Bowen Ratio Surface Flux: UNL (FIFE)

Summary:

The Bowen Ratio Surface Flux Observations (UNL) Data Set contains surface flux and micrometeorolgical measurements collected at one location located in a flat area of uniform surface vegetation approximately in the center of the FIFE study area. The data collection effort was during the four Intensive Field Campaigns in the spring, summer, and fall of 1987 (May 28 - Oct 17).

The Bowen ratio system that collected these data was designed to retrieve all major components of the surface energy budget along with a large set of measured and derived parameters describing the dynamical, thermodynamical, hydrological, and radiative properties of the ground surface and atmosphere surface layer.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Bowen Ratio Surface Flux: UNL (FIFE)
(Bowen Ratio Surface Flux Observations (UNL)).

Data Set Introduction:

The Bowen Ratio Surface Flux Observations (UNL) Data Set contains surface flux and micrometeorolgical measurements collected at one location located in a flat area of uniform surface vegetation approximately in the center of the FIFE study area.

Objective/Purpose:

The combined aim of the surface flux group was to use a network of ground based observing systems to measure fluxes of heat, water vapor and radiation at a number of points within the FIFE study area. The specific objectives were to:

1. Measure and analyze, employing the Bowen ratio energy balance technique, the fluxes of sensible heat, latent heat, and momentum over the tallgrass prairie.
2. Estimate the aerodynamic characteristics (e.g., roughness, zero plane displacement, and the drag coefficient) of the prairie vegetation at various stages of growth and to develop functional relationships between these parameters and vegetation height.

Summary of Parameters:

Latent heat flux, net radiation, sensible heat flux, soil heat flux, soil temperature, Bowen ratio, wind speed, air temperature, vapor pressure.

Discussion:

Surface flux measurements were made at selected sites within the FIFE area. The major data collection effort was conducted in 1987 when 16 stationary sites were equipped with Bowen ratio equipment that was operated by several different groups. In 1988 and 1989, surface flux stations were installed at 12 and 19 sites, respectively. Surface flux stations were capable of measuring the fluxes of net radiation, sensible heat and latent heat. The Bowen ratio stations measured the soil heat flux as well.

The surface flux and micrometeorolgical measurements available in the data set described here were collected at one location within the FIFE study area during the four Intensive Field Campaigns in the spring, summer, and fall of 1987 (May 28-Oct 17). During this period there are 56 days of data. This site was located in a flat area of uniform surface vegetation approximately in the center of the FIFE study area.

The Bowen ratio system that collected these data was designed to retrieve all major components of the surface energy budget along with a large set of measured and derived parameters describing the dynamical, thermodynamical, hydrological, and radiative properties of the ground surface and atmosphere surface layer.

Related Data Sets:

- Eddy Correlation Surface Flux Observation (USGS).

- Eddy Correlation Surface Flux Observation (UNL).
- Eddy Correlation Surface Flux Observation (GSFC).
- Eddy Correlation Surface Flux Observation (UK).
- Eddy Correlation Surface Flux Observation (Argonne).
- Bowen Ratio Surface Flux Observation (GSFC).
- Bowen Ratio Surface Flux Observation (KSU).
- Bowen Ratio Surface Flux Observation (Fritschen).
- Bowen Ratio Surface Flux Observation (UNL).
- Bowen Ratio Surface Flux Observation (USGS).
- Bowen Ratio Surface Flux Observation (Smith).

FIS Data Base Table Name:

SURFACE_FLUX_30MIN_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. Shashi B. Verma
Dept. of Agricultural Meteorology, University of Nebraska

Title of Investigation:

Measurement and analysis of latent and sensible heat flux by Bowen ratio and aerodynamic characteristics of vegetation at the FIFE study area.

Contact Information:

Contact 1:
Dr. Shashi B. Verma
University of Nebraska
Lincoln, NE
(402) 472-3679/6702

Requested Form of Acknowledgment.

The Bowen Ratio Surface Flux Observation (UNL) were collected by Dr. Shashi B. Verma and his colleagues at the University of Nebraska-Lincoln. Their contribution of these data are particularly appreciated.

3. Theory of Measurements:

The components of the energy balance were determined with the Bowen Ratio Energy Balance (BREB) method. The Bowen ratio, **B** {a ratio of sensible heat, **H** and latent heat, **E**} is given by:

B = H / E. (1).

Where:

H = -rho.c(p).K(h). dT/dz

E = -(rho.epsilon / P).l(v).K(v). de/dz

where symbols are defined as:

e = Air vapor pressure
epsilon = Ratio of the molecular weights of wet and dry air
c(p) = Specific heat of air
K(h) = Eddy diffusivity for heat
K(v) = Eddy diffusivity for water vapor
p = Atmospheric pressure
rho = Air density
T = Air temperature
z = Height or depth
l(v) = Latent heat of vaporization

Substituting (1) in the energy balance equation (2) yields equation (3). **Q** is net radiation and **G** is soil heat flux density.

Q + G + H + E = 0 (2).

In this system surface-air interface is considered as a closed system. Any energy flux coming in is considered positive and going out is negative.

E = -(Q + G) / (1 + B) (3).

4. Equipment:

Sensor/Instrument Description:

- Net radiation sensor: REBS Q*4 and Swissteco
- Method of calculating net Averaged 1-min samples from radiation: two net radiometers.
- Soil heat flux sensor: REBS HFT 1
- Upper layer heat storage sensor: Three-probe PRTs in parallel.
- Method of calculating G1: Averaged 1-min samples from seven plates
- Method of calculating G2: Averaged 1-min samples from six dT/dt measurements.
- Heat capacity equation: C(s) = rho(s) (0.785 + 4.18 RWC)
- Bowen ratio sensors: Dual T -T(w) fan aspirated Ni-Fe resistance temperature detectors (used with mechanical exchanger).
- Lower arm height May 26 to July 15 (0.60 m), Aug. 10 to Aug. 11 (1.75 m), Aug. 12 (0.90 m), Aug. 13 to Oct. 10 (1.75 m), Oct. 11-16 (1.25 m) (measured above ground).
- Lower-upper arm separation: 1.0 m
- Pressure: parameter in specified psychrometric constant
- Temperature and vapor sampling: 5 s frequency

- Exchange frequency: 5 min
- Duty cycle for 30-min averaging: 50% period

For more information on the instrumentation used to collect these data, see Gay and Greenberg 1985.

Collection Environment:

Ground-based.

Source/Platform:

The Bowen ratio sensors were mounted on a scaffold at 2.25 m above the ground.

Source/Platform Mission Objectives:

To measure fluxes of sensible and latent heat using the Bowen ratio, energy balance technique.

Key Variables:

Latent heat flux, net radiation, sensible heat flux, soil heat flux, soil temperature, Bowen ratio, wind velocity, air temperature, vapor pressure.

Principles of Operation:

Net radiation was measured with net radiometers at 2m above the ground. Seven heat flow transducers were installed at a depth of 50 mm. Platinum resistance thermometers were used to measure an average soil temperature from the surface to a depth of 50 mm. Soil heat fluxes were corrected for differences in thermal conductivity among calibration medium, transducer and soil following a method described by Philip (1961). Surface soil heat flux was estimated by employing a combination method (Kimball et al. 1976). Mean air temperature and humidity were measured with an aspirated ceramic wick psychrometer at 2.25 m above ground. To reduce the effects of instrument bias they were mounted on a 1 m arm that interchanged their positions every 5 minutes (Hartman and Gay 1981). Fritschen and Gay 1979 and Fritschen and Simpson 1989 also provide details on the principles guiding the operation of the Bowen ratio instrumentation.

Sensor/Instrument Measurement Geometry:

Net radiation was measured with net radiometers at 2 m above the ground. Seven heat flow transducers were installed at a depth of 50 mm. Psychrometers were mounted at 2.25 m above the ground.

Manufacturer of Sensor/Instrument:

Soil Heat Transducers:

Radiation & Energy Balance Systems, Inc. (REBS)
P.O. Box 15512
Seattle, WA 98115-0512.

Pyranometer:

Eppley Laboratories
Newport, RI.

Net radiometers:

Radiation & Energy Balance System, Inc. (REBS)
P.O. Box 15512
Seattle, WA 98115-0512.

Quantum sensor:

LI-COR, Inc.
4421 Superior Street
P.O. Box 4425
Lincoln, NE 68504.

Psychrometer:

EnviroMet Instrument Company
90 Calle Encanto
Tucson, AZ 85716.

Cup anemometer:

Cayuga Development
Ithaca, NY.

Data logging system:

IBM.

Calibration:

Specifications:

Not supplied by Principal Investigator.

Tolerance:

Not provided by Principal Investigator.

Frequency of Calibration:

Resistance thermometer devices were calibrated before and after the field experiment.

Cup anemometers were calibrated in a wind tunnel before the field experiment.

Other Calibration Information:

Pyranometer: supplied by the manufacturer.

- Net radiometer: supplied by the manufacturer.
- Quantum sensor: supplied by the manufacturer.
- Soil heat transducer: supplied by the manufacturer.
- Psychrometer (RTDs): calibrated in a water bath.
- Cup anemometer: calibrated in a wind tunnel.

5. Data Acquisition Methods:

The data were collected by an automated procedure using sensors described in the *Sensor/Instrument Description Section*. Sampling, recording, and near real-time processing of the data were done with a microcomputer.

6. Observations:

Data Notes:

Not available.

Field Notes:

Fluxes toward the surface are positive and fluxes away from the surface are negative. * -999.00 = No data available

Lower levels of TA1 and EA1 in 1987 were variable as indicated below (in 1989 the lower level was 1.5 m above ground throughout the measurement periods):

- May 26-Jul 15, 1987: 0.60 m
- Aug 10-11, 1987 : 1.75 m
- Aug 12, 1987 : 0.90 m
- Aug 13-Oct 10, 1987: 1.75 m
- Oct 11-Oct 16, 1987: 1.25 m

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 at the following location within the FIFE study area:

SITEGRID	STN_ID	LATITUDE	LONGITUDE	EASTING	NORTHING	ELEVATION
4439-BRV	18	39 03 07	-96 32 28	712792	4325218	445

Spatial Coverage Map:

Not available.

Spatial Resolution:

The footprint of the surface sampled is approximately 100 - 200 m upwind of the sensor, depending on the atmospheric stability, wind speed and direction. A thorough discussion of spatial resolution of flux measurement can be found in Leclerc and Thurtell 1990, and Schuepp et al. 1990.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

These flux data were collected during the following periods:

- IFC1: May 28 - June 7, 1987
- IFC2: June 25 - July 12, 1987
- IFC3: August 9 - August 22, 1987
- IFC4: October 5 - October 15, 1987

There are 56 days of data during these periods.

Temporal Coverage Map:

Not available.

Temporal Resolution:

The data values are 30 minute averages. Measurements are daily during each of the time periods listed above. There are no measurements between these periods.

Data Characteristics:

The SQL definition for this data table is found in the SF_30MIN.TDF file located on FIFE CD-ROM Volume 1. The following chart lists only those variables that are contained in the data set described in this document.

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 the east (EE)
cell number in a 100 x 100 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).

OBS_TIME
The time that the observation [GMT]
was taken, in GMT. The format
is HHMM.

LATENT_HEAT_FLUX

The latent heat flux, the flux of the energy due to the evaporation of water.	[Watts] [meter^-2]
NET_RADTN The net radiation, including both downward and upward energy.	[Watts] [meter^-2]
SENSIBLE_HEAT_FLUX The sensible heat flux, the flux of the energy due to temperature differences.	[Watts] [meter^-2]
SOIL_HEAT_FLUX The surface soil heat flux, the flux of energy into the soil.	[Watts] [meter^-2]
SOLAR_RADTN_DOWN The downward (incoming) solar radiation.	[Watts] [meter^-2]
PAR_DOWN The downward (incoming) photo-synthetically active radiation (PAR).	[Watts] [meter^-2]
SOIL_TEMP_0_TO_25MM The soil temperature recorded somewhere between 0 and 25 mm in depth. This is an average value from 0 to 5 cm, same as in the column SOIL_TEMP_25MM_TO_5CM.	[degrees Celsius]
SOIL_TEMP_25MM_TO_5CM The soil temperature recorded somewhere between 25 mm and 5 cm in depth. This is an average value from 0 to 5 cm, same as in the column SOIL_TEMP_0_TO_25MM.	[degrees Celsius]
WIND_SPEED The average wind speed in this 30 minutes.	[meters] [sec^-1]
AIR_TEMP_MEAN The mean air temperature in this 30 minutes.	[degrees Celsius]

```
VAPOR_PRESS_MEAN
The mean vapor pressure in this                          [kiloPascals]
30 minutes.
```

```
FRICTION_VELOC
The friction velocity.                                   [meters]
[sec^-1]
```

```
CO2_FLUX
The carbon dioxide flux.                                 [mg]
[meter^-2]
[sec^-1]
```

```
FIFE_DATA_CRTFCN_CODE
The FIFE Certification Code
for * the data, in the format:
CGR (Certified by Group), CPI
(Certified by PI), CPI-???
(CPI - questionable data).
```

```
LAST_REVISION_DATE
data, in the format (DD-MMM-YY).
```

Footnotes:

* 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 that is "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

** There are several missing value indicators in each column. The values may be positive or negative 9.9, 9.99, 99.99, 999, 999.99, 9999, or 99999.99.

Sample Data Record:

The following sample record contains all the fields in the surface flux record but only those fields that are described here (i.e., reported by S.B. Verma) contain data.

SITEGRID_ID	STATION_ID	OBS_DATE	OBS_TIME	LATENT_HEAT_FLUX
4439-BRV	18	17-AUG-87	1215	-9999
4439-BRV	18	17-AUG-87	1245	-102.85
4439-BRV	18	17-AUG-87	1315	-128.73
4439-BRV	18	17-AUG-87	1345	-147.46

NET_RADTN	SENSIBLE_HEAT_FLUX	SOIL_HEAT_FLUX	DIFFUSE_SOLAR_RADTN_DOWN
12.91	-9999	-9999	
50.66	30.85	21.33	
115.19	2.57	10.97	
180.17	-32.44	-.27	

SOLAR_RADTN_DOWN	SOLAR_RADTN_UP	SOLAR_RADTN_NET	SOLAR_RADTN_DOWN_SDEV

SOLAR_RADTN_UP_SDEV	PAR_DOWN	PAR_UP	SURF_ALBEDO

LONGWAVE_RADTN_DOWN	LONGWAVE_RADTN_UP	LONGWAVE_RADTN_NET

BB_TEMP_LONGWAVE_DOWN	BB_TEMP_LONGWAVE_UP	TOTAL_RADTN_DOWN

TOTAL_RADTN_UP	SOIL_HEAT_FLUX_0_TO_5CM	SOIL_HEAT_FLUX_5_TO_10CM

SOIL_HEAT_FLUX_10_TO_20CM	HEAT_STORAGE	SOIL_WATER_POTNTL_0_TO_5CM

SOIL_WATER_POTNTL_5_TO_20CM	SURF_RADIANT_TEMP	SURF_RADIANT_TEMP_SDEV

SOIL_TEMP_0_TO_25MM	SOIL_TEMP_25MM_TO_5CM	SOIL_TEMP_5_TO_10CM
22.05	22.05	
22.11	22.11	
22.27	22.27	
22.5	22.5	

SOIL_TEMP_10_TO_20CM	SOIL_TEMP_20_TO_50CM	RAINFALL	BOWEN_RATIO
-.35			
-.3			
-.02			
.22			

WIND_SPEED	WIND_DIR	WIND_SPEED_MIN	WIND_SPEED_MAX	WIND_SPEED_SDEV
1.08				
1.78				
1.97				
1.65				

WIND_DIR_SDEV	TIME_WIND_SPEED_MIN	TIME_WIND_SPEED_MAX

TIME_WIND_DIR_MIN	TIME_WIND_DIR_MAX	WIND_SPEED_HOR_MEAN

WIND_SPEED_LAT_MEAN	WIND_SPEED_VERT_MEAN	WIND_SPEED_HOR_SDEV

WIND_SPEED_LAT_SDEV	WIND_SPEED_VERT_SDEV	AIR_TEMP_LOW	AIR_TEMP_HIGH
23.25			

```
21.82
23.35
25.5
AIR_TEMP_OTHER   AIR_TEMP_MEAN   AIR_TEMP_MEAN_SDEV   AIR_TEMP_OTHER_SDEV
--------------   -------------   ------------------   -------------------
DELTA_TEMP   WET_BULB_TEMP_LOW   WET_BULB_TEMP_HIGH   VAPOR_PRESS_LOW
----------   ------------------   ------------------   ---------------
2.41
1.77
1.84
1.91
VAPOR_PRESS_HIGH   VAPOR_PRESS_MEAN   VAPOR_PRESS_SDEV   REL_HUMID_LOW
----------------   ----------------   ----------------   -------------
REL_HUMID_HIGH   REL_HUMID_SDEV   SURF_AIR_PRESS   FRICTION_VELOC
--------------   --------------   --------------   --------------
 W_T_MEAN     W_E_MEAN     CO2_CONTENT   OZONE_CONTENT   CO2_CONTENT_SDEV
----------   ----------   -----------   -------------   ----------------
OZONE_CONTENT_SDEV   CO2_FLUX     OZONE_FLUX   FIFE_DATA_CRTFCN_CODE
------------------   ----------   ----------   ---------------------
CPI
CPI
CPI
CPI
LAST_REVISION_DATE
------------------
11-JAN-90
11-JAN-90
11-JAN-90
11-JAN-90
```

8. Data Organization:

Data Granularity:

The data values are 30 minute averages from measurements made daily during the time periods listed in the *Temporal Coverage Section*.

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 begins 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:

The theory described in the *Theory of Measurements Section* was used to derive the algorithm used to compute the fluxes reported in this data set. See Verma 1990 for details.

Data Processing Sequence:

Processing Steps:

- Remove data from processing stream during the periods when instruments malfunction.
- Calculate 30 minute averages of key variables (e.g., temperature, vapor pressure, radiation) and compute fluxes using Equations (1)-(3) given in the *Theory of Measurements Section*.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

Soil heat flux was corrected for differences in thermal conductivity among calibration medium, transducer and soil following a method described by Philip 1961. Surface soil heat flux was estimated by employing a combination method (Kimball et al. 1976).

Calculated Variables:

Not available.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

No information provided by the Principal Investigator.

Quality Assessment:

It was recognized early in the study that standardization's of "constant" (e.g. physical constants of the air, psychrometric constant, etc.), methods of computation, integration and reporting time, etc. were necessary. These were agreed upon in planning sessions. Preliminary data sets were compared among stations and instruments from different manufacturers for estimating net radiation, soil heat flux, water vapor density, temperature, solar radiation, and wind speed, it was necessary to have confidence that differences in observations were due to site differences and not due to instrumentation.

Data Validation by Source:

The Hydrological Sciences Branch at NASA Goddard Space Flight Center was given the responsibility to compare flux data from all flux stations. This served two purposes: 1) as a data quality check, and 2) a preliminary analysis of site differences.

Confidence Level/Accuracy Judgment:

The following are the best estimates of accuracy for a single flux estimate:

- Net radiation +/- 4 to 7%
- Soil heat flux +/- 30%
- Latent heat flux +/- 15 to 20 % or +/-30 W m^-2, whichever is larger
- Sensible heat flux +/- 15 to 20 % or +/-30 W m^-2, whichever is larger

None of these estimates addresses the variability of flux estimates from site to site.

Measurement Error for Parameters:

See the *Confidence Level/Accuracy Judgment Section*.

Additional Quality Assessments:

Several of the key surface flux parameters have undergone extensive intercomparisons and examination for spikes in the data. These data have also been checked for an imbalance in the energy equation. Details of these analyses are described in the Surface Flux Baseline 1992 document on FIFE CD-ROM Volume 1.

FIS staff applied a general QA procedure to some of the fields in this data set 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 numerical field. Inconsistencies and problems found in the QA check are described 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).
- 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:

Different missing values are used within each column. They can be positive or negative 9.9, 9.99, 99.99, 999.99, 9999, or 99999.99.

Nighttime flux data are noisy, especially when the Bowen ratio approaches -1. These data should be used with caution.

The missing value indicators in the following fields may have been inadvertently converted to 1000. Use these data with caution.

Name	Name
DIFFUSE_SOLAR_RADTN_DOWN	TOTAL_RADTN_DOWN
SOLAR_RADTN_DOWN	TOTAL_RADTN_UP
SOLAR_RADTN_UP	HEAT_STORAGE
SOLAR_RADTN_NET	RAINFALL
SOLAR_RADTN_DOWN_SDEV	WIND_DIR_MIN
SOLAR_RADTN_UP_SDEV	WIND_DIR_MAX
LONGWAVE_RADTN_DOWN	CO2_CONTENT
LONGWAVE_RADTN_UP	O3_CONTENT
LONGWAVE_RADTN_NET	CO2_STDEV
BB_TEMP_LONGWAVE_DOWN	O3_STDEV
BB_TEMP_LONGWAVE_UP	

Usage Guidance:

None.

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

This data set can be used to estimate the aerodynamic characteristics (e.g., roughness, zero plane displacement, and the drag coefficient) of the prairie vegetation at various stages of growth and to develop functional relationships between these parameters and vegetation height.

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:

The Bowen Ratio Surface Flux Observations (UNL) data are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\SUR_FLUX\30_MIN\GRIDxxxx\YyyMmm\ydddgrid.BRV or
\DATA\SUR_FLUX\30_MIN\GRIDxxxx\Yyyyy\ydddgrid.BRV

Where *xxxx* is the four digit code for the location within the FIFE site grid, *yy* is the last two digits of the year (e.g., Y87 = 1987), *yyyy* is the four digits of the century and year (e.g., Y1987 - 1987), *mm* is the month of the year (e.g., M12 = December), and *ddd* is the day of the year, (e.g., 061 = sixty-first day in the year). 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: *ydddgrid.sfx*, where *grid* is the four-number code for the location within the FIFE site grid, *y* is the last digit of the year (e.g., 7 = 1987, and 9 = 1989), and *ddd* is the day of the year. The filename extension (*.sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .BRV for this data set.

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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:

AMS Automatic Meteorological Station BPI Byte per inch BREB Bowen Ratio Energy Balance CCT Computer Compatible Tape DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIS FIFE Information System HFT Heat Flux Thermometer IFOV Instantaneous Field-of-View LAI Leaf Area Index Mbps Megabyte per second ORNL Oak Ridge National Laboratory PAMS Portable Automatic Mesonet PRT Platinum Resistance Thermometers REBS Radiation and Energy Balance Systems SAMS Super AMS URL Uniform Resource Locator

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

20. Document Information:

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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 as archived on the FIFE CD-ROM series.

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