SMEX02 Watershed Vegetation Sampling Data, Walnut Creek, Iowa, Version 1

USER GUIDE

How to Cite These Data

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

Anderson, M. 2003. *SMEX02 Watershed Vegetation Sampling Data, Walnut Creek, Iowa, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/XCGVUPGKER17. [Date Accessed].

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1 DETAILED DATA DESCRIPTION

This part of the SMEX02 experiment focused on modeling soil moisture and surface fluxes during periods of rapid vegetation growth. It was important to fully and accurately quantify the temporal development and spatial variability of primary canopy characteristics. Correction for water contained in surface biomass is essential for deriving soil moisture estimates from remote microwave observations. Canopy height and cover information is also important for estimating surface roughness, soil-plant flux partitioning, and other parameters required for modeling land-atmosphere interactions. Four rounds of intensive sampling were conducted at the 31 soil moisture sampling sites within the Walnut Creek Watershed.

Land cover in the Walnut Creek Watershed consists of corn and soybean fields, with some forested areas in localized riparian zones. The vegetation sampling scheme for SMEX02 was designed to characterize variability in surface vegetation conditions within the watershed, given the range of landcover and soil types, crop planting dates, and cultivation techniques encountered in the Iowa landscape.

1.1 Format

Data are provided as ASCII text files and as a Microsoft Excel file.

1.2 File Naming Convention

"smex02_wc_veg_site.txt" contains descriptions and coordinates of sampling locations.

"smex02_wc_veg_loc.txt" contains vegetation data averaged over rows at each sampling location.

"smex02_wc_veg_row.txt" contains vegetation data collected in each row, at each sampling location.

"smex02_wc_veg.xls" is an Excel file that contains the location-averaged data, row data, and data broken out by station.

1.3 Spatial Coverage

Southernmost Latitude: 41.7° N

Northernmost Latitude: 42.7° N

Westernmost Longitude: 93.8° W

Easternmost Longitude: 93.2° W

1.4 Temporal Coverage

The study was conducted between 15 June and 9 July 2002. Actual sampling dates were 16, 17, 18, 19, 27, 28, 29, and 30 June, and 2, 3, 5, 6, 7, and 8 July 2002.

1.5 Parameter or Variable

1.5.1 Parameter Description

The parameters are stand density, plant height, phenological stage, ground cover, green and dry biomass, row spacing, stem and leaf water content, and leaf area index (LAI).

The following table describes each column in the "smex02_wc_site.txt" data file.

Column heading	Description
Site	Watershed site location number (WC01, WC02, etc.)
Loc	Sampling point for each site location 1=high vegetation cover, 2=low cover, 3=average cover
Easting	UTM Easting in meters (Zone 15)
Northing	UTM Northing in meters (Zone 15)
Target_corner	The corner of the sampling location where the aerial target was installed
Row_sp	Row spacing - the distance in meters between the center of one plant row to the center of the next plant row
Row_dir	Direction of the row
Crop	The type of crop growing - corn, soy

The following table describes each column in the "smex02_wc_loc.txt" data file. Units of measure are given for parameters. (The flexcoil technique refers to a planting method that has no clear row structure.)

Column heading	Description	Unit of Measure
Site	Watershed site location number (WC01, WC02, etc.)	
Crop	C=corn S=soy	
Loc	Sampling point for each site location 1=high vegetation cover, 2=low cover, 3=average cover	
Date CST	DD/MM/YYYY Central Standard Time	
DOY CST	Numerical day of the year (Julian date)	
Time CST	HHMM Central Standard Time	
Row_sp m	Space between rows (Flex=flexcoil planting)	meters

Column heading	Description	Unit of Measure
Row_dir	Row direction (NA=not applicable, flexcoil planting)	East, West, North, South
AvgDensity pl/m^2	Average stand density	plants/m2
AvgHeight m	Average plant height over five plants	meters
AvgGr_cover	Average ground cover	percentage
AvgGBM_st g	Average stem green biomass	grams
AvgGBM_lf g	Average leaf green biomass	grams
AvgGBM_pl g	Average plant green biomass	grams
AvgAGBM_st kg/m^2	Average stem green biomass	kg/m^2
AvgAGBM_lf kg/m^2	Average leaf green biomass	kg/m^2
Avg_AGBM_pl	Average plant green biomass	kg/m^2
AvgWC_st g	Average stem water content	grams
AvgWC_lf g	Average leaf water content	grams
AvgWC_pl g	Average plant water content	grams
AvgAWC_st kg/m^2	Average stem water content	kg/m^2
AvgAWC_lf kg/m^2	Average leaf water content	kg/m^2
AvgAWC_pl kg/m^2	Average plant water content	kg/m^2
AvgLAI	Average LAI	

The following table describes each column in the "smex02_wc_row.txt" data file. Units of measure are given for parameters.

Column heading	Description	Unit of Measure
Site	Watershed site location number (WC01, WC02, etc.)	
Crop	C=corn S=soy	
Loc	Sampling point for each site location 1=high vegetation cover, 2=low cover, 3=average cover	
Row	Row number	
Date CST	DD/MM/YYYY Central Standard Time	
DOY CST	Numerical day of the year (Julian date)	
Time CST	HHMM Central Standard Time	
Row_sp m	Row spacing - distance in meters between the center of one plant row to the center of the next plant row (Flex=flexcoil planting)	meters
Row_dir	Row direction (NA=not applicable, flexcoil planting)	East, West, North, South
Density pl/m^2	Stand density - number of plants in a meter length within a row	plants/m^2
Height m	Plant height over five plants	meters
Pheno	Average phenological stage of plants within the sampling rows (See the Iowa State corn phenological guide and the Iowa State soy phenological guide for stage designations)	
Gr_cover	Ground cover	percentage

Column heading	Description	Unit of Measure
GBM_st g	Stem green biomass	grams
GBM_lf g	Leaf green biomass	grams
AvgGBM_pl g	Plant green biomass	grams
AGBM_st kg/m2	Areal stem green biomass	kg/m^2
AGBM_lf kg/m2	Areal leaf green biomass	kg/m^2
AGBM_pl kg/m2	Areal plant green biomass	kg/m^2
WC_st g	Stem water content	grams
WC_lf g	Leaf water content	grams
WC_pl g	Plant water content	grams
AWC_st kg/m2	Areal stem water content	kg/m^2
AWC_lf kg/m2	Areal leaf water content	kg/m^2
AWC_pl kg/m2	Areal plant water content	kg/m^2
LAI	LAI	
Sky	Weather conditions	sun or shade

1.5.2 Parameter Source

LAI is measured by a plant canopy analyzer. Other parameters were measured manually.

1.5.3 Sample Data Record

The following sample is taken from the "smex02_wc_site.txt" data file.

Site	Loc	Easting	Northing	Target_corner	Row_sp	Row_dir	Crop
-	-	m	m	-	m	-	-
WC01	1	437265.98	4646549.05	NE	0.76	E-W	corn
WC01	2	437256.94	4646703.58	NE	0.76	E-W	corn
WC01	3	437220.73	4646847.81	NE	0.76	E-W	corn
WC03	1	437728.68	4647902.96	SE	0.38	N-S	soy

The next sample is taken from the "smex02_wc_row.txt" data file. Only the first 19 columns are represented in the sample.

Site	Crop	Loc	Row	Date	DOY	Time	Row_sp	Row_dir	Density	Height	Pheno	Gr_cover	GBM_st	GBM_lf	GBM_pl	AGBM_st	AGBM_lf	AGBM_pl	...
-	-	-		CST	CST	CST	m	-	pl/m2	m	-	%	g	g	g	kg/m2	kg/	kg/m2	...
WC01	C	1	2	6/29/2002	180	820	0.76	E-W	6.56	1.52	v8	80	461.31	195.73	657.04	3.03	1.28	4.31	...

WC01	C	1	4	6/29/2002	180	820	0.76	E-W	7.87	1.55	v9	80	406.32	174.76	581.08	3.20	1.38	4.58 ...
WC01	C	1	6	6/29/2002	180	820	0.76	E-W	7.22	1.46	v9	80	324.18	149.64	473.82	2.34	1.08	3.42 ...
WC01	C	1	8	6/29/2002	180	820	0.76	E-W	7.22	1.49	v8	80	392.21	169.69	561.90	2.83	1.22	4.06 ...
WC01	C	1	10	6/29/2002	180	820	0.76	E-W	5.91	1.47	v8	80	369.57	175.63	545.20	2.18	1.04	3.22 ...

The next sample is taken from the "smex02_wc_loc.txt" data file. Only the first 16 columns are represented in the sample.

Site	Crop	Loc	Date	DOY	Time	Row_sp	Row_dir	AvgDensity	AvgHeight	AvgGr_cover	AvgGBM_st	AvgGBM_lf	AvgGBM_pl	AvgAGBM_st	...
-	-	-	CST	CST	CST	m	-	pl/m2	m	%	g	g	g	kg/m2	...
WC01	C	1	6/29/2002	180	820	0.76	E-W	6.96	1.50	80	390.72	173.09	563.81	2.72	...
WC01	C	2	6/29/2002	180	820	0.76	E-W	6.69	1.00	55	218.02	114.37	332.39	1.42	...
WC01	C	3	6/29/2002	180	820	0.76	E-W	8.53	1.32	70	290.52	172.51	463.03	2.47	...
WC01	C	1	7/6/2002	187	1100	0.76	E-W	8.40	2.09	90	481.76	220.00	701.75	4.04	...
WC01	C	2	7/6/2002	187	1100	0.76	E-W	8.53	1.53	70	394.28	164.13	558.42	3.38	...

2 DATA ACQUISITION AND PROCESSING

Vegetation data were collected in watershed soil moisture sampling sites during four rounds of sampling: the 12 watershed sites containing flux towers were sampled 4 times during the experiment; the remaining 19 sites were sampled twice. This sampling schedule allowed characterization of the rapid evolution in biomass and surface cover that occurred during the course of this study.

Three vegetation sampling locations were identified in each site using aerial imagery. One location with high vegetation cover, one with low cover, and a third with average cover (see Figure 1).

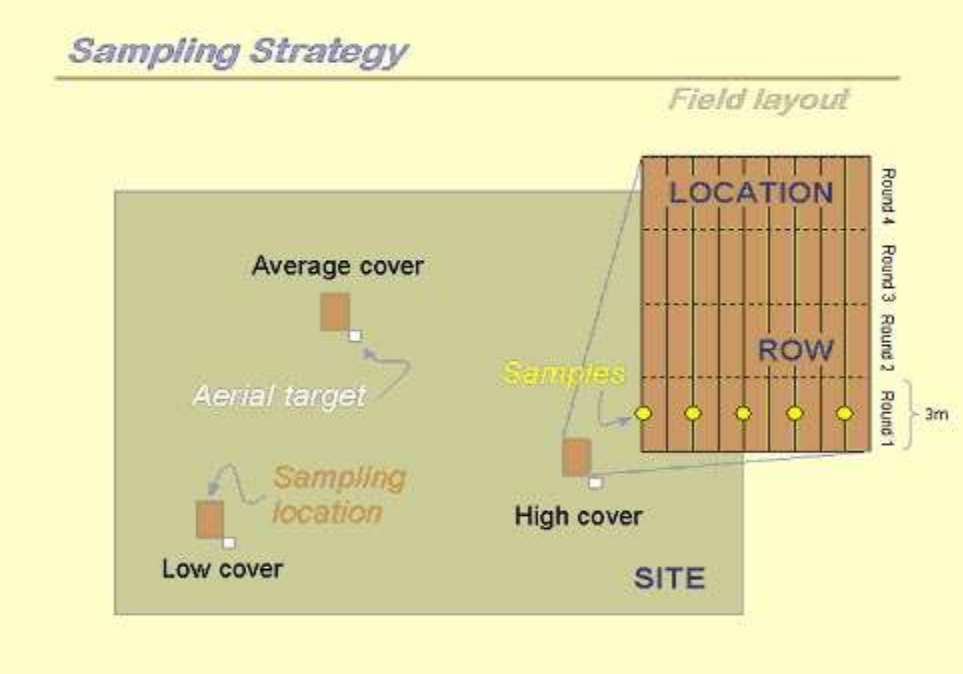

Figure 1. Schematic of vegetation sampling strategy

At the corner of each sampling location, a large white aerial target (1 m by 1 m) was stapled to the ground (see Figure 2). The locations of each target were recorded on the ground with handheld Global Positioning System (GPS) units.

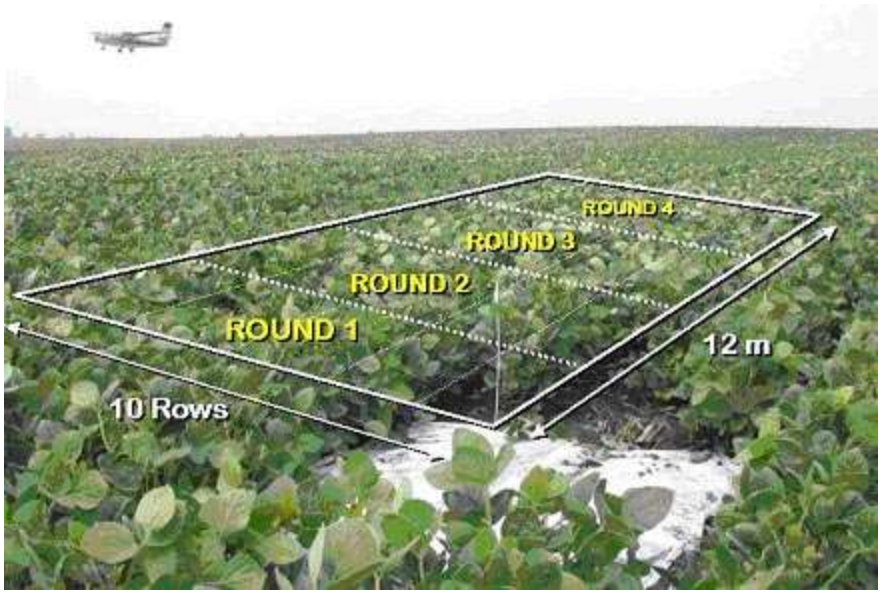

Figure 2. Photograph of aerial target

Each sampling location was 10 rows across and 12 m long. Biomass samples, LAI, plant height, and stand density measurements were collected from every second row, yielding 5 sets of observations per location times 3 locations per field, which equals 15 data sets per field per

sampling round. In the first sampling round, vegetation samples were collected in the first 3 m segment closest to the aerial target; in the second round, from the second 3 m segment, etc.

2.1 Theory of Measurements

The purpose of vegetative sampling is to provide an estimate of the variation in the vegetative components in the corn and soybean fields across the SMEX02 study sites.

2.2 Data Acquisition Methods

2.2.1 Stand Density

Stand density was measured by placing a meter stick along the row in each of the five rows sampled. The meter stick was placed at the center of a plant stem, with that stem counting as the first plant. All plants within the 1 m length were counted. If a plant was at the end of the meter stick and more than half of the stalk extended beyond the end of the meter stick, it was not counted.

For soybean fields planted with the flexcoil technique, which has no clear row structure (WC10 and WC14), a wire frame with dimensions 1 m by 0.5 m was used to measure stand density. The frame was placed on the soil surface and all plants within the frame were counted.

2.2.2 Vegetation Height

Samplers used a meter stick, to estimate the average height of the canopy within a 3 m segment in each sampling row. In corn, this nominal height estimate excluded the extreme tips of vertical leaves.

2.2.3 Ground Cover

Samplers assessed percentage ground cover as the fraction of the spacing between rows that the crop canopy occupied. For example, if a soybean row were visualized as a cylinder, ground cover would be the ratio between the diameter of the cylinder and the row spacing.

2.2.4 Green and Dry Biomass

Biomass samples were collected in each sampling row, yielding five plants sampled per location per sampling round. One plant of average height was cut at the ground surface from each sampling row and transported back to the lab for weighing.

Corn: Leaves and stalks were removed from each corn plant in the field and placed in separate paper bags. The samples were dropped off at the lab as quickly as possible.

Soybean: In the field, each whole plant was placed in a paper bag. Lab workers separated leaf and stem components at the lab.

At the lab, each paper bag was weighed and the green biomass and tare weight recorded. (Several empty bags were weighed to assess tare weights.) The filled bags were taken to drying ovens operated by the Iowa State University Agronomy Department and dried for 4-5 days at 110° F. Weights of representative corn samples were obtained periodically during the drying process to ascertain that weight loss had ceased before the samples were removed from the ovens. After drying, the dry biomass and tare weights were recorded.

2.2.5 Leaf Area Index (LAI)

Leaf Area Index was measured using an LAI-2000 (LiCor Inc.) canopy analyzer, which compares above- and below-canopy light levels to compute LAI and canopy architecture. The canopy analyzers were set to average four locations into a single value, using one observation taken above the canopy and four beneath the canopy: in the row, ¼ of the way across the row, ½ of the way across the row and ¾ of the way across the row. This gives a good spatial average for row crops of partial cover.

The manufacturer recommends using the LAI-2000 units only in diffuse light, in overcast conditions, or near dawn or dusk. Direct-beam radiation reflected into the sensor from upper leaves in the canopy can be confused with open sky, causing LAI to be underestimated. Because of restrictions in time and manpower, LAI observations in SMEX02 were taken in both sunlit and shaded/diffuse conditions. Observers were instructed to note local sky conditions that existed during each measurement. If no shadows could be seen during the measurement, then the measurement was marked "shade." If shadows could be seen during the measurement then the measurement was marked "sun." If sky conditions changed during the course of a measurement, the measurement was not used. A series of observations were taken in several fields to test the effect of sunlit vs. shaded conditions on derived LAI, and a simple analytical routine is being developed to correct observations that were acquired in sun. The effect appears to be a negative bias on the order of <0.5 units of LAI.

2.3 Derivation Techniques and Algorithms

Biomass water content (BWC; g/plant) in plant stems and leaves was computed as:

$BWC = B_g' - B_d'$

where B_g' is the green biomass + tare weight and B_d' is the dry biomass plus tare weight. This assumes that water loss from the tares (paper bags) was negligible in comparison with that from the plant samples.

In row crops, stand density (*ASD*; plants/m2) was estimated from the row plant density (*RD*; plants/m) using:

$ASD = RD/RS$ (row crops)

where *RS* is the row spacing. In flexcoil plots, it was computed as

$ASD = AD * 2$ (flexcoil plots)

where AD is the plant density measured using the 1m by 0.5 m wire frame. Biomass water content (kg/m^2) was then computed as:

$ABWC = 10^{-3} * BWC * ASD$

2.4 Quality Assessment

In some data files, a misalignment between the sensor mask and the sun caused direct sunlight to enter the detector. In these cases, the LAI was recomputed excluding the offending sensor ring/location combination. All data were assessed and corrected for these errors. The data were also examined for evidence of variable sky conditions during the measurement sequence.

Phenology observations in later sampling rounds were corrected slightly for low leaves that had likely matured and fallen off and may have been disregarded in the phenological stage assessment. In corn, 3 leaves were added in Round 3 to plants in V stages. In Round 4, 5 leaves were added to plants in V stages, and capped at stage V18.

3 REFERENCES AND RELATED PUBLICATIONS

Please see the SMEX02 site for more information, and the AMSR-E site to access data.

Iowa State corn phenological guide

Iowa State soy phenological guide

4 CONTACTS AND ACKNOWLEDGMENTS

Martha Anderson

Assistant Scientist

Space Science and Engineering Center

University of Wisconsin, Madison, WI, USA.

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5 DOCUMENT INFORMATION

5.1 Publication Date

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5.2 Date Last Updated

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