# SMEX02 Iowa Satellite Vegetation and Water Index (NDVI and NDWI) Data, Version 1

## USER GUIDE

**How to Cite These Data**

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

Jackson, T. and M. Cosh. 2003. *SMEX02 Iowa Satellite Vegetation and Water Index (NDVI and NDWI) Data, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/2R7KUXDQ3S44. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0184

National Snow and Ice Data Center

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# 1 DETAILED DATA DESCRIPTION

## 1.1 Format

Files are in flat binary format with no header. Data are in PC byte order (little endian). SGI and Sun users will need to byte-swap these data before using them

Regional files for NDVI and NDWI are 1851 columns by 3831 rows.

Watershed files for NDVI and NDWI are 1216 columns by 611 rows.

The data are eight-bit binary or byte data. To maximize the dynamic range, the following scaling was performed:

Scaled NDVI = DN / 255
or
NDWI = DN / 255-0.5

## 1.2 File and Directory Structure

There are two main directories, NDVI and NDWI. The two subdirectories under each of these are Regional and Watershed, named for the different coverage areas.

## 1.3 File Naming Convention

File names begin with a six-digit date, followed by the data type, NDVI or NDWI. Regional files have no other designation, for example, "`071702_NDVI.bil.`" Watershed files include "WC" after the data type, for example, "`071702_NDVI_WC.bil.`"

## 1.4 File Size

File sizes range from 725 KB and 6.76 MB.

## 1.5 Volume

Total volume of all images is 27 MB.

# 1.6 Spatial Coverage

Table 1. Regional Area

| Location | Latitude | Longitude | Easting | Northing |
|---|---|---|---|---|
| Upper Left | 42.729 N | 93.416 W | 431100.000 E | 4731100.000 N |
| Upper Right | 42.732 N | 93.163 W | 486600.000 E | 4731100.000 N |
| Lower Left | 41.694 N | 93.827 W | 431100.000 E | 4616200.000 N |
| Lower Right | 41.697 N | 93.161 W | 486600.000 | 4616200.000 N |

Table 2. Watershed Area

| Location | Latitude | Longitude | Easting | Northing |
|---|---|---|---|---|
| Upper Left | 42.037 N | 93.832 W | 431100.000 E | 4654300.000 N |
| Upper Right | 42.040 N | 93.392 W | 467550.000 E | 4654300.000 N |
| Lower Left | 41.872 N | 93.830 W | 431100.000 E | 4636000.000 N |
| Lower Right | 41.875 N | 93.391 W | 467550.000 E | 4636000.000 N |

## 1.6.1 Spatial Resolution

The Landsat TM and ETM+ data were used to produce high resolution (30 m) NDVI and NDWI data sets.

## 1.6.2 Projection Description

Universal Transverse Mercator (UTM) Zone 15

# 1.7 Temporal Coverage

Select dates during June and July 2002 were covered.

## 1.7.1 Temporal Resolution

Daily coverage for the dates 6 June, 23 June, 1 July, 8 July, 16 July, and 17 July 2002.

# 1.8 Parameter or Variable

## 1.8.1 Parameter Description

Parameters are NDVI and NDWI. NDVI is the difference between the visible (red) and near-infrared (nir) bands, over their sum. The NDVI is a measure of vegetation amount and condition. It is

associated with vegetation canopy characteristics such as biomass, leaf area index and percentage of vegetation cover. NDWI divides the difference between reflected green-light and reflected near-infrared by the sum of those two bands. NDVI helps researchers determine the density of vegetation in an area, and NDWI gives a measurement of the soil moisture.

### 1.8.2 Parameter Source

Two TM scenes from Landsat 5 and four ETM+ from Landsat 7 were acquired during the primary study period. These data were used to produce high resolution (30 m) NDVI and NDWI data sets. The following table details the Landsat coverage for the dates of the study.

Table 3. Landsat Data Coverage Periods

| Date | Landsat number | Path | Row |
|---|---|---|---|
| June 6 | 7 | 27 | 31 |
| June 23 | 5 | 26 | 31 |
| July 1 | 7 | 26 | 31 |
| July 8 | 7 | 27 | 31 |
| July 16 | 5 | 27 | 31 |
| July 17 | 7 | 26 | 31 |

### 1.8.3 Sample Data Record

The following image is a screen shot of a portion of the image file "`060602_NDVI.bil`."

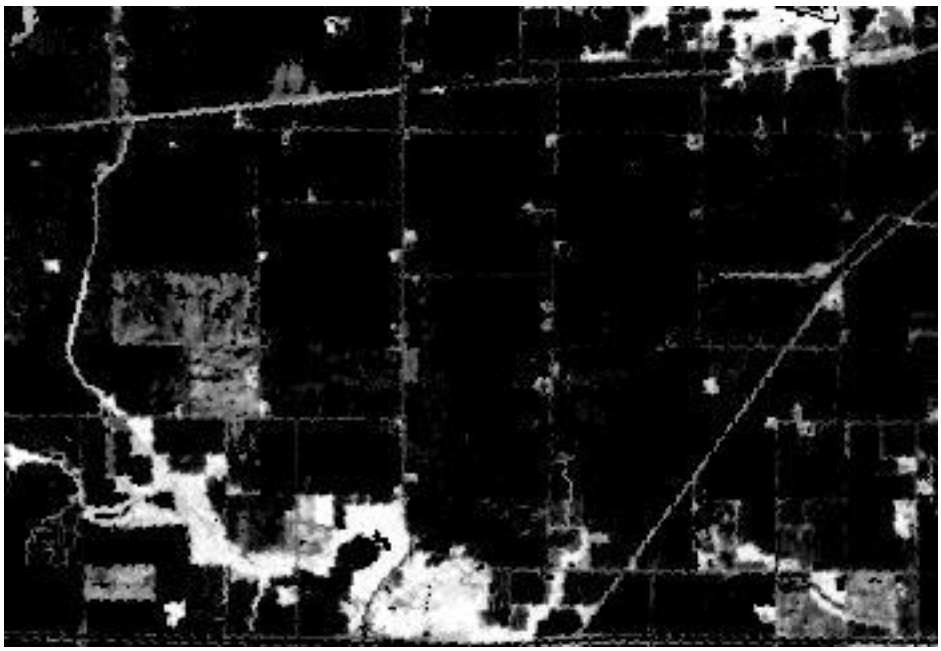

Figure 1. Screen shot of image file 060602_NDVI.bil

The next image is a screen shot of a portion of the image file "`071702_NDWI.bil`."

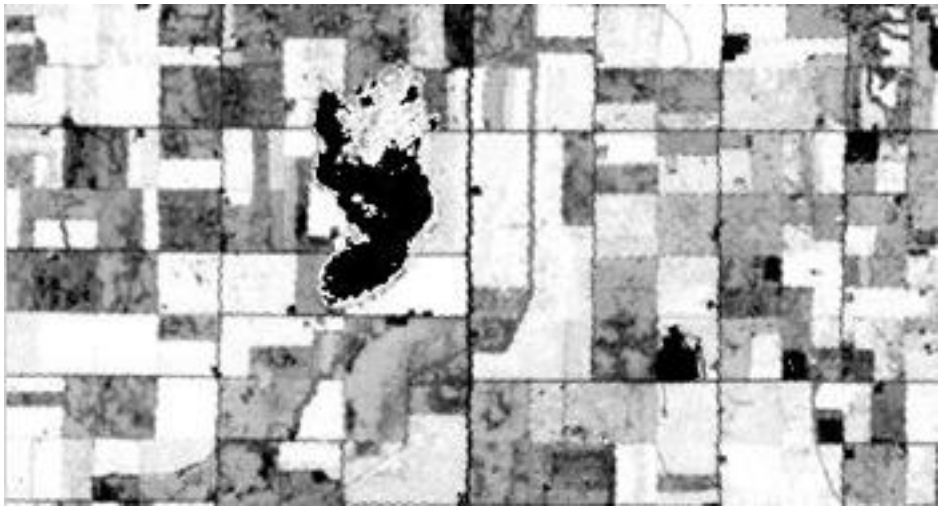

Figure 2. Screen shot of image file 071702_NDMI.bil

# 2 SOFTWARE AND TOOLS

Open these files in an appropriate image processing or image viewing application.

# 3 DATA ACQUISITION AND PROCESSING

## 3.1 Derivation Techniques and Algorithms

Radiance from a satellite platform is strongly affected by the presence of the atmosphere. Atmospheric correction is needed to convert satellite-based radiance to an estimate of ground reflectance.

The atmospheric correction for the visible and near infrared channels was conducted using the Second Simulation of the Satellite Signal in the Solar Spectrum (6S) code during the SMEX02 experiment (Vermote et al., 1997a). The input data for the 6S included Cimel sun photometer data obtained through the AERONET network.

The sun photometer is designed to view the sun and sky at preprogrammed intervals for aerosol optical thickness, water vapor amounts, particle size distribution, aerosol scattering, phase function, and single scattering albedo. It measures the intensity of sunlight arriving directly from the sun. These measurements are used to radiometrically correct satellite imagery in the visible and infrared bands using the interpreted information about atmospheric aerosols. The instrument was installed at a central location (41.963 N, 93.661 W) to provide data appropriate for the intensive site and for the regional area studies.

If the area surrounding a target is assumed to be the same as the target and we assume the target is Lambertian and uniform, the reflectance at the target can be expressed conveniently as (Vermote, et al., 1997b; Vermote and Vermeulen,1999; Adler-Golden et al., 1999):

$$\rho = \frac{\pi(Lt - Lp)}{(Edir + Ediff)T + \pi S(Lt - Lp)}$$

Where:
Lt is the satellite based radiance
S is the reflectance of the atmosphere
Lp is the atmospheric path radiance
Edir is the direct irradiance at the surface
Ediff is the diffuse irradiance at the surface
T is the total diffuse transmittance from the ground to the top of the atmosphere in the view direction of the satellite.

### 3.1.1 Formulae

The NDVI and NDWI were computed for each pixel using the following equations (Gao, 1996):

$$NDVI = \frac{\rho(band4) - \rho(band3)}{\rho(band4) + \rho(band3)}$$

$$NDWI = \frac{\rho(band4) - \rho(band5)}{\rho(band4) + \rho(band5)}$$

Values of NDVI and NDWI are in the range between -1 and +1. Values less than 0 were filtered out to maximize the NDVI values of interest (0 to 1). These values composed less than 1% of the imagery.

## 3.2 Sensor or Instrument Description

TM is a multispectral scanning radiometer carried on Landsat 4 and 5. The TM has seven spectral band, with a spatial resolution of 30 meters for most bands.

ETM+, an improved version of TM, is carried on Landsat 7. The ETM+ has eight spectral bands with a spatial resolution of 30 meters for most bands. ETM+ calibration is good to within five percent.

# 4 REFERENCES AND RELATED PUBLICATIONS

Gao, B.C., 1996: NDWI - A normalized difference water index for remote sensing of vegetation liquid water from space. Remote Sensing of Environment, Vol. 58: 257-266

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Vermote, E.F., D.Tanre, J.L. Deuze, M. Herman and J.J. Morcrette, 1997a. Second Simulation of the Satellite Signal in the Solar Spectrum, 6S: An Overview. IEEE Transactions on Geoscience and Remote Sensing, Vol. 35: 675-686.

Vermote, E.F., N.E. Saleous, C.O. Justice, Y.J. Kaufman, J.L. Prevette, L. Remer, J.C. Roger and D. Tanre, 1997b. Atmospheric correction of visible to middle-infrared EOS-MODIS data over land surface: Background, operational algorithm and validation. Journal of Geophysical Research, Vol. 102: 17131-17141.

Vermote, E.F. and A.Vermeulen, 1999. Atmospheric correction algorithm: spectral reflectances (MOD09). Algorithm Technical Background Document.

Landsat Project information

# 5 CONTACTS AND ACKNOWLEDGMENTS

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# 6 DOCUMENT INFORMATION

## 6.1 Publication Date

August 2003

## 6.2 Date Last Updated

16 March 2021