

**Notice to Data Users:**  
**The documentation for this data set was provided solely by the Principal Investigator(s) and was not further developed, thoroughly reviewed, or edited by NSIDC. Thus, support for this data set may be limited.**

## SMEX05 Vegetation Water Content Data: Iowa

### Summary

This data set contains vegetation water content data of the Ames, Iowa, USA area. Large-scale maps of vegetation water content are necessary for the accurate estimation of surface soil moisture via microwave remote sensing. To support this type of remote sensing during the Soil Moisture Experiment 2005 (SMEX05), a vegetation sampling campaign was conducted in coordination with satellite calibration and correction to result in an estimated map of Vegetation Water Content (VWC). The data were collected on 06 June 2005 and 17 July 2005. The total volume of this data set is approximately 56 megabytes. Data are provided in Band Interleaved by Line (BIL) files with corresponding Environment for Visualizing Images (ENVI) header files, and are available via FTP.

The Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) is a mission instrument launched aboard NASA's Aqua satellite on 04 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:

Yilmaz, M. T., E. Raymond Hunt Jr., and Thomas J. Jackson. 2009. *SMEX05 Vegetation Water Content Data: Iowa*. Boulder, Colorado USA: NASA DAAC at the National Snow and Ice Data Center.

### Overview Table

Category	Description
<u>Data Format</u>	Band Interleaved by Line (BIL) format
<u>Spatial Coverage</u>	<u>Study Area</u> 41.8666° to 42.0666° N, 93.5166° to 94.0166° W
	<u>Imagery Coverage</u>

	Northwestern Corner: 413459 meters Easting, 4705830 meters Northing 2444 columns, 2999 Rows UTM Zone 15, WGS84 30 meter resolution
<u>Temporal Coverage</u>	06 June 2005 and 17 July 2005
<u>File naming Convention</u>	SMEX05_June_06_VWC.bil and hdr SMEX05_July_17_VWC.bil and hdr
<u>File Size</u>	28 MB per file
<u>Parameter(s)</u>	Vegetation Water Content
<u>Procedures for obtaining Data</u>	Data are available via FTP.

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## 1. Contacts and Acknowledgments

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**Acknowledgments:**

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**2. Detailed Data Description****Format:**

Band Interleaved by Line (BIL) format

**File Naming Convention:**

SMEX05\_June\_06\_VWC.bil  
SMEX05\_June\_06\_VWC.hdr  
SMEX05\_July\_17\_VWC.bil  
SMEX05\_July\_17\_VWC.hdr

**File size:**

Each .bil file is approximately 28.6 MB. Each .hdr file is 1 KB.

**Spatial Coverage:**Study Area

Southernmost Latitude: 41.8666° N  
Northernmost Latitude: 42.0666° N  
Westernmost Longitude: 94.0166° W  
Easternmost Longitude: 93.5166° W

Imagery Coverage

Northwestern Corner: 413459 meters Easting, 4705830 meters Northing  
UTM Zone 15, WGS84  
2444 columns, 2999 Rows  
30 meter resolution

**Temporal Coverage:**

Image files were captured 06 June 2005 and 17 July 2005.

**Parameter or Variable:**

Thematic Mapper 5 imagery was used in the development of values for Vegetation Water Content in kg/m<sup>2</sup>. Vegetation Water Content (VCN) is the digital number (DN) in the .bil data files.

**3. Data Access and Tools****Data Access:**

Data are available via FTP at: [ftp://sidads.colorado.edu/pub/DATASETS/AVDM/data/soil\\_moisture/SMEX05/vegetation/VWC/](ftp://sidads.colorado.edu/pub/DATASETS/AVDM/data/soil_moisture/SMEX05/vegetation/VWC/)

### Software and Tools:

Tools appropriate for viewing these data are ENVI or other similar visualization software packages.

## 4. Data Acquisition and Processing

The following discussion describes methodology used to arrive at VWC values for various surface coverage types.

Five different regressions were used for the VWC estimation:

Regression 1: used for corn (and applied to sunflower)

Regression 2: used for soybean

Regression 3: constant of 9 kg/m<sup>2</sup> used for forest

Regression 4: constant of 2.3 kg/m<sup>2</sup> used for alfalfa

Regression 5: used for grasses, pasture, and small grains

Cloud, urban, and water covers were masked out and assigned zero VWC (0 kg/m<sup>2</sup>) based on the National Agricultural Statistics Service (NASS) classification.

DN	Npts	Percent	Class	VWC algorithm	VWC Equation (kg/m <sup>2</sup> )
1	2987401	40.8	Corn	Reg. 1	$0.779 \cdot \exp(4.2385 \cdot \text{NDII})$
5	2259157	30.9	Soybean	Reg. 2	$0.2876 \cdot \exp(7.1293 \cdot \text{NDII})$
6	2572	0.0	Sunflower	Reg. 1	$0.779 \cdot \exp(4.2385 \cdot \text{NDII})$
25	33756	0.5	Other Small Grains & Hay (Oats, Millet, Rye & Winter Wheat, Alfalfa & Other Hay)	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
28	3904	0.1	Oats	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
32	1421	0.0	Flaxseed	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
36	28640	0.4	Alfalfa		2.3
44	35482	0.5	Other Crops (Canola, Flaxseed, Safflower & very small acreage crops)	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
61	97701	1.3	Fallow/Idle Cropland	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
62	1021532	14.0	Pasture/Range/CRP/Non Ag (Permanent & Cropland Pasture, Waste & Farmstead)	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
63	521280	7.1	Woods, Woodland Pasture		9
70	37499	0.5	Christmas Trees		9
81	589	0.0	Clouds		0
82	220240	3.0	Urban		0
83	43968	0.6	Water		0
87	942	0.0	Wetlands	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$
88	28030	0.4	Grassland	Reg. 5	$1.1922 \cdot \text{NDII} + 0.2347$

Vegetation water content values were derived from Thematic Mapper (TM) microwave imagery. The TM images for June 06 2005 (Path 27/row 31) and July 17 2005 (Path 26/row 31) had different paths, so there was a difference in spatial coverage. So, NaN values were assigned to have -1 kg/m<sup>2</sup> VWC. For corn and soy, SMEX05 VWC-NDII regressions were used. Based on the ground data, forest has average wood VWC of 8.7 kg/m<sup>2</sup> and foliage VWC of 0.30 kg/m<sup>2</sup>. For forested areas, VWC was assumed to be a constant 9 kg/m<sup>2</sup>. Again, based on ground data, alfalfa was assumed to have a constant VWC of 2.3 kg/m<sup>2</sup>. Other land cover types were assumed to have negligible stem water content (Regression 5), so the total VWC was estimated from the average EWT-NDII regression used, based on the ground leaf data.

## **5. References and Related Publications**

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

## **6. Document Information**

### **List of Acronyms & Abbreviations:**

AMSR-E – Advanced Microwave Scanning Radiometer – Earth Observing System  
BIL – Band Interleaved by Line format  
CIRES – Cooperative Institute for Research in Environmental Science  
DN – Digital Number from imagery  
ENVI – Environment for Visualizing Images  
EWT – Equivalent Water Thickness  
FTP – File Transfer Protocol  
NaN – Not a Number  
NASS - National Agricultural Statistics Service  
NDII – Normalized Difference Infrared Index  
NDWI – Normalized Difference Water Index  
NSIDC – National Snow and Ice Data Center  
SMEX05 – Soil Moisture Experiment 2005  
TM – Thematic Mapper  
USDA ARS – United States Department of Agriculture Agricultural Research Service  
UTM – Universal Transverse Mercatur  
VWC – Vegetation Water Content  
WGS84 – World Geodetic System 1984

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