



SMAPVEX16 Manitoba Probe-Based In Situ Soil Moisture Data, Version 1

USER GUIDE

How to Cite These Data

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

McNairn, H., K. Gottfried, and J. Powers. 2018. *SMAPVEX16 Manitoba Probe-Based In Situ 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/10.5067/1U1H8BGW6GDM>. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SV16M_PSM



National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

Table 1 describes the parameters included in this data set.

Table 1. Parameters

Parameter	Location of Measurement	Units	Sensor
Soil Moisture	Depth of 0 - 5 cm	cm ³ / cm ³	Steven's Poke and Go (POGO)
Real Dielectric Constant (RDC)	Depth of 0 - 5 cm	millivolts, mV	Steven's Poke and Go (POGO)
Soil Temperature	Depth of 0 - 5 cm	degrees Celsius, °C	Probe thermometer
Soil Surface Temperature	Sunlit and shaded surfaces	degrees Celsius, °C	Infrared Radiometer (IR)
Vegetation Temperature	Sunlit and shaded surfaces	degrees Celsius, °C	Infrared Radiometer (IR)

1.2 File Information

1.2.1 Format

Data are available in Comma-Separated Values (.csv) files.

Location information for the relevant field sites are available in a Keyhole Markup Language zipped (.kmz) file.

Extensible Markup Language (.xml) files with associated metadata are also provided.

1.2.2 File Contents

Soil moisture and RDC data are presented in one file, SV16M_PSM_SoilMoistureHandheld_Vers3.csv. Table 2 describes the contents of this file in more detail, while Figure 1 displays the file headers and ten lines of sample data.

Table 2. Soil Moisture and RDC Data Column Descriptions

Column Header	Description
SITE_ID	Unique ID of the field site where sampling occurred. Each field had 16 possible sample locations.
TIMESTAMP	Date and time of sampling in Central Daylight Savings Time (YYYY-MM-DD HH:MM)
LOCATION	Identifies where the POGO was inserted relative to the planter/seeder furrow (top, middle, or bottom) or marks the measurement as a calibration for soil core samples
RDC	Real dielectric constant (mV), measured at a depth of 0 - 5 cm
SOIL_MOISTURE	Calibrated volumetric soil moisture (cm ³ /cm ³), measured at 0-5 cm depth

SITE_ID	TIMESTAMP	LOCATION	RDC	SOIL_MOISTURE
14-16	6/8/16 11:03	Bottom	8.543	0.157
14-16	6/8/16 11:03	Middle	8.334	0.154
14-16	6/8/16 11:03	Top	6.509	0.118
14-15	6/8/16 11:01	Bottom	9.636	0.177
14-15	6/8/16 11:01	Middle	9.147	0.168
14-15	6/8/16 11:01	Top	8.615	0.159
14-14	6/8/16 11:00	Bottom	9.573	0.176
14-14	6/8/16 10:59	Middle	9.217	0.17
14-14	6/8/16 10:59	Top	8.89	0.164
14-13	6/8/16 10:58	Bottom	9.227	0.17

Figure 1. Sample Data

Soil and vegetation surface temperatures are presented in a second file, SV16M_PSM_SoilCropTemp_Vers3.csv. Table 3 describes the contents of this file in more detail, while Figure 2 displays the file headers and ten lines of sample data.

Table 3. Soil and Vegetation Temperature Data Column Descriptions

Column Header	Description
SITE_ID	Unique ID of the field site where sampling occurred. Each field had 16 possible sample locations.
START_TIME	Date and time at the start of sampling, in Central Daylight Savings Time (YYYY-MM-DD HH:MM)
END_TIME	Date and time at the end of sampling in Central Daylight Savings Time (YYYY-MM-DD HH:MM)
SOIL_TEMP_5	Soil temperature taken at a depth of 5 cm, °C
SOIL_TEMP_10	Soil temperature taken at a depth of 10 cm, °C
SUN_VEG_TEMP	Temperature of sunlit vegetation surfaces, °C
SHADE_VEG_TEMP	Temperature of shaded vegetation surfaces, °C
SUN_SOIL_TEMP	Temperature of sunlit soil surfaces, °C
SHADE_SOIL_TEMP	Temperature of shaded soil surfaces, °C

SITE_ID	START_TIME	END_TIME	SOIL_TEMP_5	SOIL_TEMP_10	SUN_VEG_TEMP	SHADE_VEG_TEMP	SUN_SOIL_TEMP	SHADE_SOIL_TEMP
103-1	6/8/16 5:41	6/8/16 7:15	11.9	13.7	6.7	6.9	6.3	6.9
103-16	6/8/16 5:41	6/8/16 7:15	13.2	14.2	11.2	11.2	11.6	11.7
103-8	6/8/16 5:41	6/8/16 7:15	11.7	13.9	10.3	10.1	10.9	10.7
103-9	6/8/16 5:41	6/8/16 7:15	13.3	14.5	10.2	10.1	11	10.6
43-1	6/8/16 5:43	6/8/16 6:56	12.3	14	7.8	7.7	7.8	7.5
43-16	6/8/16 5:43	6/8/16 6:56	12.7	13.9	11.1	11.1	11.9	11.9
43-8	6/8/16 5:43	6/8/16 6:56	12.6	13.9	10.3	10.3	10.6	10.6
43-9	6/8/16 5:43	6/8/16 6:56	13.1	14.3	10.3	10.3	11.3	11.3
227-1	6/8/16 5:55	6/8/16 7:45	11.3	12.7	9.8	9.8	9.6	9.8
227-8	6/8/16 5:55	6/8/16 7:45	12	13.3	10.3	10.3	10	10

Figure 2. Sample Data

1.2.3 Naming Convention

File names are:

SV16M_PSM_SoilCropTemp_Vers3.csv

SV16M_PSM_SoilMoistureHandheld_Vers3.csv

SV16M_PSM_FieldSites.kmz

SV16M_PSM is short for SMAPVEX16 (Soil Moisture Active Passive Validation Experiment 2016) Manitoba Probe-Based In Situ Soil Moisture Data.

1.2.4 File Size

CSV files range between approximately 0.15 and 1.3 MB.

The KMZ files is approximately 29 KB.

1.3 Spatial Information

1.3.1 Coverage

Northernmost Latitude: 49.761171° N

Southernmost Latitude: 49.384076° N

Easternmost Longitude: 97.756264° W

Westernmost Longitude: 98.098417° W

1.3.2 Resolution

Data are point measurements. The distance between measurements varied.

1.3.3 Geolocation

Table 4 provides information on the appropriate coordinate reference system for this data set.

Table 4. Coordinate Reference System

Geographic coordinate system	NAD83(CSRS)
Projected coordinate system	NAD83(CSRS) / UTM Zone 14N
Longitude of true origin	-99
Latitude of true origin	0
Scale factor at longitude of true origin	0.9996
Datum	NAD83 Canadian Spatial Reference System
Ellipsoid/spheroid	GRS 1980
Units	meter
False easting	500000
False northing	0
EPSG code	3158
PROJ4 string	+proj=utm +zone=14 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
Reference	https://epsg.io/3158

1.4 Temporal Information

1.4.1 Coverage

08 June 2016 through 22 July 2016

1.4.2 Resolution

Locations were sampled on 13 separate dates during the campaign. The time between measurements varied.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

This data set was collected as part of the [2016 Soil Moisture Active Passive Validation Experiment](#) conducted in the Carman/Elm Creek region of Manitoba, Canada. The experiment was designed to calibrate and increase the accuracy of NASA's Soil Moisture Active Passive (SMAP) products. For this data set, soil moisture measurements were collected to coincide with SMAP satellite overpasses and Passive Active L- and S-band Sensor (PALS) flights.

2.2 Acquisition

Data were collected on seven dates during Phase 1 (8 June to 20 June 2016) of the campaign and six dates during Phase 2 (10 July to 22 July 2016). All measurements were collected to coincide with SMAP satellite overpasses and PALS flight days. Prior to the campaign, the location of each sample site was assigned in ArcGIS. During the campaign, sites were identified using Garmin GPS units. The accuracy of each GPS unit was approximately 3 m.

A Stevens Poke and Go (POGO) unit was used to collect real dielectric constant (RDC) data at 50 agricultural fields and two radiometer sites. Each field had a total of 16 sampling locations. Three measurements were taken at each sampling location - one at the top of the crop ridge, one in the middle of the crop ridge, and one at the bottom of the furrow (Figure 3). A total of 48 measurements were collected per field on each sampling date. For all samples the POGO unit was inserted perpendicular to the soil surface (Figure 3).

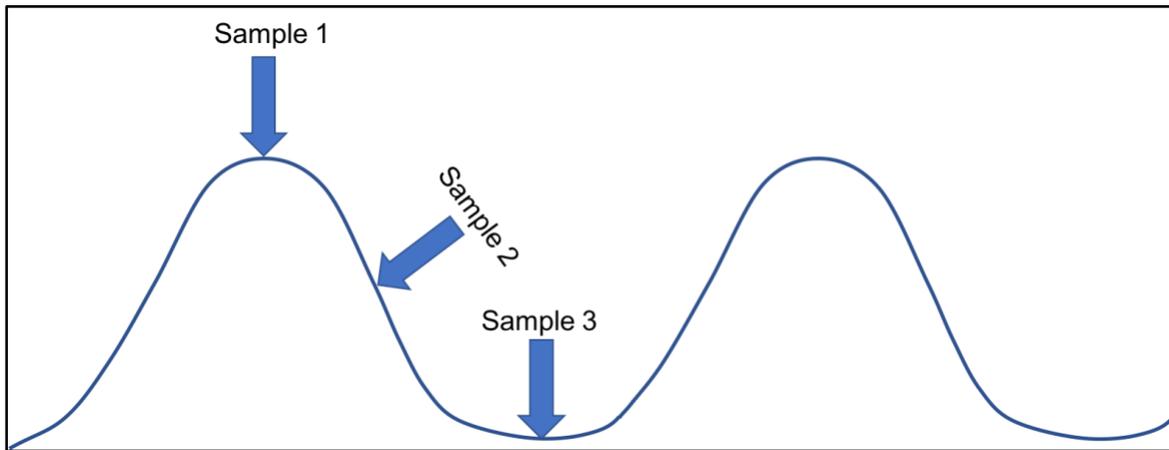


Figure 3. Three soil moisture measurements were collected at each sampling location.

As a means of calibration, three measurements were made approximately 10 cm from volumetric soil core samples (see [SMAPVEX16 Manitoba Core-Based In Situ Soil Moisture Data](#) for more details). Soil core samples were collected from Site 1 and one other sampling location (Sites 2-16). Soil cores represented a range of soil moisture conditions (wet through dry). A total of six calibration measurements were collected per field on each sampling date. Calibration was conducted per the methodologies described by Rowlandson et al. 2013.

Temperature measurements were taken at 50 agricultural fields. Though each field had a total of 16 sampling location, temperatures were only measured at Sites 1, 8, 9, and 16. A probe thermometer was used to record soil temperature at depths of 5 cm and 10 cm at each site. An Infrared Radiometer (IR) was used to record shaded and unshaded soil and vegetation surface temperatures.

2.3 Processing

Soil moisture was derived from RDC values using field-specific calibration equations. The basic form of the calibration equation is:

$$\theta_v = a(RDC)^{0.5} + b$$

where θ_v = soil moisture, RDC = the measured real dielectric constant, and a and b are constants. Per Rowlandson et al. 2013, a linear regression was used to define the constants a and b . This regression utilized the soil moisture values measured through the volumetric soil core samples (see [SMAPVEX16 Manitoba Core-Based In Situ Soil Moisture Data](#) for more details) and the three corresponding RDC readings.

2.4 Quality, Errors, and Limitations

All data has been quality controlled; any erroneous records have been removed. Null values appear where error or instrument failure occurred. Records were removed when no measurements were made at a site.

2.5 Instrumentation

2.5.1 Description

Temperature measurements were collected using a probe thermometer and infrared radiometer.

Soil moisture and RDC data were collected using a Stevens Poke and Go (POGO) sensor. Table 5 contains specifications for this sensor; more details can be found on the [POGO Turf Pro](#) website.

Table 5. Stevens POGO Specifications

Number of sensor tines	4
Sensor tine length	2.26" (5.74 cm)
Sensor tine diameter	0.125" (3.175 mm)
Sample volume	3.6 cubic inches (59 cm ³)
Moisture - range	Completely dry to fully saturated
Moisture - accuracy	± 0.01 wfv for most soil systems, no more than ± 0.03 wfv for very fine textured soils
Electroconductivity (EC in dS/m) - range	0.1 - 15.0 dS/m (mmhos/cm)
Electroconductivity (EC in dS/m) - accuracy	± 2.0% or 0.05 dS/m
Canopy temperature - range	-10.0°C - 55.0°C
Canopy temperature - accuracy	± 0.1°C

3 RELATED DATA SETS

[SMAP Validation Experiment 2016 Soil Core Data](#)

[SMAP Data | Overview](#)

4 RELATED WEBSITES

[SMAP at NASA](#)

[SMAPVEX16](#)

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6 REFERENCES

Rowlandson, T. L., Berg, A. A., Bullock, P. R., Ojo, E. R., McNairn, H., Wiseman, G., and Cosh, M. H. 2013. Evaluation of several calibration procedures for a portable soil moisture sensor. *Journal of Hydrology* 498:335-344. DOI: [10.1016/j.jhydrol.2013.05.021](https://doi.org/10.1016/j.jhydrol.2013.05.021)

7 DOCUMENT INFORMATION

7.1 Publication Date

3 August 2018

7.2 Date Last Updated

27 September 2018