SMEX03 Vegetation Data: Oklahoma, Version 1

USER GUIDE

How to Cite These Data

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

Jackson, T. and L. McKee. 2007. *SMEX03 Vegetation Data: Oklahoma, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/A1E1EWIHPHAO. [Date Accessed].

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National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

This data set contains various vegetation parameters for several locations from Oklahoma North (ON) and Oklahoma South (OS).

1.1 Format

Data are in tab-delimited ASCII text files.

1.2 File and Directory Structure

The following files are contained in this data set.

File Name	Description	File Size
SMEX03_Raw_MSR_Overpass.txt	Raw data file of MSR and LAI.	52 KB
SMEX03_Raw_Vegetation.txt	Raw data file containing all data.	30 KB
SMEX03_Sum_MSR_Overpass.txt	Summary data file of MSR and LAI data only.	5 KB
SMEX03_Sum_Vegetation.txt	Summary data file containing all data.	10 KB

Table 1. Column Headings and Definitions SMEX03_Raw_MSR_Overpass.txt

Column Heading	Description
FIELD	Site location identification number, OS is the Oklahoma South region, ON is the Oklahoma North region, LW is Little Washita Watershed, SOY1 is a soybean field located in the Little Washita Watershed
CROP	`WW_Stubble` is winter wheat that has been harvested.
DATE	Month/day/year
DOY	Day of year
TIME (CDT)	Time of sampling in Central Daylight Time (CDT)
SITE	Number of site within given field
Latitude WGS84	Decimal degrees
Longitude WGS84	
UTM_Easting WGS84_Zone 14	
UTM_Northing WGS84_Zone 14	WGS84, Zone 14, in meters
LAI	Leaf Area Index

Column Heading	Description
CropScan Multispectral Radiometer Reflectance Percent	
485 nm AVG	Average of % reflectance at wavelength: 485 nm
485 nm STD	Standard deviation of % reflectance at wavelength: 485 nm
560 nm AVG	Average of % reflectance at wavelength: 560 nm
560 nm STD	Standard deviation of % reflectance at wavelength: 560 nm
650 nm AVG	Average of % reflectance at wavelength: 650 nm
650 nm STD	Standard deviation of % reflectance at wavelength: 650 nm
660 nm AVG	Average of % reflectance at wavelength: 660 nm
660 nm STD	Standard deviation of % reflectance at wavelength: 660 nm
830 nm AVG	Average of % reflectance at wavelength: 830 nm
830 nm STD	Standard deviation of % reflectance at wavelength: 830 nm
850 nm AVG	Average of % reflectance at wavelength: 850 nm
850 nm STD	Standard deviation of % reflectance at wavelength: 850 nm
1240 nm AVG	Average of % reflectance at wavelength: 1240 nm
1240 nm STD	Standard deviation of % reflectance at wavelength: 1240 nm
1640 nm AVG	Average of % reflectance at wavelength: 1640 nm
1640 nm STD	Standard deviation of % reflectance at wavelength: 1640 nm
1650 nm AVG	Average of % reflectance at wavelength: 1650 nm
1650 nm STD	Standard deviation of % reflectance at wavelength: 1650 nm

Table 2. Column Headings and Definitions for SMEX03_Raw_Vegetation.txt

Column Heading	Description
FIELD	Site location identification number, OS is the Oklahoma South region, ON is the Oklahoma North region, LW is Little Washita Watershed, SOY1 is a soybean field located in the Little Washita Watershed
CROP	WW_Stubble is winter wheat that has been harvested. Plowed_WW is winter wheat that has been harvest and plowed.
DATE	Month/day/year
DOY	Day of year
TIME (CDT)	Time of sampling in Central Daylight Time (CDT)
SITE	Number of site within field
Latitude WGS84	Decimal degrees, WGS84
Longitude WGS84	Decimal degrees, WGS84

Column Heading	Description
UTM_Easting WGS84_Zone 14	WGS84_Zone 14, in meters
UTM_Northing WGS84_Zone 14	WGS84, Zone 14, in meters
LAI	Leaf Area Index
CropScan Multispectral Radiometer Reflectance Percent	
485 nm AVG	Average of % reflectance at wavelength: 485 nm
485 nm STD	Standard deviation of % reflectance at wavelength: 485 nm
560 nm AVG	Average of % reflectance at wavelength: 560 nm
560 nm STD	Standard deviation of % reflectance at wavelength: 560 nm
650 nm AVG	Average of % reflectance at wavelength: 650 nm
650 nm STD	Standard deviation of % reflectance at wavelength: 650 nm
660 nm AVG	Average of % reflectance at wavelength: 660 nm
660 nm STD	Standard deviation of % reflectance at wavelength: 660 nm
830 nm AVG	Average of % reflectance at wavelength: 830 nm
830 nm STD	Standard deviation of % reflectance at wavelength: 830 nm
850 nm AVG	Average of % reflectance at wavelength: 850 nm
850 nm STD	Standard deviation of % reflectance at wavelength: 850 nm
1240 nm AVG	Average of % reflectance at wavelength: 1240 nm
1240 nm STD	Standard deviation of % reflectance at wavelength: 1240 nm
1640 nm AVG	Average of % reflectance at wavelength: 1640 nm
1640 nm STD	Standard deviation of % reflectance at wavelength: 1640 nm
1650 nm AVG	Average of % reflectance at wavelength: 1650 nm

Column Heading	Description
1650 nm STD	Standard deviation of % reflectance at wavelength: 1650 nm
Plant Height	Plant height in cm
Plant Density	Number of plants/m^2
Total Wet Wt	Total areal green biomass kg/m^2
Leaves Wet Wt	Areal green biomass kg/$m^2$of leaves only
Stalks Wet Wt	Areal green biomass kg/m^2 of stalks only
Ears Wet Wt	Areal green biomass kg/m^2 of ears only
Total Dry Wt	Total areal dry biomass kg/m^2
Leaves Dry Wt	Areal dry biomass kg/m^2 of leaves only
Stalks Dry Wt	Areal dry biomass kg/m^2 of stalks only
Ears Dry Wt	Areal dry biomass kg/m^2 of ears only
Total Water	Total areal water content kg/m^2
Leaves Water	Areal water content kg/$m^2$of leaves only
Stalks Water	Areal water content kg/m^2 of stalks only
Ears Water	Areal water content kg/$m^2$of ears only
Notes	Sampling notes

Table 3. Column Headings and Definitions for SMEX03_Sum_MSR_Overpass.txt

Column Heading	Description
FIELD	Site location identification number, LW is Little Washita Watershed, SOY1 is a soybean field located in the Little Washita Watershed
CROP	WW_Stubble is winter wheat that has been harvested.
DATE	month/day/year
DOY	Day of year
TIME (CDT)	Time of sampling in Central Daylight Time (CDT)
Latitude WGS84	Decimal degrees, WGS84
Longitude WGS84	Decimal degrees, WGS84
UTM_Easting WGS84_Zone14	WGS84, Zone 14, in meters
UTM_Northing WGS84_Zone14	WGS84, Zone 14, in meters
LAI - AVG	Average of Leaf Area Index
LAI - STD	Standard deviation of Leaf Area Index

Column Heading	Description
Cropscan Multispectral Radiometer Reflectance Percent	
485 nm – AVG	Average of % reflectance at wavelength: 485 nm
485 nm – STD	Standard deviation of % reflectance at wavelength: 485 nm
560 nm - AVG	Average of % reflectance at wavelength: 560 nm
560 nm - STD	Standard deviation of % reflectance at wavelength: 560 nm
650 nm - AVG	Average of % reflectance at wavelength: 650 nm
650 nm - STD	Standard deviation of % reflectance at wavelength: 650 nm
660 nm - AVG	Average of % reflectance at wavelength: 660 nm
660 nm - STD	Standard deviation of % reflectance at wavelength: 660 nm
830 nm - AVG	Average of % reflectance at wavelength: 830 nm
830 nm - STD	Standard deviation of % reflectance at wavelength: 830 nm
850 nm - AVG	Average of % reflectance at wavelength: 850 nm
850 nm - STD	Standard deviation of % reflectance at wavelength: 850 nm
1240 nm - AVG	Average of % reflectance at wavelength: 1240 nm
1240 nm - STD	Standard deviation of % reflectance at wavelength: 1240 nm
1640 nm - AVG	Average of % reflectance at wavelength: 1640 nm
1640 nm - STD	Standard deviation of % reflectance at wavelength: 1640 nm
1650 nm - AVG	Average of % reflectance at wavelength: 1650 nm
1650 nm - STD	Standard deviation of % reflectance at wavelength: 1650 nm

Table 4. Column Headings and Definitions for SMEX03_Sum_Vegetation.txt

Column Heading	Description
FIELD	Site location identification number, OS is the Oklahoma South region, ON is the Oklahoma North region, LW is Little Washita Watershed, SOY1 is a soybean field located in the Little Washita Watershed
CROP	WW_Stubble is winter wheat that has been harvested. Plowed_WW is winter wheat that has been harvest and plowed.
DATE	Month/day/year
DOY	Day of year
TIME	Time of sampling in CDT
Latitude WGS84	Decimal degrees, WGS84
Longitude WGS84	Decimal degrees, WGS84
UTM_Easting WGS84_Zone 14	WGS84, Zone 14, in meters

Column Heading	Description
UTM_Northing WGS84_Zone 14	WGS84, Zone 14, in meters
LAI – AVG	Average of Leaf Area Index
LAI – STD	Standard deviation of Leaf Area Index
Cropscan Multispectral Radiometer Reflectance Percent	
485 nm – AVG	Average of % reflectance at wavelength: 485 nm
485 nm – STD	Standard deviation of % reflectance at wavelength: 485 nm
560 nm – AVG	Average of % reflectance at wavelength: 560 nm
560 nm – STD	Standard deviation of % reflectance at wavelength: 560 nm
650 nm – AVG	Average of % reflectance at wavelength: 650 nm
650 nm – STD	Standard deviation of % reflectance at wavelength: 650 nm
660 nm – AVG	Average of % reflectance at wavelength: 660 nm
660 nm – STD	Standard deviation of % reflectance at wavelength: 660 nm
830 nm – AVG	Average of % reflectance at wavelength: 830 nm
830 nm – STD	Standard deviation of % reflectance at wavelength: 830 nm
850 nm – AVG	Average of % reflectance at wavelength: 850 nm
850 nm – STD	Standard deviation of % reflectance at wavelength: 850 nm
1240 nm – AVG	Average of % reflectance at wavelength: 1240 nm
1240 nm – STD	Standard deviation of % reflectance at wavelength: 1240 nm
1640 nm – AVG	Average of % reflectance at wavelength: 1640 nm
1640 nm – STD	Standard deviation of % reflectance at wavelength: 1640 nm
1650 nm – AVG	Average of % reflectance at wavelength: 1650 nm
1650 nm – STD	Standard deviation of % reflectance at wavelength: 1650 nm
Plant Height - AVG	Average of plant height in cm
Plant Height - STD	Standard deviation of plant height in cm
Plant Density - AVG	Average – Plants/m^2
Plant Density - STD	Standard deviation – Plants/m^2
Total Wet Wt – AVG	Average of total areal green biomass kg/m^2
Total Wet Wt – STD	Standard deviation of total areal green biomass kg/m^2
Leaves Wet Wt - AVG	Average – areal green biomass kg/m^2 of leaves only

Column Heading	Description
Leaves Wet Wt - STD	Standard deviation – areal green biomass kg/m^{2}of leaves only
Stalks Wet Wt – AVG	Average – areal green biomass kg/m^2 of stalks only
Stalks Wet Wt – STD	Standard deviation – areal dry biomass kg/m^2 of stalks only
Ears Wet Wt – AVG	Average – areal green biomass kg/m^2 of ears only
Ears Wet Wt – STD	Standard deviation – areal green biomass kg/m^2 of ears only
Total Dry Wt - AVG	Average of total areal green biomass kg/m^2
Total Dry Wt - STD	Standard deviation of total areal green biomass kg/m^2
Leaves Dry Wt - AVG	Average – areal dry biomass kg/m^2 of leaves only
Leaves Dry Wt – STD	Standard deviation – areal dry biomass kg/m^2 of leaves only
Stalks Dry Wt – AVG	Average – areal dry biomass kg/m^2 of stalks only
Stalks Dry Wt – STD	Standard deviation – areal dry biomass kg/m^2 of stalks only
Ears Dry Wt – AVG	Average – areal dry biomass kg/m^2 of ears only
Ears Dry Wt – STD	Standard deviation – areal dry biomass kg/m^2 of ears only
Total Water - AVG	Average of total areal water content kg/m^2
Total Water – STD	Standard deviation of total areal water content kg/m^2
Leaves Water – AVG	Average – areal water content kg/m^2 of leaves only
Leaves Water – STD	Standard deviation – areal water content kg/m^2 of leaves only
Stalks Water – AVG	Average – areal water content kg/m^2 of stalks only
Stalks Water – STD	Standard deviation – areal water content kg/m^2 of stalks only
Ears Water - AVG	Average – areal water content kg/m^2 of ears only
Ears Water - STD	Standard deviation – areal water content kg/m^2 of ears only
Notes	Sampling notes

1.3 Volume

The total volume is approximately 97 KB.

1.4 Spatial Coverage

Southernmost Latitude: 34.8º N
Northernmost Latitude: 35.9º N
Westernmost Longitude: 98.3º W
Easternmost Longitude: 97.6º W

1.5 Temporal Coverage

Data were collected daily from 1-18 July 2003

1.5.1 Temporal Resolution

Data were collected 1-3 times on multiple days at multiple sites throughout the project.

1.6 Parameter or Variable

1.6.1 Parameter Description

Parameters in this data set are Leaf Area Index (LAI), Multispectral Radiometer Reflectance (MSR), plant height, plant density, areal wet biomass, areal dry biomass, and areal water content. The following table describes the units of measurement and sources of each parameter.

Table 5. Parameter Units of Measurement and Sources

Parameter	Unit of Measurement	Sensor
Leaf Area Index (LAI)	NA	LI-COR LAI-2000
Multispectral Radiometer Reflectance (MSR)	%	CropScan MSR-16R
Plant height	cm	manual data collection
Plant density	plants/m2	manual data collection
Areal wet biomass	kg/m2	manual data collection
Areal dry biomass	kg/m2	manual data collection
Areal water content	kg/m2	manual data collection

1.6.2 Sample Data Record

For each sample file of this data set shown below, the first four and last four columns are displayed. The value -99 is a fill value for missing data.

The following sample shows the first five rows from `SMEX03_Raw_MSR_Overpass.txt`.

Table 6. Sample Data Record for `SMEX03_Raw_MSR_Overpass.txt`

					1640 nm		1650 nm	
FIELD	**CROP**	**DATE**	**DOY**	**...**	**AVG**	**STD**	**AVG**	**STD**
LW03	Pasture	7/01/2003	182	...	32.16	2.93	29.22	3
LW32	Bare_Soil	7/02/2003	183	...	32.72	1.19	39.31	1.71
LW31	Corn	7/02/2003	183	...	25.9	2.74	10.02	0.92
Quarry	Gypsum_Quarry	7/02/2003	183	...	70.2	4.37	35.41	2.48
LAKE	Lake	7/02/2003	183	...	9.92	1.7	5.31	2.19

The following sample shows the first five rows from `SMEX03_Raw_Vegetation.txt`.

Table 7. Sample Data Record for `SMEX03_Raw_Vegetation.txt`

					Leaves	Stalks	Ears	
		DATE			**Water**	**Water**	**Water**	
FIELD	**CROP**	**(m/dd/yyyy)**	**DOY**	**...**	**kg/m2**	**kg/m2**	**kg/m2**	**NOTES:**
SOY1	Soybeans	7/03/2003	184	...	-99	-99	-99	Biomass samples taken 7/04/2003
SOY1	Soybeans	7/03/2003	184	...	-99	-99	-99	Biomass samples taken 7/04/2003
SOY1	Soybeans	7/03/2003	184	...	-99	-99	-99	Biomass samples taken 7/04/2003
LW33	Alfalfa	7/04/2003	185	...	-99	-99	-99	
LW33	Alfalfa	7/04/2003	185	...	-99	-99	-99	

The following sample shows the first five rows from `SMEX03_Sum_MSR_Overpass.txt`.

Table 8. Sample Data Record for SMEX03_Sum_MSR_Overpass.txt

					1640 nm		1650 nm	
FIELD	**CROP**	**DATE**	**DOY**	**...**	**AVG**	**STD**	**AVG**	**STD**
LW03	Pasture	7/01/2003	182	...	32.16	2.93	29.22	3
LW32	Bare_Soil	7/02/2003	183	...	32.72	1.19	39.31	1.71
LW31	Corn	7/02/2003	183	...	25.9	2.74	10.02	0.92
Quarry	Gypsum_Quarry	7/02/2003	183	...	70.2	4.37	35.41	2.48
LAKE	Lake	7/02/2003	183	...	9.92	1.7	5.31	2.19

The following sample shows the first five rows from SMEX03_Sum_Vegetation.txt.

Table 9. Sample Data Record for SMEX03_Sum_Vegetation.txt

					Stalks	Ears	Ears	
					Water	Water	Water	
		Date			kg/m2	kg/m2	kg/m2	
FIELD	**CROP**	**(m/dd/yyyy)**	**DOY**	**...**	**STD**	**AVG**	**STD**	**NOTES:**
SOY1	Soybeans	7/03/2003	184	...	-99	-99	-99	Biomass samples taken 7/04/2003
LW33	Alfalfa	7/04/2003	185	...	-99	-99	-99	
LW11	Pasture	7/04/2003	185	...	-99	-99	-99	
LW12	Pasture	7/05/2003	186	...	-99	-99	-99	
LW13	Pasture	7/05/2003	186	...	-99	-99	-99	

2 DATA ACQUISITION AND PROCESSING

2.1 Theory of Measurements

The goal of vegetation sampling is to generate the vegetation products used to estimate surface soil moisture from passive microwave radiometers. Sampling was designed to coincide with satellite overpasses, such as LandSat Thematic Mapper (TM5) and Terra-MODIS, which can be used to estimate vegetation water content on the regional scale.

2.1.1 Vegetation Moisture

Samples were collected manually. In the laboratory they were weighed, dried at 60º C for 48 to 96 hours, and then weighed again.

2.1.2 Section Sampling

Sampling was performed on sites approximately a quarter section (0.8 km by 0.8 km) in size. The sampling was concentrated in the Little Washita watershed, but several locations from Oklahoma North (ON) and Oklahoma South (OS) were also sampled. Each Little Washita watershed site was sampled twice during the field campaign, Oklahoma North and South sites were only sampled once. Sampling consisted of recording vegetation height and plant density, collecting vegetation biomass samples, and taking reflectance and LAI measurements. Three locations in each of the sites were sampled, and every effort was made to have these three locations coincide in soil moisture sampling points. The sampling was conducted between 09:00 and 15:00 local time.

2.1.3 Transect Sampling

Several Little Washita watershed sites (representing the dominate types of vegetation) were characterized by transect sampling. Reflectance and LAI measurement were collected at each of the soil moisture sampling locations (14 total). A gypsum quarry and a lake were also sampled for calibration purposes. This was done three times, once to coincide with the each Landsat overpass.

2.1.4 Computing Areal Water Content

The following steps were used to compute areal water content.

Row Crops

1. Determine by manual collection the water content for a known number of plants
2. Convert to a per plant basis
3. Calculate the number of plants per square meter using the row and plant spacing
4. Multiply the water content per plant by the number of plants per square meter to get water content per square meter

Non-Row Crops

1. Determine by manual collection the water content for a 0.44 meter by 0.44 meter area
2. Divide the water content by 0.1936 to get water content per square meter

2.2 Derivation Techniques and Algorithms

2.2.1 Errors and Limitations

2.2.1.1 Leaf Area Index

Direct-beam radiation reflected into the sensor from upper leaves in the canopy can be confused with open sky, causing LAI to be underestimated. Samplers were instructed to sample with the sun

to their backs, but occasionally direct sunlight may enter the sensor. The data were examined for this and for evidence of variable sky conditions during the measurement sequence.

2.2.1.2 Multispectral Radiometer

The radiometer performs near simultaneous inputs of incident as well as reflected irradiation. This allows useful measurements of percent reflectance to be obtained during cloudy conditions with incident irradiance levels down to approximately 300 watts/m2. Measurements obtained with an incident irradiance level of less than 300 watts/m2 had to be discarded. One day it was too cloudy to take any multispectral radiometer measurements.

2.3 Sensor or Instrument Description

2.3.1 Leaf Area Index Meter

Investigators used LiCor LAI-2000 plant canopy analyzers to measure LAI using an indirect noncontact method based on light transmittance through the canopy. The LAI-2000 calculates LAI from radiation measurements made with a fish-eye optical sensor (148 degree field-of-view). Measurements made above and below the canopy are used to determine canopy light interception at five angles. Measurements are made by positioning the optical sensor and pressing a button, which sends the data to the data logger. Multiple below-canopy readings are taken so that LAI calculations are based on a large sample of the foliage canopy. After collecting above-canopy and below-canopy measurements, the control data logger performs all calculations and the results are available for immediate inspection. For more information, visit www.licor.com/env/Products/AreaMeters/index.jsp.

2.3.2 Multispectral Radiometer

Investigators used MSR-16R multispectral radiometers manufactured by CropScan to measure reflectance. The CropScan MSR is an inexpensive instrument that has up-and-down-looking detectors and the ability to measure sunlight at different wavelengths. The CropScan MSR systems consist of a radiometer, data logger controller (DLC) or A/D converter, terminal, telescoping support pole, connecting cables and operating software. The radiometer uses silicon or germanium photodiodes as light transducers. Matched sets of the transducers with filters to select wavelength bands are oriented in the radiometer housing to measure incident and reflected irradiation. In this experiment the wavelengths measured were 485, 560, 650, 660, 830, 850, 1240, 1640, and 1650 nm. These bands provide data for selected channels of the Landsat Thematic Mapper and MODIS instruments. Channels were chosen to provide Normalized Difference Vegetation Index (NDVI) as well as a variety of vegetation water content indices under consideration. For more information, visit www.cropscan.com/msr.html.

3 REFERENCES AND RELATED PUBLICATIONS

Jackson, T. and L. McKee. 2007. *SMEX03 Vegetation Data: Oklahoma*. [indicate subset used]. Boulder, Colorado USA: NASA National Snow and Ice Data Center Distributed Active Archive Center. 10.5067/A1E1EWIHPHAO.

3.1 Related Websites

AMSR-E Validation Data Sets

4 CONTACTS AND ACKNOWLEDGMENTS

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5 DOCUMENT INFORMATION

5.1 Publication Date

December 2006

5.2 Date Last Updated

19 April 2021