SMAPVEX12 Vegetation Water Content Map, Version 1

USER GUIDE

How to Cite These Data

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

Cosh, M. 2014. *SMAPVEX12 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/10.5067/4C7MN0KJILTI. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SV12VWC

National Snow and Ice Data Center

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1 DATA DESCRIPTION

The daily Vegetation Water Content (VWC) maps for the Soil Moisture Active Passive Validation Experiment 2012 (SMAPVEX12) were derived by calculating Normalized Difference Vegetation Index (NDVI) from SPOT and RapidEye satellite overpasses and then interpolating it for each day of the campaign. In addition, samples from a range of vegetation types were used to compare ground-based measurements to the satellite-based estimates.

1.1 Parameters

The parameter for this data set is Vegetation Water Content (VWC), given in kg/m^2. Valid parameter values range between 0 and 40 kg/m^2.

1.2 File Information

1.2.1 Format and File Contents

Data are provided as Georeferenced Tagged Image File Format (GeoTIFF) image files with associated TIFF world files (TFW) containing georeferencing information. Extensible Markup Language (XML) metadata files are also provided.

1.2.2 Naming Convention

Data files are named according to the following convention, and as described in Table 1:

`SV12VWC_YYYYMMDD_SMAPVEX12_VWC_XX(XX_XX).tif`

Where:

Table 1. Description of File Naming Convention

Variable	Description
SV12VWC	Short Name
YYYYMMDD	4-digit year, 2-digit month, 2-digit day
SMAPVEX12	Soil Moisture Active Passive Validation Experiment 2012
VWC	Vegetation Water Content (VWC)
XX	Indicates platform (RE: RapidEye; SP: SPOT). Files without XX in the name indicate data are interpolated between the observations made with either Rapideye or SPOT. Files named RE_SP indicate data are directly from Rapid Eye scene, and that there was a SPOT measurement on this day as well.
.tif	Indicates this is a GeoTIFF file

Variable	Description
.tfw	Indicates this is a TIFF World file
.MET.xml	Indicates this is an XML metadata file

1.3 Spatial Information

1.3.1 Coverage

Southernmost Latitude: 49.31°N
Northernmost Latitude: 50.17°N
Westernmost Longitude: 98.74°W
Easternmost Longitude: 97.36°W

1.3.2 Resolution

The data images have a 5 m x 5 m resolution.

1.3.3 Geolocation

1.3.3.1 Projection

Data are provided in Universal Transverse Mercator (UTM), Zone 14 N, World Geodetic System 1984 (WGS84) coordinates.

1.3.3.2 Grid Description

Data are provided as a GeoTIFF image file with associated TIFF World file (TFW) containing georeferencing information. GeoTIFF defines a set of publicly available TIFF tags that describe cartographic and geodetic information associated with TIFF images. GeoTIFF enables referencing a raster image to a known geodetic model or map projection. The initial tags are followed by image data, that in turn may be interrupted by more descriptive tags. By using the GeoTIFF format, both metadata and image data can be encoded into the same file.

The TFW file provides georeference information for the image with the same file name and is a text file with six numbers. Refer to Table 2 for a description of the TFW file contents.

Table 2. TFW File Rows

Row	Description
1	the dimension of a pixel in map units in the x direction
2	rotation term for row
3	rotation term for column

4	the dimension of a pixel in map units in the y direction
5	x coordinate for upper left corner
6	y coordinate for upper left corner

1.4 Temporal Information

1.4.1 Coverage

VWC data are available for each day between 14 May and 19 July 2012.

1.4.2 Resolution

VWC data are provided daily, but only for seven days within the coverage period were they obtained directly from satellite scenes. The remaining days were obtained via linear interpolation of existing scenes (see the **Data Acquisition and Processing** section for details).

2 DATA ACQUISITION AND PROCESSING

Four satellite scenes from RapidEye and four scenes from SPOT provided several NDVI estimates throughout the SMAPVEX12 Intensive Observation Period. Cloud-free scenes were available for the following dates:

RapidEye: 14 May, 20 May, 4 June, 5 July
SPOT: 23 June, 28 June, 5 July, 14 July

To compensate for the difference in sensors between RapidEye and SPOT, the SPOT NDVI was regressed to a RapidEye NDVI standard for this exercise. There was a very good relation between the NDVI values for the concurrent date of July 5 and this conversion was applied to all of the SPOT scenes (Figure 1). For 5 July, the original RapidEye scene was used.

RapidEye NDVI= 1/1.0541 * SPOT NDVI

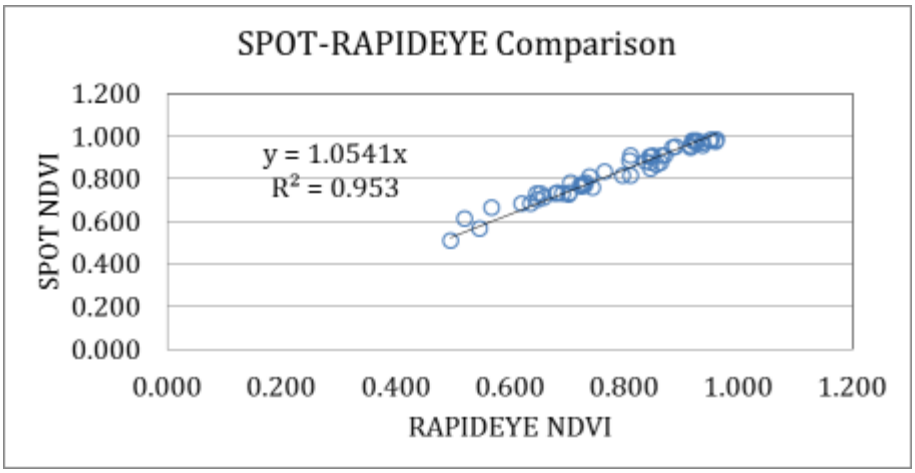

Figure 1. Differences in NDVI between RapidEye and SPOT for the 5 July scenes

For each major crop in the study, a relationship was developed to compute VWC:

Beans/Soybeans

VWC = 11.716 * NDVI^3 - 12.879 * NDVI^2 + 4.5647 * NDVI - 0.46846

Canola

VWC = .028207 * exp(5.7649 * NDVI)

Corn

VWC = .0045908 * exp(7.5898 * NDVI)

Forage/Pasture

VWC = .31827 * NDVI - 1.7483

Spring Wheat

VWC = 0.95474 * NDVI + 1.3506

Winter Wheat

VWC = 1.1116 * exp(1.0321 * NDVI)

Forest

VWC = 162.24 * NDVI - 121.26

First, VWC was calculated for each day of satellite overpass. Next, these VWC images were linearly interpolated to produce daily VWC. The last satellite image is 14 July, so the VWC values for all crop pixels beyond that date were extrapolated out to 19 July on the same trend as prior to 14 July. For forest pixels they were held static to the 14 July values.

2.1 Quality, Errors, and Limitations

The interpolation of the Normalized Vegetation Index (NDVI) between satellite acquisitions causes some uncertainty in both regression with the field observations and estimation of the value for a particular campaign day.

In situ measurements were collected on thirteen days within the coverage period and compared to the satellite-based estimates. Refer to SMAPVEX12 In Situ Vegetation Data for Agricultural Area for more information regarding in situ sampling.

The quality of the VWC estimation from the NDVI images is in accordance with the expected fidelity of such estimations, with the exception of the uncertainty caused by the interpolation of NDVI between the satellite acquisitions. Table 3 shows the RMS difference between the VWC retrieved with equation and VWC obtained from the ground-based measurements.

Table 3. RMS Differences between Satellite and In Situ Measurements

Crop Type	**RMS_{diff} (kg/m^2)**
Beans/Soybeans	0.250
Canola	0.800
Corn	0.760
Forage/Pasture	0.164/0.130
Spring Wheat	0.620
Winter Wheat	0.660

3 SOFTWARE AND TOOLS

Various software packages can be used to read the GeoTIFF data file, such as ArcGIS, ENVI/IDL, or MATLAB.

4 CONTACTS

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5 REFERENCES

McNairn, H., T. Jackson, G. Wiseman, S. Belair, A. Berg, P. Bullock, A. Colliander, M. Cosh, S. Kim, R. Magagi, M. Moghaddam, J. Adams, S. Homayouni, E. Ojo, T. Rowlandson, J. Shang, K. Goita, and M. Hosseini. 2013, In Press. The Soil Moisture Active Passive Validation Experiment 2012 (SMAPVEX12): Pre-Launch Calibration and Validation of the SMAP Satellite. *IEEE Trans. Geosci. Rem. Sens*.

6 DOCUMENT INFORMATION

6.1 Publication Date

March 2014

6.2 Date Last Updated

March 2020