Soil Gas Fluxes Using Soil Cores (FIFE)

Summary:

Nitrogen gas fluxes are important to ecosystem productivity and atmospheric chemistry. Scaling of these microscale fluxes to landscape and regional scales relevant to ecosystem and atmosphere-biosphere exchange questions is difficult. For FIFE, two approaches were explored to accomplish scaling. First the relationships between hourly and daily gas fluxes and soil moisture were established and then large area estimates of soil moisture from simulation models or a push broom microwave radiometer were used to scale data from experimental sites to larger areas. The second approach was to establish relationships between annual gas fluxes and plant productivity and then use large area data on plant productivity derived from SPOT images as a scaling tool. Both approaches were based on hypotheses and previous studies that established strong relationships between soil moisture and plant productivity and gas fluxes.

FIFE Soil Gas Fluxes Using Soil Cores Data Set contains the daily flux rates of denitrification, nitrous oxide flux and carbon dioxide flux obtained from 10 sites at four sampling dates during 1987. Soil gas fluxes were measured using an intact extracted core technique. The data set includes estimates of in situ fluxes as well as denitrification fluxes measured in cores amended with either water or water plus nitrate. Analysis of relationships between daily flux rates and soil moisture and between annual fluxes and plant productivity are reported elsewhere (Groffman and Turner submitted to Ecology, Groffman and Wood in preparation). Analysis of the denitrification data, and evaluation of denitrification fluxes in the context of the ecosystem ecology of the FIFE study area are presented in Groffman et al. (1992).

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Soil Gas Fluxes Using Soil Cores (FIFE).

Data Set Introduction:

The FIFE Soil Gas Fluxes Using Soil Cores Data Set contains estimates of in situ fluxes as well as denitrification fluxes measured in cores amended with either water or water plus nitrate.

Objective/Purpose:

The investigator sought to characterize the rates and spatial and temporal patterns of denitrification, nitrous oxide and carbon dioxide fluxes across the landscape at the FIFE study area. From these fluxes, relationships between soil water and plant productivity were to be developed. These remotely sensed soil water and plant productivity data could be used to produce large-area estimates of gas fluxes.

Summary of Parameters:

Daily rates of soil denitrification, nitrous oxide flux, and carbon dioxide flux.

Discussion:

Nitrogen gas fluxes are important to ecosystem productivity and atmospheric chemistry. Scaling of these micro-scale fluxes to landscape and regional scales relevant to ecosystem and atmosphere-biosphere exchange questions is difficult. For FIFE, we explored two approaches to accomplish scaling. First we wanted to establish relationships between hourly and daily gas fluxes and soil moisture and then use large area estimates of soil moisture from simulation models or a push broom microwave radiometer to scale data from experimental sites to larger areas. Our second approach was to establish relationships between annual gas fluxes and plant productivity and then use large area data on plant productivity derived from SPOT images as a scaling tool. Both approaches were based on hypotheses and previous studies that established strong relationships between soil moisture and plant productivity and gas fluxes.

The data set presented here contains the daily flux rates of denitrification, nitrous oxide flux and carbon dioxide flux obtained from 10 sites at four sampling dates during 1987. The data set includes estimates of in situ fluxes as well as denitrification fluxes measured in cores amended with either water or water plus nitrate. Analysis of relationships between daily flux rates and soil moisture and between annual fluxes and plant productivity are reported elsewhere (Groffman and Turner submitted to Ecology, Groffman and Wood in preparation). Analysis of the denitrification

data, and evaluation of denitrification fluxes in the context of the ecosystem ecology of the FIFE study area are presented in Groffman et al. (1992).

Related Data Sets:

- Soil Carbon Dioxide Flux.
- Soil Impedance Measurements of Soil Moisture.
- Soil Moisture Transect.
- Neutron Probe Soil Moisture.
- Gravimetric Soil Moisture.

FIS Data Base Table Name:

SOIL_GAS_FLUX_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. Peter M. Groffman
Institute of Ecosystem Studies

Title of Investigation:

Denitrification, Nitrous Oxide, Carbon Dioxide and Soil Moisture Dynamics Evaluated at the Landscape Level Using Remote Sensing Techniques.

Contact Information:

Contact 1:
Peter M. Groffman
Institute of Ecosystem Studies
Millbrook, NY
Tel. (914) 677-5343
Email: capg@marist.bitnet

Requested Form of Acknowledgment.

The soil gas flux data were collected by Dr. Peter Groffman. The contribution of these data is appreciated.

3. Theory of Measurements:

Soil gas fluxes were measured using an intact extracted core technique. Intact soil cores were removed from soil and returned to the laboratory. Within 24 hours of sampling, cores were sealed with rubber stoppers and gas fluxes were measured. To measure denitrification, cores were treated with acetylene and to measure nitrous oxide and carbon dioxide flux cores were incubated without any amendment. Cores were incubated for 6 hours. Gas samples were removed from the headspace of the cores at 2 and 6 hours and concentrations of nitrous oxide and carbon dioxide were measured by gas chromatography. In acetylene-treated cores, nitrous oxide accumulation is taken to represent the rate of denitrification.

4. Equipment:

Sensor/Instrument Description:

The soil samples were obtained using standard core samples. A gas chromatograph was used to analyze the fluxes from the cores.

Collection Environment:

Ground-based.

Source/Platform:

Samples were obtained by a field sampling crew using hand-carried tools.

Source/Platform Mission Objectives:

The purpose was to measure gas fluxes from soil cores.

Key Variables:

Nitrous oxide and carbon dioxide fluxes, denitrification rates, soil bulk, density, gravimetric soil moisture, and air-filled pore space.

Principles of Operation:

Soil cores were incubated for 6 hours and samples of the core headspace were removed at 2 and 6 hours and were analyzed by gas chromatography. The results were used to calculate the rate of gas accumulation or depletion.

Sensor/Instrument Measurement Geometry:

Cylindrical soil cores measuring 2 cm in diameter and 15 cm in length were taken at each site.

Manufacturer of Sensor/Instrument:

Gas chromatograph for nitrous oxide and carbon dioxide analysis:

Tracor, Inc.

Calibration:

Specifications:

The gas chromatograph was calibrated before analysis of samples. Standards were prepared by dilution of certified standards for nitrous oxide and carbon dioxide. Spike blanks were prepared in the field and carried along with samples throughout the analysis process.

Tolerance:

Nitrous oxide standards were prepared to cover a range of concentration from approximately 1 to 50 ppmv. Carbon dioxide standards were prepared to cover a range of concentration from approximately 500 to 5000 ppmv.

Frequency of Calibration:

The gas chromatograph was calibrated at the beginning and end of each day samples were analyzed.

Other Calibration Information:

No other information is available at this revision.

5. Data Acquisition Methods:

Samples for denitrification analyses were collected four times in 1987 (20 April, 28 May, 28 June, 5 October). At each sample date, 20 soil cores (2 cm diam. x 15 cm length) were taken at each site and returned to the laboratory. Bulk soil samples were taken from each site within the area where soil cores were obtained. All soils were stored at 4 degrees C between time of sampling and analysis.

Soil gas fluxes were measured using the technique described by Tiedje et al. (1989). Within 24 hours of sampling, cores were removed from refrigeration immediately prior to incubation and sealed with rubber serum stoppers. Half of the cores were amended with at least 10 kPa acetylene and the other half were left unamended. Acetylene was mixed with the soil air by repeated pumping with a 30 ml syringe. Cores were incubated for 6 h, and gas samples were taken at 2 and 6 h. Unamended cores gave estimates of nitrous oxide and carbon dioxide production in soil and cores amended with acetylene gave estimates of nitrous oxide and dinitrogen produced by denitrification. Gas flux rates were calculated as the rate of accumulation or depletion in the soil cores between 2 and 6 hours. Bulk density of each core was calculated and used to express results on an areal basis. Gas samples and standards were stored in 3 ml rubber-stoppered vials (VenojectTM, Terumo Scientific, NJ). After incubations were completed, the internal headspace volume of each core was measured using a pressure transducer. Gas

samples were analyzed for nitrous oxide and carbon dioxide by electron-capture gas chromatography.

Immediately following incubation, distilled water was added to the unamended cores to simulate a 2 cm rainfall, and the acetylene-amended cores received a simulated 2 cm rainfall containing 100 mg nitrate-N/L. The cores were held overnight (12-15 hours) at room temperature with stoppers off. The following day, the cores were re-stoppered and denitrification rate was measured as described above.

Soil moisture and nitrate were measured on the bulk samples taken within the area where soil cores were taken. Soil moisture was determined gravimetrically and soil nitrate was extracted with 1 M KCl and analyzed colorometrically. Microbial biomass C was measured using the chloroform fumigation-incubation method, nitrification enzyme activity was measured using the chlorate inhibition method, and denitrification enzyme activity was measured using a short-term anaerobic assay. Only gas flux and soil moisture data are included in this data set. Soil nitrate and associated microbial parameter data are presented in Groffman 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, 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:

Samples were taken in and around six of the FIFE study sites (see Table below). Three sites were sampled near station #44, two sites were sampled near sites 4 and 10.

SITEGRID_ID	STATION_ID	NORTHING	EASTING	LONGITUDE	LATITUDE
1916-SGF	2	4330296	708270	-96 35 30	39 05 56
2731-SGF	4	4328678	711110	-96 33 34	39 05 01
3221-SGF	7	4327682	709112	-96 34 58	39 04 30

```
3414-SGF      10        4327286    707854    -96 35 51    39 04 19
5926-SGF      15        4322227    710270    -96 34 16    39 01 32
2043-SGF      44        4330003    713536    -96 31 51    39 05 42
```

ELEVATION	SITEGRID_ID	STATION_ID	COLOCATED
340	1916-SGF	2	70,150,902
446	2731-SGF	4	1,50,71,114,402,403
410	3221-SGF	7	
410	3414-SGF	10	
370	5926-SGF	15	
415	2043-SGF	44	35

Spatial Coverage Map:

Not available.

Spatial Resolution:

These were point data.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

Soil cores were collected four times in 1987; April 20, May 28 (IFC-1), June 28 (IFC-2), and October 5 (IFC-4). Samples were taken in April because N gas fluxes are high in early spring. Samples were not taken during IFC-3 because fluxes are very low in mid-summer.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Fluxes are expressed on a daily basis.

Data Characteristics:

The SQL definition for this table is found in the SOIL_GAS.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 FIFE site number. 4, 7, 10, 15, 44	2,		FIS
OBS_DATE The date of the observation.	min = 28-MAY-87 max = 28-JUN-87		FIS
CORE_NUM The number of the soil core sampled.	min = 1, max = 300		FIS
SOIL_MOISTURE The percent gravimetric soil moisture for the core. missing = 999	min = 19.2, max = 33.45,		FIS
BULK_DENSITY The soil bulk density (g/cm**3) of the sample. missing = 999	min = 0.79, max = 1.64,		FIS
POROSITY The percent air filled porosity for the sample. missing = 999	min = -75.69, max = 57.86,		FIS

UNAMEND_RESPRTN_1 The soil respiration for an unamended core in units ug CO2/g hr. This provides an estimate of in situ CO2 flux.	min = -1.08, max = 1595.4	FIS
UNAMEND_N2O_FLUX The N2O flux for an unamended core in units of ng N2O/g hr. This provides an estimate of core in situ N2O flux.	min - -0.33, max = 5.71, missing = 999	FIS
UNAMEND_RESPRTN_2 The soil respiration for an unamended core in units of g CO2/m**2 day. This provides an estimate of in situ CO2 flux.	min = -2.388, max = 15.162, missing = 999	FIS
UNAMEND_TOTAL_N_FLUX The total nitrogen flux for an unamended core in units g N/ha/ day. This provides an estimate of in situ nitrogen flux.	min = -7.24, max = 134.56, missing = 999	FIS
ACET_RESPRTN_1 The soil respiration of an acetylene amended core in units ug CO2/g hr.	min = -1.93, max = 13.85, missing = 999	FIS
ACET_N2O_FLUX The N2O flux for an acetylene amended core in units of ng N2O /g/hr. This provides an estimate of in situ N gas production to denitrification.	min = -0.44, max = 17.44, missing = 999	FIS
ACET_RESPRTN_2 The soil respiration for an acetylene amended core in units g CO2/m**2/day.	min = -4.782, max = 30.983, missing = 999	FIS
ACET_TOTAL_N_FLUX The total nitrogen flux from acetylene amended cores in units g N/ha/day. This provides an estimate of in situ N gas production due to denitrification.	min = -7.53, max = 288.24, missing = 999	FIS

AW_RESPRTN_1 The soil respiration for acetylene and water amended cores in units of ug CO2/g/hr. This shows if water is limiting to respiration in the field.	min = -36.3, max = 10.34, missing = 999	FIS
AW_N2O_FLUX The N2O flux for acetylene and water amended cores in units ng N2O/g/hr. This shows if water is limiting denitrification in the field.	min = -4.13, max = 458.51, missing = 999	FIS
AW_RESPRTN_2 The soil respiration for acetylene and water amended cores in units g CO2/m**2/day. This shows if water is limiting respiration in the field.	min = -102.83, max = 32.104, missing = 999	FIS
AW_TOTAL_N_FLUX The total nitrogen flux for acetylene and water amended cores in units g N/ha/day. This shows if water is limiting denitrification in the field.	min = -125.25, max = 8823.03	FIS
AWN_RESPRTN_1 The soil respiration for acetylene, water and nitrate amended cores in units ug CO2/g/ hr.	min = -3.93, max = 58.32, missing = 999	FIS
AWN_N2O_FLUX The N2O flux for acetylene, water and nitrate amended cores in units of ng N2O /g hr. This shows if nitrate is limiting denitrification in the field.	min = -27.02, max = 409.47, missing = 999	FIS
AWN_RESPRTN_2 The soil respiration for acetylene, water and nitrate amended cores in units g CO2/m**2/ day.	min = -8.182, max = 99.377, missing = 999	FIS
AWN_TOTAL_N_FLUX The total nitrogen flux from acetylene, water and nitrate	min = -846.68, max = 6797.67	FIS

```
amended cores in units g N/ha/
day.  This shows if nitrate is
limiting denitrification in the
field.
```

```
LAST_REVISION_DATE
data, in the format (DD-MMM-YY).       max = 16-NOV-88
```

```
FIFE_DATA_CRTFCN_CODE                          **
The FIFE Certification Code for        CPI=Checked by                    FIS
the data, in the following format:     Principal
CPI (Certified by PI), CPI-???         Investigator
(CPI - questionable data).
```

Note:

** 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	CORE_NUM	SOIL_MOISTURE	BULK_DENSITY
1916-SGF	2	28-JUN-87	1	28.800	1.250
1916-SGF	2	28-JUN-87	2	28.800	1.060
1916-SGF	2	28-JUN-87	3	28.800	999.000
1916-SGF	2	28-JUN-87	4	28.800	999.000

POROSITY	UNAMEND_RESPRTN_1	UNAMEND_N2O_FLUX	UNAMEND_RESPRTN_2
4.5500	999.0000	.1200	999.00000
28.3500	999.0000	.1800	999.00000
999.0000	999.0000	999.0000	999.00000
999.0000	999.0000	999.0000	999.00000

UNAMED_TOTAL_N_FLUX	ACET_RESPRTN_1	ACET_N2O_FLUX	ACET_RESPRTN_2
4.4400			
5.1800			
999.0000			
999.0000			

ACET_TOTAL_N_FLUX	AW_RESPRTN_1	AW_N2O_FLUX	AW_RESPRTN_2	AW_TOTAL_N_FLUX

AWN_RESPRTN_1	AWN_N2O_FLUX	AWN_RESPRTN_2	AWN_TOTAL_N_FLUX

LAST_REVISION_DATE	FIFE_DATA_CRTFCN_CODE

```
16-NOV-88              CPI
16-NOV-88              CPI
16-NOV-88              CPI
16-NOV-88              CPI
```

8. Data Organization:

Data Granularity:

This data set contains flux point data expressed on a daily basis.

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:

Several simple formulas are used to calculate rates. Headspace gas concentrations were multiplied by headspace volume to get total gas flux from the core. Total gas flux was then divided by the dry weight of soil in the core to produce gas flux on a per gram of dry soil basis. Gases dissolved in soil water were accounted for using Bunsen coefficients. Bulk density values were used to convert flux values to a volumetric basis (flux per cubic centimeter of soil). These values were then multiplied to produce flux values on a grams per hectare to the depth of the core basis.

Data Processing Sequence:

Processing Steps:

Information on data processing sequence was not provided by the investigator.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

None were applied.

Calculated Variables:

Total gas flux.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

Random errors arise from removal of gas samples from core headspace and gas chromatography analysis. The contamination of Venoject gas sample vials with nitrous oxide may also contribute to errors. Note that natural spatial variation of soil gas fluxes is very high, and that coefficients of variation greater than 100% are commonly encountered.

Quality Assessment:

Percent recovery of spike samples was always near 100%. Contamination of gas vials with nitrous oxide was accounted for by calculating rates as the difference between two and six hour samples.

Data Validation by Source:

No information on data validation was provided by the investigator.

Confidence Level/Accuracy Judgment:

The investigator places a high degree of confidence in the accuracy of their data.

Measurement Error for Parameters:

Minimum detectable flux for nitrous oxide of 1 g N [ha^-1] [d^-1], for carbon dioxide of 0.1 g C [m^-2][d^-1].

Additional Quality Assessments:

FIS staff applied a general 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 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, that 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:

Results of the FIS staff quality assessment:

- The missing data indicator in this data set is +999 instead of the FIS standard -999. In general, this does not appear to conflict with any valid data values, therefore, it has been left to us.
- There are multiple entries for each core sample. These entries correspond to the different types of treatment, and hence, different fields are supplied for each entry. The fields supplied are the only way of determining (by inference), which treatment is being reported in a particular entry.
- Negative porosities are reported for almost all amended cores. However, negative porosities are also reported for some unamended cases.
- At station 15on June 28, cores 285 and 286 are shown as having unamended respiration (UNAMEND_RESPRTN_1) in excess 1400 [ugCO2][g^-1][hr^-1]. These values are inconsistent with the rest of the data, and hence appear erroneous.
- There are three values of ACET_TOTAL_N_FLUX in excess of 100 [g N][ha^-1]. These are improbable values given the distribution of the rest of the measurements, and may therefore be in error.

Usage Guidance:

Fluxes reported here should be comparable with those obtained by similar core techniques and from in situ chamber techniques.

The investigator requests that users of the data set contact him for additional information.

Any Other Relevant Information about the Study:

None provided at this revision.

12. Application of the Data Set:

From these fluxes, relationships between soil water and plant productivity were to be developed. These remotely sensed soil water and plant productivity data could be used to produce large-area estimates of gas fluxes.

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 Gas Fluxes Using Soil Cores are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\BIOLOGY\SOIL_GAS\ydddgrid.SGF

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 .SGF for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Tiedje, J.M., S. Simkins, and P.M. Groffman. 1989. Perspectives on measurement of denitrification in the field including recommended protocols for acetylene based methods. Plant and Soil. 115:261-284.

Journal Articles and Study Reports.

Groffman, P.M., C.W. Rice, and J.M. Tiedje. 1993. Denitrification in a tallgrass prairie landscape. Ecology (In press).

Groffman, P.M. and C.L. Turner. 1993. Plant productivity and nitrogen gas fluxes in tallgrass prairie. Ecology (submitted).

Groffman, P.M. and E. Wood, in preparation. Using a soil moisture model to scale nitrogen gas fluxes in tallgrass prairie. (In preparation).

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 (optical), 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 IFOV Instantaneous Field of View ISLSCP

International Satellite Land Surface Climatology Project Mbps Megabyte per second ORNL Oak Ridge National Laboratory URL Uniform Resource Locator UTM Universal Transverse Mercator

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

20. Document Information:

April 28, 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:

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