moisture
Procedures for obtaining data	Data are available via FTP.

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1. Contacts and Acknowledgments:

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2. Data Description:

Format:

One ASCII tab-delimited text file.

File Data Containing:

The file contains data from Sonora regional sampling sites taken by student teams from Mexico. The dataset belongs to the SMEX04 (Soil Moisture Experiment 2004). The file contains data from Theta probe sensor, soil thermometer, as well as gravimetric soil moisture taken at several locations within six regional squares (or boxes, each 25-km by 25-km), as described below.

File Size:

File size is 272 KB.

Spatial Coverage:

Southernmost Latitude: 29.028702 N
Northernmost Latitude: 31.283901 N
Westernmost Longitude: 111.074860 W
Easternmost Longitude: 109.732430 W

Figure 1 shows the spatial coverage as well as the study site divided into six regional squares with the sample point locations.

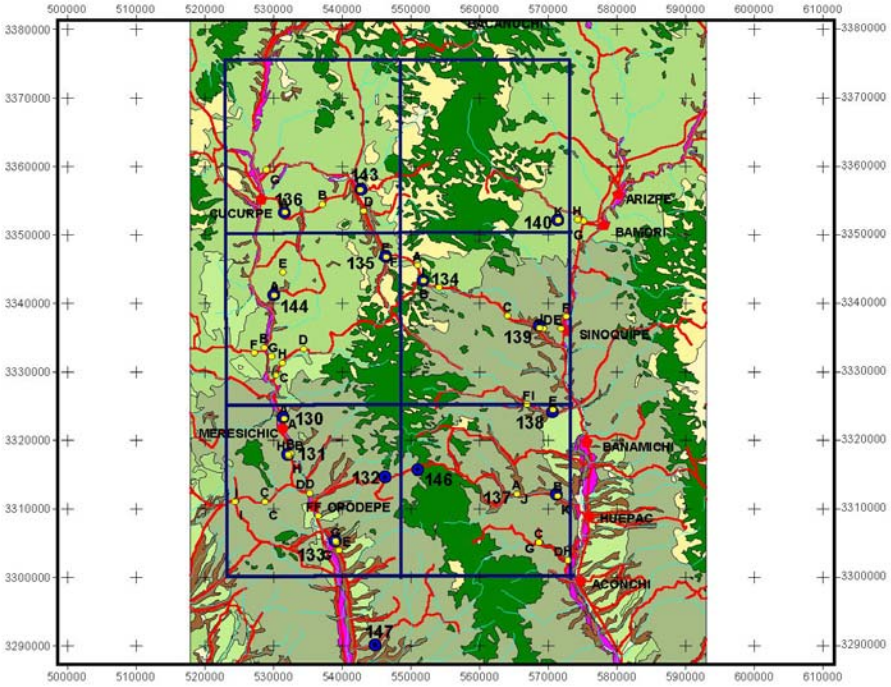

Figure 1. Spatial coverage and sampling point locations

The numeration of the squares used in this dataset based in the map previously described above is shown in Figure 2.

1	2
3	4
5	6

Figure 2. Square distribution inside the study area, each is 25-km by 25-km.

Spatial Location:

SQUARE	LOCATION	X_M	Y_M	Z_M
1	A	531640	3353299	994
1	B	537109	3354456	1048
1	C	542578	3356545	957
1	D	543122	3353497	993
1	E	546387	3346806	1046
1	F	546388	3346805	1075
1	G	528907	3359452	906
2	G	575154	3352019	886
2	H	574232	3352202	948
2	K	571456	3352055	1007
3	A	530141	3341138	786
3	B	528598	3333507	790
3	C	530264	3329526	783
3	D	534351	3333307	898
3	E	531404	3344524	832
3	F	527206	3332641	847
3	G	529699	3332195	763
3	H	531242	3331272	795
4	A	550937	3345488	1137
4	B	554044	3342268	1109
4	C	564037	3338105	876
4	D	569271	3336271	752
4	E	571866	3336270	763
4	F	572570	3338021	747
4	I	551853	3343283	1193
4	J	568742	3336421	766
5	A1	531512	3323111	717
5	A2	531523	3323093	720
5	B1	532561	3317885	693
5	B2	532519	3318065	690
5	C1	528766	3311026	904
5	C2	528762	3310948	903
5	D1	535266	3312232	621
5	D2	535277	3312254	644
5	E1	539514	3303828	618
5	E2	539490	3303846	612
5	F1	536484	3308897	649
5	F2	536484	3308925	638
5	G1	539139	3305014	665
5	G2	539043	3305199	631
5	H1	532225	3317645	766
5	H2	532123	3317806	717
5	I1	524493	3311036	963
5	I2	524408	3310996	955
6	A	565384	3312129	702
6	B	571358	3311868	655
6	C	568654	3305027	646
6	D	572848	3302435	598
6	E	570692	3324462	731
6	F	566905	3325235	769
6	G	568645	3305001	648
6	H	572856	3302448	610
6	I	566914	3325223	756
6	J	565389	3312125	721
6	K	571350	3311863	655

Temporal Coverage:

Temporal coverage of dataset goes from August 4 th 2004 (Julian day 217) to August 15th 2004 (Julian day 228).

Temporal Resolution:

All variables were taken at different times on a daily basis over the study period. The columns HOUR and MIN indicate the hour and minute that each sample was measured.

Parameter or Variable:

Parameter Description:

Parameters in this data set include volumetric soil moisture, voltage, soil temperature and gravimetric soil moisture. The following table describes the units of measurement and sources of each parameter.

Parameter	Unit of measurement	Sensor
Voltage	mV (millivolts)	Theta probe
Soil Temperature	Celsius degrees	Thermometer
Soil Moisture	Percentage (%)	Theta probe and gravimetric soil samples

The volumetric soil moisture (θ in [m^3 / m^3]) was calculated using the following formula:

$$\theta = \frac{\left[1.07 + 6.4V - 6.4V^2 + 4.7V^3\right] - a_o}{a_1}$$

where V is voltage (in volts), a_o and a_1 are parameters. We considered all soil in Sonora sites as mineral soil, therefore the values for the constants were: a_o = 1.6 and a_1 = 8.4.

Gravimetric soil moisture was transformed to volumetric water content using an average bulk density value for the study area. The bulk density of the area was assumed to be 1.25 g/cm^3 based on averaging existing field measurements.

Parameter Range:

The following tables detail the column headings for each data file. No data flag -6999 was utilized. A dash (-) represents that data was not collected at the point.

Column Header	Description
SQUARE	Describe the site ID for each square (1 to 6)
LOC	Location of the sample (labeled with letters)
X_M	'X' coordinate of the sampling point in UTM 12-N coordinated system (meters) from GPS
Y_M	'Ý' coordinate of the sampling point in UTM 12-N coordinated system (meters) from GPS
Z_M	Height above the sea level (meters) from GPS
DEPTH	Depth range which the soil moisture were measured (cm)
YEAR	Year when the variables were collected
DOY	Julian day of the year, 2004
HOUR	Hour of the day at which the sample was measured
MIN	Minute of an hour at which the sample was measured
STEMP_1	Soil temperature at 1 cm depth (C)
STEMP_5	Soil temperature at 5 cm depth (C)
STEMP_10	Soil temperature at 10 cm depth (C)
VOLT	Voltage of Theta probe sensor (mV)
VSM	Volumetric Soil Moisture measured with theta-probe sensor (%)
CANWT	Can weight used for gravimetic estimation of soil moisture (grams)
WWT	Wet weight of the sample (grams)
DWT	Dry weight of the sample (grams)
GSM	Gravimetric soil moisture (%)
VSM_2	Volumetric soil moisture calculated from the gravimetric sample (%)

3. Data Access and Tools:

Data Access:

Data are available via FTP.

Software and Tools:

No special tools are required to view these data. A spreadsheet program, which recognizes tab-delimited text files, such as MS Excel, is recommended.

Related Data Collections:

See related information on the Soil Moisture Experiment (SMEX) Web site:
http://nsidc.org/data/amsr_validation/soil_moisture/index.html

4. Data Acquisition and Processing:

Theory of Measurements:

Sampling Technique

A scoop tool was used to retrieve approximately the top 6 cm of soil at each site.

Sensor or Instrument Description:

Gravimetric

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

Theta Probes

Investigators 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 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 V and about 1 V. Transect surface soil moisture was sampled each day (9:00AM-4:00PM) during the experiment.

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

$Theta=(1.07+6.4*V-6.4*V2+4.7*V3-a_0)/a_1$

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

Processing Steps:

Gravimetric Processing

Researchers weighed the wet soil obtained in the field, heated the soil in an oven to dry it, then weighed the dry soil.

5. References and Related Publications:

Please see the SMEX04 site for more information, and the NSIDC SMEX site to access data:
http://nsidc.org/data/amsr_validation/soil_moisture/smex04/index.html

6. Document Information:

List of Acronyms

The following acronyms are used in this document:

AMSR-E - Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E)
FTP – File Transfer Protocol
GSM – Gravimetric Soil Moisture
SMEX - Soil Moisture Experiment
UTM - Universal Transverse Mercator
VSM – Volumetric Soil Moisture

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