Soil CO2 Flux Data (FIFE)

Summary:

In the Soil Carbon Dioxide Flux study, a prototype gas exchange system and sensor were used to determine the soil surface flux of CO2 and associated parameters at the three FIFE supersites. The goal of this investigation was to characterize fluxes of carbon dioxide from the surface of the soil for a representative portion of the FIFE study area. These measurements are required to understand the carbon budget of the prairie and necessary for comparing vegetation models of photosynthesis with CO2 flux measurements by micrometeorological methods. The flux of the carbon dioxide from the surface of the soil is an important component of the carbon budget of a prairie ecosystem.

The results from this study indicate that a soil chamber can be used to obtain reasonable estimates of soil surface carbon dioxide fluxes when operated in a closed system that is ported to the free atmosphere. Further, the flux of carbon dioxide from the soil surface of a grassland can be a large part of the carbon budget and should never be assumed to be negligible. Both soil temperature and soil water content are critical parameters for predicting soil surface CO2 flux, and leaf area index is a surrogate for the plant contribution through root respiration.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Soil CO2 Flux Data (FIFE).
Soil Carbon Dioxide Flux Data.

Data Set Introduction:

The Soil Carbon Dioxide Flux study determined the soil surface flux of CO2 and associated parameters at the three FIFE supersites. The goal of this investigation was to characterize fluxes of carbon dioxide from the surface of the soil for a representative portion of the FIFE study area.

Objective/Purpose:

The goal of this investigation was to characterize fluxes of carbon dioxide from the surface of the soil for a representative portion of the FIFE study area. These measurements are required to understand the carbon budget of the prairie and necessary for comparing vegetation models of photosynthesis with CO2 flux measurements by micrometeorological methods.

Summary of Parameters:

Ambient carbon dioxide concentration, carbon dioxide flux, soil temperature, leaf area index (LAI), relative humidity, surface conductance of water vapor, and volumetric soil water content.

Discussion:

The flux of the carbon dioxide from the surface of the soil is an important component of the carbon budget of a prairie ecosystem. In this study, a prototype gas exchange system and sensor were used to determine the soil surface flux of CO2 and associated parameters at the three FIFE supersites (2133-LCN, 4439-LCN, and 8739-LCN). Approximate daily coverage was obtained during FIFE IFC-5 (July/August, 1989).

The results from this study indicate that a soil chamber can be used to obtain reasonable estimates of soil surface carbon dioxide fluxes when operated in a closed system that is ported to the free atmosphere. Further, the flux of carbon dioxide from the soil surface of a grassland can be a large part of the carbon budget and should never be assumed to be negligible. Both soil temperature and soil water content are critical parameters for predicting soil surface CO2 flux, and leaf area index is a surrogate for the plant contribution through root respiration.

Related Data Sets:

- Soil Gas Fluxes Using Soil Cores.
- Leaf Area Index and PAR Determined from KSU Light Bar Measurements.
- Indirect Leaf Area Index Obtained from the KSU Light Wand.
- Leaf Photosynthesis.
- Canopy Photosynthesis.
- Eddy Correlation Surface Flux Observations (Argonne).

- Eddy Correlation Surface Flux Observations (UK).
- Eddy Correlation Surface Flux Observations (GSFC).
- Eddy Correlation Surface Flux Observations (UNL).
- Eddy Correlation Surface Flux Observations (USGS).

FIS Data Base Table Name:

SOIL_CO2_FLUX_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. John M. Norman
University of Wisconsin-Madison

Title of Investigation:

Soil Surface Carbon Dioxide Fluxes on the Konza Prairie.

Contact Information:

Contact 1:
Dr. John M. Norman
Univ. of Wisconsin-Madison
Madison, WI
Tel. (608)262-4576
Email: norman@calshp.cals.wisc.edu

Requested Form of Acknowledgment.

Please include the following reference in all work using the soil respiration data from FIFE:

> Norman, J.M., R. Garcia and S.B. Verma. 1992. Soil surface CO2 fluxes and the carbon budget of a grassland. J. Geophys. Res. 97:18,845-18,853.

3. Theory of Measurements:

The flux of carbon dioxide from the surface of the soil is an important component of the carbon budget of a prairie ecosystem. This soil surface flux of carbon dioxide may be 1/4 to 1/2 the magnitude of the mid-day canopy photosynthetic rate, and when integrated over a 24-hour period it may be an even larger fraction of the total carbon dioxide flux. If models of photosynthesis are to be evaluated by field measurements of carbon dioxide fluxes, the contribution of the soil surface carbon dioxide flux must be considered. Although numerous complications to interpretation of soil carbon dioxide flux measurements exist, the importance of the respiration of

soil biota and plant roots is well established. The fraction of soil carbon dioxide flux arising from root respiration can vary from 15 to 70% for grasslands depending upon many factors. Because soil and plant respiration are of approximately equal importance, the soil carbon dioxide flux is likely to depend on soil temperature, soil water content, and photosynthetic rate within the plant as well as substrates available for decomposition within the soil.

4. Equipment:

Sensor/Instrument Description:

The measurement of soil carbon dioxide flux was obtained by attaching a 0.75-liter chamber with a 41.3 cm^2 circular cross-section to a LI-COR, Inc. LI-6200 gas exchange system. A sensor head was attached to one end of the cylinder (chamber) to provide entry and exit tubes for circulating gas and sensors for measurement of humidity, air temperature, and 1-cm soil temperature. This was a prototype chamber built in 1987 by engineers at LI-COR, Inc., Lincoln, NE. In 1993, LI-COR, Inc., began to manufacture a soil CO2 flux chamber with different dimensions, but working on the same principles.

Soil temperature was measured with a portable temperature probe (Cole-Palmer thermistor thermometer L-08110-20).

Soil water content were measured using a 1502B Time Domain Reflectometer (TDR) [Topp et al., 1980].

Collection Environment:

Ground-based.

Source/Platform:

Ground.

Source/Platform Mission Objectives:

To measure soil surface carbon dioxide fluxes.

Key Variables:

Carbon dioxide flux, soil temperature, soil water content, and leaf area index.

Principles of Operation:

Chamber gas was withdrawn at the top of the soil chamber, passed through the infrared gas analyzer and re-entered the chamber at a manifold ring at the bottom of the soil chamber just above the soil. No fan was used to mix the air in the soil chamber as circulating gas was sufficient to provide adequate mixing. Pressure equilibrium between the air in the chamber and

the surrounding air was maintained by a tube that was connected to the chamber and had a length of 30 cm and a diameter of 2 mm. The long tube provided pressure equilibrium with negligible leakage.

Sensor/Instrument Measurement Geometry:

The soil chamber was sharpened so that it could be easily pressed about 1 cm into the soil. The chamber was also used on thin-walled PVC collars that were sharpened and inserted into the ground about 2 cm. A foam gasket was placed around the flange of the soil chamber to provide a seal.

Manufacturer of Sensor/Instrument:

LI-6200 and LAI-2000:

LI-COR, Inc.
P.O. Box 4425
Lincoln, Nebraska 68504.

Temperature probe:

Cole-Palmer Instrument Company
Chicago, Illinois.

TDR:

Tektronix, Inc.
Beaverton, Oregon

Calibration:

The soil chamber was tested by comparing measurements from it with the difference between a canopy chamber (which measures both soil and plant fluxes) and individual leaf measurements. The comparison measurements were done at night using a 40-liter canopy chamber that was fitted with gas ports so that carbon dioxide concentration was measured with a LI-COR LI-6200 gas exchange system. In addition, measurements from the closed chamber were compared with eddy correlation fluxes of CO2 at night at site 916 (4439-LCN) (Norman et. al., 1992).

Every day before measurements were taken, the infrared gas analyzer was calibrated with a standard gas accurate to 1 micromol/mol CO2 concentration. The humidity sensor was checked against a secondary standard daily. The temperature sensors were calibrated at beginning of 1989 season.

Specifications:

The specifications for the LI-6200 gas exchange system are given by LI-COR, Inc., Lincoln, NE 68504.

Tolerance:

Accuracy of CO2 flux is about 5 - 10%.

Frequency of Calibration:

Daily.

Other Calibration Information:

None.

5. Data Acquisition Methods:

The soil surface carbon dioxide fluxes were measured using the prototype instrument described in the *Equipment Section* above. Soil temperature was measured at a 10 cm depth to an accuracy of 0.3 degree Celsius with a portable temperature probe inserted into the ground within 10 cm of the carbon dioxide flux measurement. Soil gravimetric water content was measured for 0-10 cm and 10-20 cm depths using soil cores obtained near (a few meters to a few hundred meters) the soil flux measuring sites. Soil water content was also measured using time-domain reflectrometry calibrated by gravimetric samples taken between the stainless steel rods used as wave guides. Leaf area index was obtained from a combination of direct harvests on 0.1 [m^-2] areas and indirect measurements using the LI-COR LAI-2000 plant canopy analyzer.

The data acquisition methods are described in detail in Norman et al., 1992.

6. Observations:

Data Notes:

Not available.

Field Notes:

None.

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, 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:

The soil chamber was used to measure the soil surface carbon dioxide flux at FIFE Site 906 (2133-LCN), 916 (4439-LCN) and 926 (8739-LCN). Measurements were taken at other locations for instrument comparisons.

Spatial Coverage Map:

Not available.

Spatial Resolution:

At each FIFE site, the CO2 flux was measured over an area of 41.3 square cm at 8 to 16 locations, spread over a 400 meter arc, 200 meter upwind of the heat and moisture flux-measuring instrumentation.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

The soil chamber was used to measure the soil surface carbon dioxide flux between July 24, 1989, and August 12, 1989, with numerous diurnal cycles and approximately daily coverage.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Measurements were made with three LI-6200 instruments and temporal resolution varied from a few hours to a few days for site averages (8 to 16 readings) depending on the site. Generally, measurements of soil surface carbon dioxide fluxes can be obtained in about 5 to 15 minutes, depending upon the magnitude of the flux. Small fluxes require longer times.

Data Characteristics:

The SQL definition for this table is found in the SOIL_CO2.TDF file located on FIFE 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 100 x 100 array of 200 m square cells. The last 3 characters (III) are an instrument identifier.			FIS
STATION_ID The three-digit FIFE site identification number for the site where the data were collected.	906, 916, 926		FIS
OBS_DATE The date on which the observation was made.	min = 24-JUL-89 max = 12-AUG-89		FIS
OBS_TIME The time of day that the observation was taken.	min = 2, max = 2400	[GMT]	FIS
OBS_SECONDS The seconds part of the observation time.	min = 0, max = 59	[seconds]	FIS
MEASUREMENT_LOCN The location of the measurements on the site WAB. missing = -99	min = 0, max = soil,		FIS
AMBIENT_CO2_CONC The ambient CO2 concentration.	min = 321,	[microMols]	FIS

max = 488 [Mol^-1]			
CO2_FLUX The CO2 flux. max = 26, [meter^-2] missing = -99 [sec^-1]	min = .01,	[microMols]	FIS
SOIL_TEMP_1CM The soil temperature at 1 cm depth. max = 46.97 Celsius]	min = 13.63,	[degrees	FIS
SOIL_TEMP_10CM The soil temperature at 10 cm depth. missing = -99	min = 18.1, max = 31.9,	[degrees Celsius]	FIS
SOIL_TEMP_20CM The soil temperature at 20 cm depth. missing = -99	min = 20, max = 34,	[degrees Celsius]	FIS
AIR_TEMP The air temperature. max = 335.67 Celsius]	min = 13.1,	[degrees	FIS
LEAF_AREA_INDEX The leaf area index measured on site with a LI-2000. missing = -99	min = .4, max = 3.13,		FIS
REL_HUMID The relative humidity. max = 98.4	min = 14.82,	[percent]	FIS
WATER_CONDCTNC The conductance of water. max = .85, [meter^-2] missing = -99 [sec^-1]	min = -.03,	[microMols]	FIS
VOLUMTRC_SOIL_MOISTURE_5CM The volumetric water content of the soil from 0 to 10 cm. missing = -99	min = 1.6, max = 42.5,	[percent]	FIS
VOLUMTRC_SOIL_MOISTURE_10CM The volumetric water content of the soil from 0 to 20 cm.	min = 10.4, max = 39.2,	[percent]	FIS

missing = -99			
KSU_SOIL_MOISTURE_5CM The volumetric water content of the soil from 0 to 10 cm as measured by KSU staff.	min = 13, max = 41.9, missing = -99	[percent]	FIS
KSU_SOIL_MOISTURE_10CM The volumetric water content of the soil from 0 to 20 cm as measured by KSU staff.	min = 12.55, max = 40, missing = -99	[percent]	FIS
FIFE_DATA_CRTFCN_CODE The FIFE Certification Code for the data, in the following format: CPI (Certified by PI), CPI-??? (CPI - questionable data).	* CPI = checked by principal investigator		FIS
LAST_REVISION_DATE data, in the format (DD-MMM-YY).	max = 07-JAN-93		

Footnote:

* 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	OBS_TIME	OBS_SECONDS	MEASUREMENT_LOCN
4439-LCN	916	12-AUG-89	1741	10	8b
4439-LCN	916	12-AUG-89	1751	18	1c
4439-LCN	916	12-AUG-89	1829	3	2
4439-LCN	916	12-AUG-89	1835	16	2b

AMBIENT_CO2_CONC	CO2_FLUX	SOIL_TEMP_1CM	SOIL_TEMP_10CM	SOIL_TEMP_20CM
324	4.300	33.210	23.400	-99.000
324	4.300	35.860	23.800	-99.000
334	11.000	40.980	24.900	-99.000
334	5.300	39.890	24.800	-99.000

AIR_TEMP	LEAF_AREA_INDEX	REL_HUMID	WATER_CONDCTNC

```
--------   ---------------   ---------   --------------
33.420          2.000         32.120          .02000
36.410          2.000         31.670          .00300
39.920          2.000         28.400          .02000
39.030          2.000         25.130          .01000
VOLUMTRC_SOIL_MOISTURE_5CM   VOLUMTRC_SOIL_MOISTURE_10CM
--------------------------   ---------------------------
-99.00                       -99.00
-99.00                       -99.00
-99.00                       -99.00
-99.00                       -99.00
KSU_SOIL_MOISTURE_5CM   KSU_SOIL_MOISTURE_10CM   FIFE_DATA_CRTFCN_CODE
---------------------   ----------------------   ---------------------
16.20                -99.000                     CPI
16.20                -99.000                     CPI
16.20                -99.000                     CPI
16.20                -99.000                     CPI
LAST_REVISION_DATE
------------------
07-JAN-93
07-JAN-93
07-JAN-93
07-JAN-93
```

8. Data Organization:

Data Granularity:

At each FIFE site, the CO2 flux was measured over an area of 41.3 square cm at 8 to 16 locations, spread over a 400 meter arc, 200 meter upwind of the heat and moisture flux-measuring instrumentation. The soil chamber was used to measure the soil surface carbon dioxide flux between July 24, 1989, and August 12, 1989, with numerous diurnal cycles and approximately daily coverage.

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, path and name of the document that describes the data in this file, and name of principal investigator for these data.

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_ID)).

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:

Data reduction is done internally in the LI-6200. See the manual from LI-COR, Inc. for details. See the *Manufacturer of Sensor/Instrument Section* for the address of LI-COR.

Data Processing Sequence:

Processing Steps:

The data collected by the LI-6200 was processed online in the field so that CO2 flux estimates were stored in the computer. Soil moisture and temperature were recorded in field notebooks and later merged with the CO2 flux data. Leaf area index was calculated online in the LAI-2000 Plant Canopy Analyzer and stored in its memory. The data contained in both LI-6200 and LAI-2000 were down-loaded onto a Personal Computer at the end of the day. At the end of the IFC, all data were merged in a spreadsheet. An ASCII output of this spreadsheet from Quattro Pro version 2.0 was the data sent to FIFE staff.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

Time Delay Reflectometer (TDR) measurement of soil water content was calibrated with gravimetric soil moisture on site and this calibration was used in the reduction of TDR soil moisture data.

Calculated Variables:

Not available.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

When a chamber with a sharpened end is pushed into the soil, leaks are unavoidable. To minimize the impact of such leaks, an ambient carbon dioxide concentration measurement is taken before regular measurements are started. Then the carbon dioxide concentration inside the chamber is drawn down to about 20 ppm with the LI-6200 scrubber, so that flux estimates can be obtained below and above ambient carbon dioxide concentrations. The best estimate of the flux is obtained when the concentration inside the chamber is equal to that outside, because the effect of the leak is zero. This value is interpolated from flux measurements made with the chamber above and below ambient concentrations.

Quality Assessment:

Data Validation by Source:

Data have been screened by the Principal Investigator.

Confidence Level/Accuracy Judgment:

The Principal Investigator considers the data to be reliable and accurate.

Measurement Error for Parameters:

CO2 flux	5-10.0%
Temperature	0.5C
Relative humidity	5.0%
Soil water content	5.0%
Leaf area index	10.0%
Water conductance	10.0%
Ambient CO2	1.0 umol/mol

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:

been reported:

Parameter	Station	Date	Comments
AMBIENT_CO2_CONC	916	7-AUG-87	2 values equal to 488
AMBIENT_CO2_CONC	916	8-AUG-87	33 values equal to or greater than 460
CO2_FLUX	916	31-JUL-89	The value of 26 is out of range for the other values reported for this parameter
SOIL_TEMP_20CM	926	29-JUL-89	An unusually high value of 34 deg C is reported.
AIR_TEMP	916	8-AUG-89	An unusually high value of 335.67 deg. C is reported.
WATER_CONDUCTANCE	916	6-AUG-89	2 values less than 0 are reported

Usage Guidance:

been reported:

Parameter	Station	Date	Comments
AMBIENT_CO2_CONC	916	7-AUG-87	2 values equal to 488
AMBIENT_CO2_CONC	916	8-AUG-87	33 values equal to or greater than 460
CO2_FLUX	916	31-JUL-89	The value of 26 is out of range for the other values reported for this parameter
SOIL_TEMP_20CM	926	29-JUL-89	An unusually high value of 34 deg C is reported.
AIR_TEMP	916	8-AUG-89	An unusually high value of 335.67 deg. C is reported.
WATER_CONDUCTANCE	916	6-AUG-89	2 values less than 0 are reported

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

This data set can be used to understand the carbon budget of a prairie and comparing vegetation models of photosynthesis with CO2 flux measurements by micrometeorological methods

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:

Soil Carbon Dioxide Flux data are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\BIOLOGY\SOIL_CO2\GRIDxxxx\ydddgrid.SCF

where *xxxx* is the four digit code for the location within the FIFE site grid. 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 (e.g. 061 = sixty-first day in the year). The filename extension (*.sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .SCF for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Anderson, J.P.E. 1982. Soil Respiration. In: Methods of Soil analysis and Microbiological Properties. (Ed) A.L. Page, R.H. Miller, and D.R. Keeney. Am. Soc. Agron. Monogr. 9, pp. 831-871.

Topp, G.C., J.L. Davis, and A.P. Annan. 1980. Electromagnetic determination of soil water content: Measurement in coaxial transmission lines. Water Resour. Res. 16:574-582.

Journal Articles and Study Reports.

Grammerer, K. 1989. Respiration of soil and vegetation in grassland. M.S. Thesis. Dept. of Agronomy. Univ. of Nebraska, Lincoln.

Norman, J.M., R. Garcia and S.B. Verma. 1992. Soil surface CO2 fluxes and the carbon budget of a grassland. J. Geophys. Res. 97:18,845-18,853.

Kim, J., S.B. Verma, and R.J. Clement. 1992. Carbon dioxide budget in a temperate grassland ecosystem. J. Geophys. Res. 97:6057-6063.

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:

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 FIS FIFE Information System ISLSCP International Satellite Land Surface Climatology Project LAI Leaf Area Index ORNL Oak Ridge National Laboratory TDR Time Domain Reflectometer URL Uniform Resource Locator UTM Universal Transverse Mercator

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

20. Document Information:

April 25, 1994 (citation revised on October 14, 2002).

Warning: This document has not been checked for technical or editorial accuracy by the FIFE Information Scientist. There may be inconsistencies with other documents, technical or editorial errors that were inadvertently introduced when the document was compiled or references to preliminary data that were not included on the final CD-ROM.

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.

Document Review Date:

December 13, 1996.

Document ID:

ORNL-FIFE_SOIL_CO2.

Citation:

Cite this data set as follows:

Norman, J. N. 1994. Soil CO2 Flux Data (FIFE). Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/105. Also published in D. E. Strebel, D. R. Landis, K. F. Huemmrich, and B. W. Meeson (eds.), Collected Data of the First ISLSCP Field Experiment, Vol. 1: Surface Observations and Non-Image Data Sets. CD-ROM. National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland, U.S.A. (available from http://www.daac.ornl.gov).

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