



# SMAPVEX08 Vegetation Water Content Map, Version 1

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## USER GUIDE

### How to Cite These Data

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

Cosh, M. 2015. *SMAPVEX08 Vegetation Water Content Map, Version 1*. [Indicate subset used].

Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center.

<https://doi.org/10.5067/93BW6041HHO2>. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT [NSIDC@NSIDC.ORG](mailto:NSIDC@NSIDC.ORG)

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/SV08VWC>



National Snow and Ice Data Center

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# 1 DETAILED DATA DESCRIPTION

The Vegetation Water Content (VWC) Map for SMAPVEX08, the Soil Moisture Active Passive Validation Experiment 2008, was derived by calculating Normalized Difference Water Index (NDWI) from Satellite Pour l'Observation de la Terre-4 (SPOT-4) overpasses. In addition, samples from a range of vegetation types were used to compare VWC and NDWI to the satellite imagery.

## 1.1 Format

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Data are provided in a binary file and a header file called ENVI FST, which indicates it is an Environment for Visualizing Images dbFast data file. An associated Extensible Markup Language (XML) metadata file is also provided.

ENVI FST (dbFast binary data file)  
BSQ (Band Sequential Format) with one band  
Samples = 8885  
Lines = 7956  
Upper left easting: 375325.0  
Upper left northing: 4361460.0  
Pixel in east-west direction: 10 m  
Pixel in north-south direction 10 m  
Projection: UTM 18 N (WGS84)

## 1.2 File Naming Convention

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The binary data file is named `SV08VWC_vwc.fst` and the header file is `SV08VWC_vwc.hdr`.

## 1.3 File Size

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The data file is approximately 270 MB.

## 1.4 Spatial Coverage

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Southernmost Latitude: 38.93°N

Northernmost Latitude: 39.09°N

Westernmost Longitude: 76.25°W

Easternmost Longitude: 75.55°W

### 1.4.1 Spatial Resolution

10 m

### 1.4.2 Projection

Data are projected to Universal Transverse Mercator (UTM) Zone 18 N, World Geodetic System 1984 (WGS84).

### 1.4.3 Grid Description

Data are on a rectangular grid with a cell size of 10 m by 10 m.

## 1.5 Temporal Coverage and Resolution

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Data were collected on 11 October 2008 at various times.

## 1.6 Parameter or Variable

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Vegetation Water Content (VWC) [kg/m<sup>2</sup>]

### 1.6.1 Parameter Ranges

Valid parameter values are as follows:

Vegetation Water Content: 0-10 kg/m<sup>2</sup>

Missing data: 0

## 2 SOFTWARE AND TOOLS

Various software packages can be used to read the data, such as the Environment for Visualizing Images (ENVI) and Interactive Data Language (IDL).

### 3 DATA ACQUISITION AND PROCESSING

Vegetation Water Content (VWC) was derived from the Normalized Difference Water Index (NDWI), which is a ratio of bands available from the Landsat (5&7) Thematic Mapper. The ratio is defined as:

$$NDWI = (Band4 - Band5) / (Band4 + Band5)$$

One day of SPOT satellite coverage was available for the calculation of NDWI during [SMAPVEX08](#). The overpasses occurred on 11 October 2008. During the study period, local farmers/operators indicated that corn remained relatively stable with respect to moisture, so only one sample of corn was taken pre-harvest and post-harvest. Soybean fields ranged widely depending on the degree of senescence and weed development; therefore, the final soybean value is held as a constant. Extensive forest measurements were made and are described herein.

The first step was to determine the trend of VWC versus NDWI for various vegetation types. All vegetation data is compared to the 7 October 2008 scene. The following equations were used to convert NDWI to VWC:

Table 1. Equations Used to Convert NDWI to VWC

Land Cover	Equation
Grassland	VWC = 1.1922 * NDWI + 0.2347 (From SMEX05 estimate)
Corn	VWC = 9.1269 * NDWI - 4.25
Soybeans	VWC = 0.5328 (a constant)
Forest	VWC = 32.509 * NDWI - 18.364

These equations were applied to the scene when available.

The Corn equation is a result of two data points, one standing dry corn (the common condition at this time of year) and harvested corn with an assumed VWC of 0.0 kg/m<sup>2</sup>.

Soybeans were transitioning from green to dry brown with the majority of moisture contained in the beans themselves. This dynamic has not been captured in previous soil moisture experiments.

Sampling did not reveal a significant pattern therefore a constant was used to estimate soybean VWC.

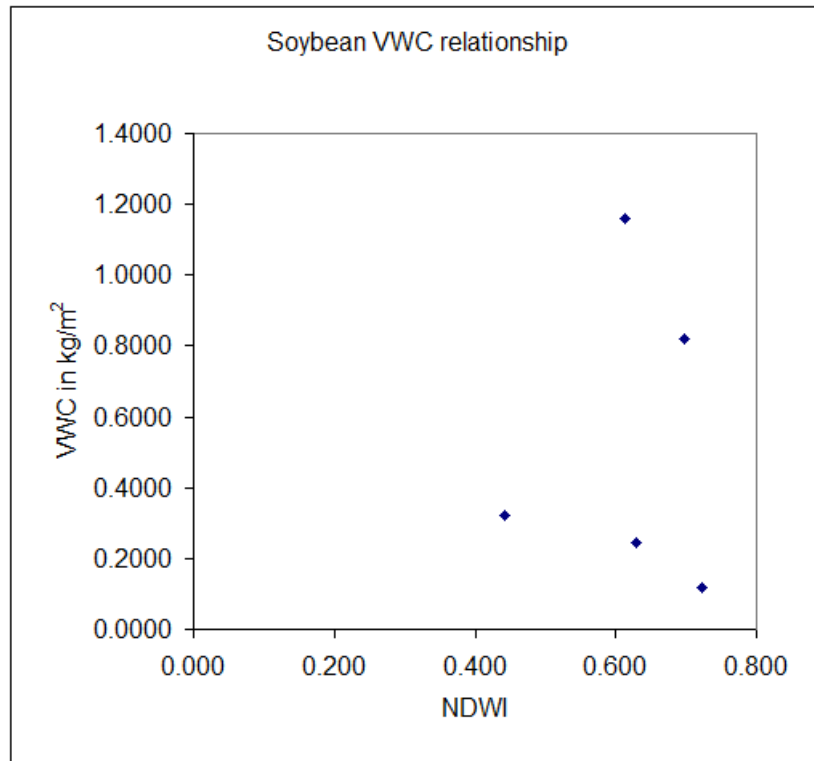


Figure 1. Relationship of Soybean VWC.

Forest measurements were the most intensive portion of the VWC study. Diameter at Breast Height (DBH), tree species, and Basal area data were collected at multiple locations throughout the Delaware portion of the study region. The Basal Area was determined by a prism with a Basal Area Factor (BAF) of 2.0 (metric). The tree count from the prism is multiplied by 2 to produce an estimate of m<sup>2</sup> of dry wood per hectare. To get volume of dry wood, the Basal Area is multiplied by the average height of the trees and divided by 2. This is an approximation from the Forest Service.

$$(\text{Prism \#}) * \text{BAF} * (\text{avg. hgt}) / 2 \sim \text{volume of dry wood per hectare}$$

Then the volume of wood is converted to kg/m<sup>2</sup> by the density of hardwood (which is determined from the tree species).

$$(\text{Vdrywood/hectare}) * (1 \text{ hectare} / 10000 \text{ m}^2) * 755 \text{ kg/m}^3 = \text{Masswood/m}^2$$

To convert to volume of water per m<sup>2</sup>, the ratio of wood weight to water weight in a forest is used (2:1) (Yilmaz et al., 2008).

$$\text{Masswood/Area} * 1 \text{ Masswater/2 Masswood} \sim \text{Masswater/Area}$$

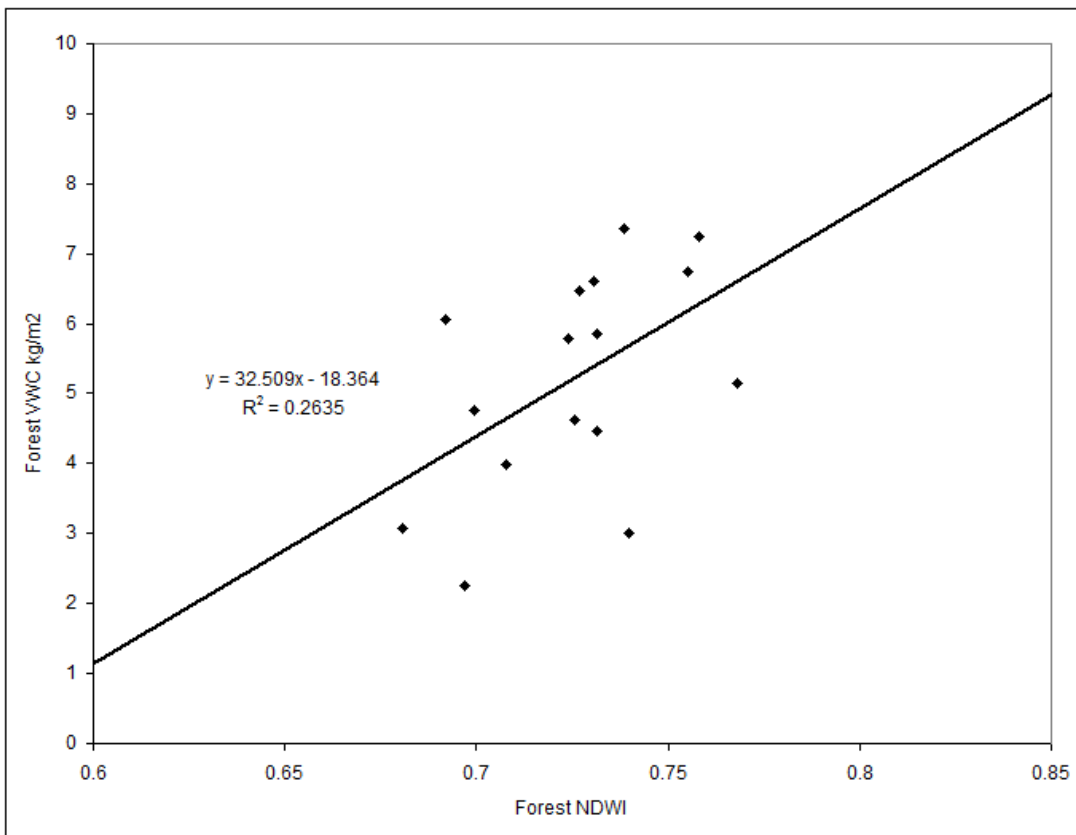


Figure 2. Relationship between NDWI and Forest VWC

The resulting relationship between NDWI and Forest VWC is shown in Figure 2 and used to compute VWC throughout the SMAPVEX08 study region.

### 3.1.1 Errors Sources

The lack of regression model and the application of a constant value to soybean fields cause error for the soybeans in particular.

### 3.1.2 Quality Assessment

The quality of the data is good with the exception of the soybean fields as pointed out in the Error Sources section above.

## 4 VERSION HISTORY

Version 1 (June 2015)

## 5 REFERENCES AND RELATED PUBLICATIONS

The following publications were used in calculating VWC for this experiment:

Jenkins, J. C., D. C. Chojnacky, L. S. Heath, and R. A. Birdsey. 2004. Comprehensive Database of Diameter-Based Biomass Regressions for North American Tree Species. USDA-Forest Service, Northeastern Research Station, General Technical Report NE-319.

Yilmaz, M. T., E. R. Hunt, and T. J. Jackson. 2008. Remote Sensing of Vegetation Water Content from Equivalent Water Thickness using Satellite Imagery, *Remote Sensing of Environment*, 112(5), 2514-2522.

## 6 CONTACTS AND ACKNOWLEDGMENTS

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## 7 DOCUMENT INFORMATION

### 7.1 Publication Date

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Version 1 (June 2015)

### 7.2 Date Last Updated

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February 2025