Vegetation Biophysical Data (FIFE)

Summary:

The Biophysical Properties of the Vegetation Data Set were collected as part of the larger FIFE Science effort to characterize the physical and biological properties of the sites within the FIFE study area over the life of the field experiment. These data were collected at 43 locations scattered throughout the FIFE study area between May 1987 and August 1989.

The measurements of leaf area were based on an optical technique in which the area of the light beam obscured by the material under the beam is a measure of the surface area of that material relative to the total surface area that the beam covers. The resulting Leaf Area Indices (LAI) provide a relative measure of leaf area. These indices, when compared between plant samples provide an indirect and relative measure of plant biomass.

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1. Data Set Overview:

Data Set Identification:

Vegetation Biophysical Data (FIFE).
(Biophysical Properties of Vegetation).

Data Set Introduction:

The Biophysical Properties of the Vegetation Data Set were collected as part of the larger FIFE Science effort to characterize the physical and biological properties of the sites within the FIFE study area over the life of the field experiment.

Objective/Purpose:

This data set was collected and prepared to provide FIFE investigators with biophysical measurements of the vegetation present at the FIFE study area throughout the duration of the experiment.

Summary of Parameters:

Area indices for leaf litter, grass stems, non-grass stems and green leaves; wet and dry weight for grasses, non-grasses, leaf litter, and standing dead; and canopy height.

Discussion:

The biophysical properties of the vegetation at the FIFE study area were collected as part of the larger FIFE Science effort to characterize the physical and biological properties of the sites within the FIFE study area over the life of the field experiment. These data were collected at 43 locations scattered throughout the FIFE study area from May 26, 1987 through August 18, 1989. There were 30 unique locations in 1987, 21 in 1988 and six in 1989. In 1987, some of the locations were co-located with the sites where surface flux measurements were made while other locations were co-located with other instrumented sites. In 1989, three of the locations were co-located with sites where surface flux and meteorological measurements were made.

Related Data Sets:

- Vegetation Species and Cover Abundance.
- Vegetation Species Reference.
- Leaf Optical Properties from UNL.
- Surface Reflectance Measured with a Mast-borne MMR.
- SE-590 Reflectance Factors and Radiances from UNL.
- Leaf Area Index and PAR Determined from UNL Light Bar Measurements.
- Indirect Leaf Area Index Obtained from the UNL Light Wand.
- Gravimetric Soil Moisture.

FIS Data Base Table Name:

VEG_BIOPHYS_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Staff Science.

Title of Investigation:

Staff Science Data Acquisition Program.

Contact Information:

For 1987 data:

Contact 1:
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For 1988 data:

Contact 1:
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For 1989 Data:

Contact 1:
Dr. Tanvir Shah
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Normal, AL
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For UNL Data:

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Requested Form of Acknowledgment.

The biophysical properties of the vegetation at the FIFE study area were collected for FIFE by the staff of the Evapotranspiration Laboratory at Kansas State University under the direction of E.T. Kanemasu, and by the staff of the University of Nebraska, Lincoln under the direction of B. Blad. The dedicated efforts of A. Nelson, J. Killeen, L. Ballou, T. Shah, and C. Hays in collecting and preparing these data is particularly appreciated.

3. Theory of Measurements:

The measurements of leaf area are based on an optical technique in which the area of the light beam obscured by the material under the beam is a measure of the surface area of that material relative to the total surface area that the beam covers. The resulting Leaf Area Indices (LAI) provide a relative measure of leaf area. These indices, when compared between plant samples provide an indirect and relative measure of plant biomass. Direct measurements of plant biomass are based on the principle that materials of equal mass hung from either side of a pendulum will come to an equilibrium. A weight of known mass applied to one side of the pendulum to counterbalance the mass of the sample on the other side is then the weight of the sample.

4. Equipment:

Sensor/Instrument Description:

LI-COR-3100 Leaf area meter, inclinometer, drying oven, and balance.

Collection Environment:

Ground-based.

Source/Platform:

Site properties (canopy height, soil depth, slope, aspect) were measured by persons on the ground, using portable field instruments. The properties of the vegetation (weight and plant indices) were measured in the lab using destructive analysis techniques on the samples collected in the field.

Source/Platform Mission Objectives:

The Mission Objectives were two-fold:

1. To measure landscape-scale variation in biophysical canopy properties in a grassland prairie.
2. Analyze community heterogeneity in a tallgrass prairie at regional and local levels to assess the effects of disturbances on community structure at different spatial scales.

Key Variables:

Biomass, indices of the vegetation (leaf area index, litter area index, grass stem area index, non-grass stem area index), canopy height, soil depth, slope.

Principles of Operation:

Leaf area measurements were taken with a leaf area meter. Leaves are conveyed by transparent belts at a uniform speed across a linear light sensor. The width of the sensor shaded by the passing leaf material and the length of time which it remains shaded as the plant material passes over it is used to compute leaf area.

Wet and dry weights of samples was obtained using a balance. Wet weights were first obtained for each sample, they were then dried in a drying oven for 5 days at 70 degrees C. Dry weights were then made on these dried samples.

Sensor/Instrument Measurement Geometry:

Not applicable.

Manufacturer of Sensor/Instrument:

LI-COR-3100 Leaf Area Meter:

LI-COR, Inc.
Lincoln, Nebraska.

Calibration:

Flat disks of known area are passed through the leaf area meter to calibrate the instrument.

Specifications:

The leaf area meter had a resolution capability of 1 square mm. The weighing balance was accurate to within 0.01 g.

Tolerance:

Not available at this revision.

Frequency of Calibration:

It is not normally necessary to recalibrate either the leaf area meter or the weighing balance. Such instruments are usually checked yearly or whenever measurements appear suspicious.

Other Calibration Information:

Not available at this revision.

5. Data Acquisition Methods:

KANSAS STATE UNIVERSITY (STAFF):

1987 and 1988 Procedures:

Vegetation samples were taken from six 0.1 square meter plots about once every week during IFCs 1 - 4, and once every two weeks during all other periods when samples were taken. The surface vegetation and ground litter were removed (physically extracted) from the plot and collected in separate plastic bags. The bagged samples were taken to the trailer at Konza headquarters where total wet weight of green material was measured immediately. The vegetation was then stored in a refrigerator until it was separated and weighed again. Once the bag was reopened for separation and weighing, the aim was to complete the LAI and wet weight measurements within an hour.

In the trailer, each sample was separated into six categories: grass leaves, grass stems, non-grass leaves, non-grass stems, litter, and standing dead vegetation. Leaf area index was measured for grass and non-grass leaves. Each of the six categories were then weighed separately and bagged for drying. The samples were dried, in an oven, for 5 to 7 days at 97 degrees Centigrade. After drying, the samples were returned to the trailer where the dry weight measurements were taken.

A team of about ten summer-hire students separated the sample vegetation, subjectively separating grass leaves from grass stems, and made the LAI and weight measurements. If the samples for the current day were not completed in that day, they were refrigerated and completed in the morning. The goal was to process the samples up to the drying stage within 24 hours of data collection. At the end of each day, checks were run on the data files with the wet weight measurements for that day to detect and correct obvious errors.

Minor procedural refinements were made throughout IFC-1 to improve consistency. The addition of a standing dead weight measurement is the only major change from IFC-1. Mention was made for a need to document procedural changes between IFCs since such changes can provide explanations for any inconsistencies within the final data set.

1989 Procedures:

After examining the 1987 and 1988 data it became apparent that prairie vegetation is inherently variable and a large number of samples are needed to obtain reliable mean values for the vegetation measurements. Collecting and processing a large number of plants is very labor intensive and expensive. It was decided for the 1989 intensive field

campaign that the destructive measurements described here would be supplemented with large numbers of non-destructive measurements of leaf area (see the document Indirect Leaf Area Index Obtained from the KSU Light Wand for a description of these non-destructive measurements).

Destructive samples were collected from stations 906, 910, 911, 921 and 944. These stations were chosen to represent the main treatment and instrumentation combinations. The treatments at these sites are shown below.

SITEGRID	STATION	ASPECT	BURN	GRAZE
2133-VBS	906*	Top	B	N
3317-VBS	910	West	U	N
4439-VBS	911*	North	B	N
8639-VBS	921*	Top	U	G
1942-VBS	944	Top	U	G

B = burned,
U = unburned,
G = grazed,
N = not grazed

* Super-sites, instrumented with eddy correlation rigs for carbon dioxide, and latent and sensible heat flux measurements. These sites were also equipped with automatic weather stations. Sites 910 and 944 were instrumented with Bowen ratio apparatus.

Samples were taken immediately after the non-destructive measurements (see the document Indirect Leaf Area Index Obtained from the KSU Light Wand for a description of these data). Samples were plucked from 0.1 m squared plots along an east-west line behind the 140-240 degree WAB zone (Wind Aligned Blobs - see FIFE Experiment Plan for 1989).

Twenty samples from each of the above sites were collected during days July 17-21, 10 samples were collected during days July 31 - August 5, and 20 samples were taken during days August 14-18.

Immediately after collection, the samples were sealed in a plastic bag with a moist paper towel and placed on ice in a Styrofoam chest. The samples were sorted into green and dead, and grass and non-grass fractions before measuring for leaf areas and biomass.

Additional samples (4 per each of the above 5 sites) were taken from plots that were well-watered a day before sampling, for determination of unstressed (i.e., unrolled) leaf area to leaf weight ratios. These samples were taken three times from each of the above sites (during days July 3-7, August 7 and 8, and August 24-26).

UNIVERSITY OF NEBRASKA (B. BLAD):

Plant Biomass:

Plant material was collected from 0.1 square meter plots demarcated by a 0.2 by 0.5 rectangle. Measurements were made at each site near the plots where ground MMR measurements were made (see MMR ground data document). The sample was separated into three categories: 1) green grass leaves and stems, 2) green non-grass leaves and stems, and 3) litter and standing dead. Dry weights were reported for each category.

Leaf Area Index:

Destructive samples of plant material were taken for Leaf Area Index (LAI) measurements. These LAI measurements were used to characterize the plant material at each site and to verify indirect site measurements of LAI that are reported in the document Indirect Leaf Area Index Obtained from the UNL Light Wand.

Plant material for the LAI measurements were sorted into four components: grass stems, forb leaves, forb stems, and litter. Surface area was measured with a LI-COR-3100 area meter. (Biomass was measured after plant material had been dried at 70 C for 5 days.)

Measurements were made at sites 906, 916, and 966 (SITEGRID 2133-VBB, 4439-VBB, and 2437-VBB). Measurements were made either within the plots used for the MMR leaf measurements (see the document Leaf Optical Properties from UNL for a description of MMR leaf plots), or in areas near the plots with similar foliage cover. Sites 906 and 916 each had five plots, but site 966 had fifteen plots. The plot number design was:

PLOT NUMBER (#)	DESCRIPTION
100 < # < 200	Outside MMR plots
# > 200	Inside MMR plots

LAI values reported in this data set are for leaves collected later in the day than the in-situ (non-destructive) LAI measurements made at the same sites and reported in the document Indirect Leaf Area Index Obtained from the UNL Light Wand. In addition, a delay between the sampling and the LAI measurements may have caused some leaves to lose water. The stressed plants had rolled leaves and produced lower LAI values.

Leaves were rolled in samples from plots 111 and 115 at site 966 (SITEGRID 2437-VBB) on June 13; in all plots at site 916 (SITEGRID 4439-VBB) on July 11 in the afternoon; in plot 103 at site 906 (SITEGRID 2133-VBB) on August 9; all plots at site 906 on August 10 and in plots 202, 203, and 205 at site 916 on August 12. Plants denoted as rolled on August 10 and 12 were rolled prior to non-destructive sampling, therefore, the differences between non-destructive and destructive sampling may be reduced.

The surface area of each of the components was normalized to 0.1 square meter to produce an area index. The litter area was only measured on July 11 and August 5. All the weights were normalized to the ground surface area; the units are grams per meter squared.

6. Observations:

Data Notes:

Not available.

Field Notes:

Stations 2 and 8 were sampled on a weekly schedule from May 5 through June 13.

Locations were sampled in several groups or collections. All sites in a group were sampled on the same day.

```
Group/Collection 1 contains 102 data points
(17 stations, 6 samples per station).
Group/Collection 2-4  contain 114 data points
(17 stations, 6 samples per station, with station 2 and 8 sampled
twice each).
Group/Collection 5-10 contain 102 data points
(17 stations, 6 samples per station).
```

The maximum depth measurable with the soil-depth probes was 44 cm. Therefore, any reading of 44 cm indicates that the soil was at least 44 cm deep. Any sample where the soil was too dry and/or hard to penetrate with the soil-depth probe is coded as -1. Any sample where the field technician noted that he/she was not able to penetrate the probe to the bottom of the soil because of hard-dry conditions is reported as a negative number. (e.g. a reading of 8 cm is reported as -8 if the technician reports soil too hard to reach the bottom.)

Total dry weight was the only dry weight measured in the period after IFC-4. Plant samples were not separated into component parts as was done up to and including IFC-4.

7. Data Description:

Spatial Characteristics:

The FIFE study area, with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM Zone 14.

Spatial Coverage:

These data were collected by the FIFE Science staff from 43 locations spread throughout the FIFE study area (30 locations in 1987, 21 in 1988 and 6 in 1989). The KSU staff visited all but one of the 43 locations (2437-VBB) and two of the sites (916 and 966). The University of Nebraska group, on the other hand, visited only 3 of the locations (4439-VBB, 2133-VBB and 2437-VBB) and 4 sites (811, 906, 916, and 966).

Spatial Coverage Map:

Not available.

Spatial Resolution:

Measurements were made in six 0.1 square meter plots surrounding each FIFE site. The leaf area meter had a resolution of 1 square mm.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

The overall time period of data acquisition was from May 26, 1987 through August 18, 1989 during and between IFCs. The data collected by the staff of the LTER site at KSU (PI_name = STAFF) covered the entire period mentioned here. However, the data collected by University of Nebraska (PI_name = B. BLAD) group covered only the periods from May 26, 1988 to August 12, 1988 and June 13, 1989 to August 12, 1989.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Sampling intervals for each station varied throughout the growing season and by year. During 1987, samples were collected weekly during the spring IFC and every other week during the summer and fall IFC's. Between IFC's samples were collected every 3 weeks. In 1988 when there were no IFC's, samples were collected approximately every 2 weeks. And in 1989, samples were collected weekly during IFC-5, and about every two weeks at other times.

Data Characteristics:

The SQL definition for this table is found in the VEG_BIOP.TDF file located on the CD-ROM Volume 1.

Parameter/Variable Name

Parameter/Variable Description	Range	Units	Source
SITEGRID_ID This is a FIS grid location code. Site grid codes (SSEE-III) give the south (SS) and east (EE) cell number in a 100x100 array of 200m square cells. The last 3 characters (III) are an instrument identifier.			
STATION_ID The station ID designating the location of the observations.			
OBS_DATE The date of the observations, in the format (DD-MMM-YY).			
PI_NAME The name of the principle investigator supervising the collection of these data.	*		
PLOT The number of the plot within the site where the data were collected. Sample size was .1 square meters.			
CANOPY_HT The measured canopy height		[cm]	
SOIL_DEPTH The soil depth, measured with a probe pushed into the ground.		[cm]	
SLOPE The slope of the plot.		[degrees]	
ASPECT The aspect direction of the plot.		[degrees]	
LITTER_AREA_INDEX			

The leaf area index of the litter
for the plot.

GRASS_STEM_AREA_INDEX
The leaf area index of the grass
stems.

NONGRASS_STEM_AREA_INDEX
The leaf area index of the
nongrass (forb) stems.

LAI_GRASS
The green leaf area index for
grass leaves.

LAI_NONGRASS
The green leaf area index of the
nongrass (forb) leaves.

LAI_TOTAL
The total green leaf area index
of the plot.

DRY_GRASS_STEM_WT
The dry biomass of the grass stems. [grams]
[meter^-2]

WET_GRASS_STEM_WT
The fresh biomass of the grass stems. [grams]
[meter^-2]

DRY_NONGRASS_STEM_WT
The dry biomass of the nongrass [grams]
(forb) stems. [meter^-2}

WET_NONGRASS_STEM_WT
The fresh biomass of the nongrass [grams]
(forb) stems. [meter^-2]

DRY_GRASS_LEAF_WT
The dry biomass of grass leaves. [grams]
[meter^-2]

WET_GRASS_LEAF_WT
The fresh biomass of the grass [grams]
leaves. [meter^-2]

DRY_NONGRASS_LEAF_WT The dry biomass of the nongrass (forb) leaves.		[grams] [meter^-2]
WET_NONGRASS_LEAF_WT The fresh biomass of the nongrass (forb) leaves.		[grams] [meter^-2]
DRY_TOTAL_WT The total dry biomass of the plot. [meter^-2]		[grams]
WET_TOTAL_WT The total fresh biomass of the plot.		[grams] [meter^-2]
DRY_STANDING_DEAD_WT The dry weight of standing dead vegetation.		[grams] [meter^-2]
WET_STANDING_DEAD_WT The weight of standing dead vegetation before drying.		[grams] [meter^-2]
DRY_LITTER_WT The dry litter weight. [meter^-2]		[grams]
WET_LITTER_WT The litter weight before drying. [meter^-2]		[grams]
FIFE_DATA_CRTFCN_CODE The FIFE Certification Code for the data, in the following format: CPI (Certified by PI), CPI-??? (CPI - questionable data).	**	
LAST_REVISION_DATE data, in the format (DD-MMM-YY).		

Footnotes:

* A separate file on FIFE CD-ROM Volume 1 contains the UNL (PI_NAME = B. BLAD) data for CANOPY_HT, SOIL_DEPTH, SLOPE, ASPECT, and Species at each PLOT.

** Valid levels

The primary certification codes are: EXM Example or Test data (not for release) PRE Preliminary (unchecked, use at your own risk) CPI Checked by Principal Investigator (reviewed for quality) CGR Checked by a group and reconciled (data comparisons and cross checks)

The certification code modifiers are: PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data which is "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

SITEGRID_ID	STATION_ID	OBS_DATE	PI_NAME	PLOT	CANOPY_HT
2437-VBB	966	11-JUL-89	B. BLAD	114	
2437-VBB	966	11-JUL-89	B. BLAD	106	
2437-VBB	966	11-JUL-89	B. BLAD	112	
2437-VBB	966	11-JUL-89	B. BLAD	102	
2437-VBB	966	11-JUL-89	B. BLAD	108	
2437-VBB	966	11-JUL-89	B. BLAD	110	
2437-VBB	966	11-JUL-89	B. BLAD	104	
1445-VBS	42	02-JUN-87	STAFF	2	36
1445-VBS	42	02-JUN-87	STAFF	3	36
1445-VBS	42	02-JUN-87	STAFF	4	35
1445-VBS	42	02-JUN-87	STAFF	6	34

SOIL_DEPTH	SLOPE	ASPECT	LITTER_AREA_INDEX	GRASS_STEM_AREA_INDEX
.12		.04		
.28		.07		
.29		.09		
.21		.12		
.51		.15		
.24		.08		
.28		.12		
5	10	0		
9	10	0		
15	9	0		
15	9	0		

NONGRASS_STEM_AREA_INDEX	LAI_GRASS	LAI_NONGRASS	LAI_TOTAL
0	.3	.01	.46
0	.38	.04	.77
0	.61	0	.99
0	1.27	0	1.6
0	.95	0	1.61
.02	.51	.06	.9
.12	.98	1.02	2.52
1.106	.424	1.53	
.595	.525	1.12	

.686 .273 .959
1.469 .234 1.703

DRY_GRASS_STEM_WT	WET_GRASS_STEM_WT	DRY_NONGRASS_STEM_WT
13.7	73.8	
21.5	80.5	
37.6	135.9	
33.5	127.6	
66.3	186.5	
27.2	95.1	
40.7	146.1	
36.12	126	14.21
18.56	53	6.24
13.4	40	10.01
44.47	133	11.51

WET_NONGRASS_STEM_WT	DRY_GRASS_LEAF_WT	WET_GRASS_LEAF_WT
.3		
1.3		
36.6		
0		
0		
10.2		
59.3		
43	107.31	275
13	90.4	189
20	67.41	163
28	119.84	308

DRY_NONGRASS_LEAF_WT	WET_NONGRASS_LEAF_WT	DRY_TOTAL_WT
.2	102.9	
5.5	141.5	
0	246.8	
0	185.2	
0	317.7	
9.4	171.5	
102.1	379	
33.8	93	199.6
48.9	96	176.2
27.09	58	124.7
17.64	56	193.5

WET_TOTAL_WT	DRY_STANDING_DEAD_WT	WET_STANDING_DEAD_WT	DRY_LITTER_WT
14.9			
32.7			
36.7			
24.1			
64.9			
29.6			
30			
614	8.2	-9	0
453	12.14	-9	0
329	6.78	-9	0
594	0	-9	0

WET_LITTER_WT	FIFE_DATA_CRTFCN_CODE	LAST_REVISION_DATE
CPI		16-JUL-91

```
CPI                 16-JUL-91
CPI                 16-JUL-91
CPI                 16-JUL-91
CPI                 16-JUL-91
CPI                 16-JUL-91
CPI                 16-JUL-91
-9       CPI                 25-SEP-91
-9       CPI                 25-SEP-91
-9       CPI                 25-SEP-91
-9       CPI                 25-SEP-91
```

8. Data Organization:

Data Granularity:

Measurements were made in six 0.1 square meter plots surrounding each FIFE site. The leaf area meter had a resolution of 1 square mm. Sampling intervals for each station varied throughout the growing season and by year.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begin with five header records. Header records contain the following information:

Record 1 Name of this file, its table name, number of records in this file, and principal investigator name. Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.) Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites, sequentially numbered by SITEGRID.) Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.) Record 5 Column names for the data within the file, delimited by commas. Record 6 Data records begin.

Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF file. These fields are in the same order as in the chart.

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

For 1987 Plant Data:

Leaf Area Index for grasses was calculated as 1-sided leaf area of all grasses in the sample divided by the ground area sampled.

Leaf Area Index for non-grasses was calculated as 1-sided leaf area of all non-grasses in the sample divided by the ground area sampled.

Data Processing Sequence:

Processing Steps:

The samples collected and analyzed by the LTER staff at KSU during each day were checked for obvious errors or inconsistencies in the wet weight or LAI measurements.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

Not available at this revision.

Calculated Variables:

Leaf Area Index for grasses and Leaf Area Index for non-grasses.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

The weighing balance used for measuring dry biomass was accurate to within 0.01 g. The fresh biomass measurements were taken with a weighing balance accurate to within 0.10 g. The main problem was with the fresh weight measurements for the different components of the vegetation (e.g. grass, non-grass, live, dead, etc.). The samples tended to dry out during sorting into the different components. An estimate of these errors can be obtained by comparing the initial weight of the whole sample (before sorting) with the sum of the component weights obtained after sorting (see KSU staff plant data).

The LAI measurements possess inaccuracies due to the way the leaves pass through the belts and over the detector that is used to measure leaf area. Leaves tend to curl or fold thus leading to an under estimate of their surface area. This is especially true with drought-stressed grass leaves. This problem depends on the type of leaf material, the degree of drought-stress, and the care taken by the operator of the leaf area meter. No precise measurement of errors due to these difficulties is available, however, it is generally felt (John Norman, personal communication) that a variation of about 25% can be attributed to these factors.

The most important sources of error in all the biophysical measurements is caused by the inherent variability of the prairie vegetation. From measurements of biomass and LAI during 1987 and 1988, it appears that the standard error is around 75% of the mean value for most of the FIFE grids. Thus a large number (about 100) of destructive samples are required to obtain a reliable estimate of the mean. Destructive measurements require a large amount of manpower and resources, so during the 1989 FIFE campaign, destructive plant measurements were supplemented with large numbers of non-destructive measurements (see the documents entitled Indirect Leaf Area Index Obtained from the UNL Light Wand and Indirect Leaf Area Obtained from KSU Light Wand).

The KSU group used both official and unofficial graduated soil probes to measure soil depth.

Quality Assessment:

Data Validation by Source:

Checks were run on the data files with the wet weight measurements at the end of each day's data collection to detect and correct obvious errors.

Confidence Level/Accuracy Judgment:

No information on this was provided by the investigators.

Measurement Error for Parameters:

No quantitative assessment was made, see the *Confidence Level/Accuracy Judgment Section*.

Additional Quality Assessments:

FIS staff applied a general Quality Assessment (QA) procedure to the data to identify inconsistencies and problems for potential users. As a general procedure, the FIS QA consisted of examining the maximum, minimum, average, and standard deviation for each numerical field in the data table. An attempt was made to find an explanation for unexpected high or low values, values outside of the normal physical range for a variable, or standard deviations that appeared inconsistent with the mean. In some cases, histograms were examined to determine whether outliers were consistent with the shape of the data distribution.

The discrepancies, which were identified, are reported as problems in the *Known Problems with the Data Section*.

Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular datasets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- Copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM;
- Using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS); and
- Creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS dataset. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.
- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.
- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).

- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

errors in the data have been reported:

- The missing value indicator for SOIL_DEPTH is '-1'. All other negative values indicate that the ground was too hard to further penetrate the probe. The integer values indicate the maximum depth of the probe.
- All columns except SOIL_DEPTH use '-9.9' or '-9' as missing value indicators.
- SOIL_DEPTH probe can only measure to a depth of 44 cm, but this column has some values greater than 44.
- The following table lists extreme high values encountered in the FIS QA, but individuals knowledgeable about these data say that these outliers are unlikely but possible values.

Column	> than	Count
CANOPY_HT	100	14
SOIL_DEPTH	44	7
LITTER_AREA_INDEX	0.035	12
NONGRASS_STEM_AREA_INDEX	0.06	2
LAI_GRASS	4.0	4
LAI_NONGRASS	3.0	7
LAI_TOTAL	5.0	3
DRY_GRASS_STEM_WT	250	8
WET_GRASS_STEM_WT	600	8
DRY_NONGRASS_STEM_WT	200	56
WET_NONGRASS_STEM_WT	400	60
WET_GRASS_LEAF_WT	950	3

DRY_NONGRASS_LEAF_WT	200	32
WET_NONGRASS_LEAF_WT	600	28
DRY_TOTAL_WT	2500	10
WET_TOTAL_WT	3000	112
DRY_STANDING_DEAD_WT	1500	8
WET_STANDING_DEAD_WT	3000	5
DRY_LITTER_WT	700	15
WET_LITTER_WT	900	24

Usage Guidance:

University of Kansas (PI_name=STAFF):

1987 Data

Complete columns of missing data were included for consistency in the data format throughout the FIFE project.

There are 180 data points per week (30 stations, 6 samples per station).

There are valid zeroes in the data for the first IFC. This reflects many burned stations with no plant material at the time of first sampling.

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

This Data Set can be used to characterize the physical and biological properties of the sites within the FIFE study area.

13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

Data Center Status/Plans:

FIFE data are available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

16. Output Products and Availability:

Biophysical Properties of Vegetation data are available on FIFE CD-ROM Volume 1.

\DATA\BIOLOGY\VEG_BIOP\Yyyyy\yyyygrid.VBP

Where *yyyy* is the four digits of the century and year (e.g., Y1987=1987). Note: capital letters indicate fixed values that appear on the CD-ROM exactly as shown here, lower case indicates characters (values) that change for each path and file.

The format used for the filenames is: *yyyygrid.sfx*, where *yyyy* is as defined above. The filename extension (.*sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .VBP for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. Northwest Science. 33:43-66.

Journal Articles and Study Reports.

Davis, F., D. Schimel, M. Friedl, J.C. Michaelsen, T.G.F. Kittel, R. Dubayah, and J. Dozier. 1992. Covariance of biophysical data with digital topographic and land use maps over the FIFE site. J. Geophys. Res. 97:19009-19021.

Schimel, D.S., T.G.F. Kittel, A.K. Knapp, T.R. Seastedt, W.J. Parton, and V.B. Brown. 1991. Physiological Interactions Along Resource Gradients in a Tallgrass Prairie. Ecology 72:672-684.

Sellers, P.J., F.G. Hall, G. Asrar, D.E. Strebel, and R.E. Murphy. 1988. The First ISLSCP Field Experiment (FIFE). Bull. Am. Meteorol. Soc. 69:22-27.

Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary.

19. List of Acronyms:

BPI Byte per inch CCT Computer Compatible Tape CD-ROM Compact Disk-Read Only Memory DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field Experiment ISLSCP International Satellite Land Surface Climatology Project KSU Kansas State University LAI Leaf Area Index MMR Multispectral Modular Radiometer ORNL Oak Ridge National Laboratory SE590 Spectron Engineering 590 radiometer SQL Structured Query Language UNL University of Nebraska URL Uniform Resource Locator UTM Universal Transverse Mercator WAB Wind Aligned Blob

A general list of acronyms for the DAAC is available at Acronyms.

20. Document Information:

April 28, 1994 (citation revised on October 14, 2002).

This document has been reviewed by the FIFE Information Scientist to eliminate technical and editorial inaccuracies. Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE Scientist generally familiar with the data. It is believed that the document accurately describes the data as collected and archived on the FIFE CD-ROM series.

Document Review Date:

December 27, 1996.

Document ID:

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Citation:

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Document URL:

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