SMAPVEX08 Surface Roughness Data, Version 1

USER GUIDE

How to Cite These Data

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

Cosh, M. and R. Bindlish. 2015. *SMAPVEX08 Surface Roughness Data, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/1UCIETYP0PUO. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SV08SR

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

Surface roughness measurements for this data set were collected at several field sites as part of the Soil Moisture Active Passive Validation Experiment 2008 (SMAPVEX08) campaign.

1.1 Format

Data are provided in the ASCII tab-delimited text file `SMAPVEX08_SR.txt`. An XML metadata file is also provided. The following table describes the column headings and contents in the data file.

Table 1. Data Fields and Descriptions

Column Heading	Description
Name	Field location and orientation (2 photos, 90° from each other)
np	Number of digitized points
sigma	Root mean square error (mm)
length	Correlation length (mm)
asigma	Root mean square error adjusted for slope (mm)
exponent	Power coefficient

1.2 File and Directory Structure

Data files are available at:

https://n5eil01u.ecs.nsidc.org/SMAP_VAL/SV08SR.001/

1.3 File Naming Convention

The data file is named `SV08SR_SMAPVEX08_SR.txt`, where SR indicates surface roughness.

1.4 File Size

The data file is approximately 1.6 KB.

1.5 Spatial Coverage

Southernmost Latitude: 38.8°N

Northernmost Latitude: 39.1°N

Westernmost Longitude: 76.3°W

Easternmost Longitude: 75.6°W

1.5.1 Spatial Resolution

A one-meter grid board was used for in situ measurements.

1.6 Temporal Coverage

Photographs were acquired once per site from 29 September 2008 through 13 October 2008.

1.7 Parameter or Variable

Parameters include root mean square of surface height variation (mm), correlation length (mm), and power coefficient.

1.7.1 Parameter Ranges

Valid parameter values lie in the following ranges:

Root mean square of surface height variation: 0 - 30 mm

Correlation length: 0 - 300 mm

Power coefficient: 0 - 2 (dimensionless)

2 SOFTWARE AND TOOLS

Any text editor or Web browser can read ASCII text files.

3 DATA ACQUISITION AND PROCESSING

3.1 Derivation Techniques and Algorithms

The soil roughness of the SMAPVEX08 data set is described using three parameters; root mean square height (rms height or sigma), correlation length (L) and the correlation function f(L). The root mean square height describes the random surface characteristics, while the correlation length and correlation function describe the periodicity of the soil surface. The correlation function is characterized by a power coefficient n ranging from 1 to 2, where 1 represents a Gaussian height distribution and 2 represents an exponential height distribution. The periodicity and random components of the soil surface roughness are schematically shown in Figures 1a and 1b.

In terms of the mean surface height $\overline{Z}$ and the second moment $\overline{Z^2}$, the rms height is represented by $rms = (\overline{Z} - \overline{Z^2})^{\frac{1}{2}}$, where z is the surface height in cm.

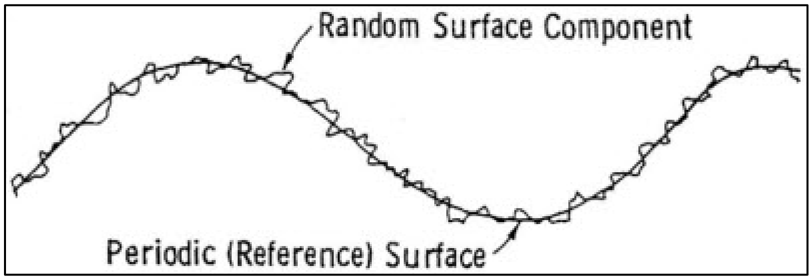

Figure 1. Visualization of random and reference roughness components (Dobson and Ulaby, 1998).

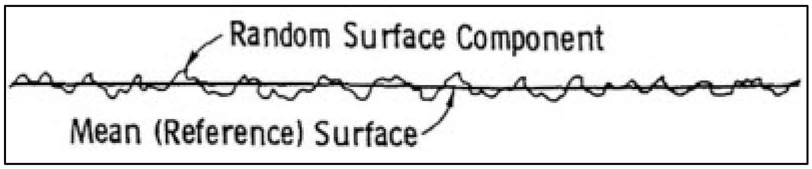

Figure 2. Visualization of random and reference roughness components (Dobson and Ulaby, 1998).

To determine the correlation length and the correlation function, the surface autocorrelation curve needs to be computed. The surface autocorrelation is a measure of the degree of correlation between the height z(x) at point x and the height z(x+d) at point x + d. The following equation can be used to calculate the autocorrelation curve:

$$\rho(d) = \frac{\int z(x)z(x+d)dx}{\int z^2(x)dx}$$

Once the autocorrelation curve has been computed, the correlation length can be determined. The correlation length is defined as the distance (d) at which the autocorrelation < e-1 (ï,» 0.3678). The computed correlation length can be used to fit the theoretical correlation function to the measured autocorrelation curve by optimizing the power coefficient (n). The correlation function is:

$$\rho(d) = \exp\left(d/L\right)^n ,$$

where L is the correlation length (cm) and n is the power coefficient describing the correlation function, which is dimensionless.

3.1.1 Sampling Strategy

At several sites, several representative locations were selected for roughness sampling. At each sampling location, one roughness picture along the row direction and one in the cross-row direction was taken. In the absence of row structure, the two pictures were taken at perpendicular angles. At some roughness sampling sites, one picture was taken. In other cases, pictures were missing.

3.1.2 Digitizing the Pictures

The commercial program Didger 3 was used to digitize the roughness pictures. Before scanning, the dimensions of the board were identified in Didger 3 using reference points on the board. The soil surface was digitized by taking a height measurement at every 1/2 cm (grid scanning). This scanning method provides a random (or normal) distribution of the surface height, which is required for a correct computation of the rms height. However, with this method of scanning some variation in the surface height is neglected, which could influence the computation of the correlation length.

3.1.3 Calculation of the Roughness Parameters

The roughness parameters were calculated using a simple spreadsheet program. Because of the variability in x increment of the digitized surface, the surface was resampled to the nearest 1 mm. The root mean square error was then calculated. Correlation length was calculated as the length at which the autocorrelation function is equal to e-1. The power coefficient was determined by visual comparison of the autocorrelation curves and idealized power curves with some guidance by the root mean square error between the curves.

3.1.4 Errors and Limitations

The roughness parameters are probably the most unreliable parameter in the process of soil moisture retrieval using microwave remote sensing. The first problem is that the scattering characteristics of natural surfaces are very complex and are still not completely understood; this makes validation of measured roughness parameters very difficult.

Second, the scale at which roughness is measured and the scale at which roughness affects microwave backscatter and emission are not the same. The typical resolution of microwave instruments is around or above ten meters, while the grid board is only one meter long. The values of the rms height and the correlation length (L) differ at each scale.

In addition, human error is possible in regard to placing the measurement equipment in the field.

3.2 Version History

Version 1 (June 2015)

4 REFERENCES AND RELATED PUBLICATIONS

Dobson, M. C., and F. T. Ulaby. 1998. "Mapping Soil Moisture Distribution with Imaging Radar," 407- 430. In: Henderson, F. M., and A. J. Lewis. 1998. Principles & Application of Imaging Radar. John Wiley & Sons, New York.

5 CONTACTS AND ACKNOWLEDGMENTS

5.1 Investigators

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5.2 Acknowledgments

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6 DOCUMENT INFORMATION

6.1 Publication Date

June 2015

6.2 Date Last Updated

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