Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Sara K. Conrad, Editors

Volume 226

BOREAS TGB-1 CH$_4$ and CO$_2$
Chamber Flux Data over NSA Upland Sites

Kathleen Savage, Woods Hole Research Center, Massachusetts
Tim R. Moore, McGill University, Montreal, Quebec

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000
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BOREAS TGB-3 CH\textsubscript{4} and CO\textsubscript{2} Chamber Flux Data over NSA Upland

Kathleen Savage, Tim R. Moore

Summary

The BOREAS TGB-3 team collected methane and carbon dioxide (CH\textsubscript{4}, CO\textsubscript{2}) chamber flux measurements at the NSA Fen, OBS, YJP, and auxiliary sites along Gillam Road and the 1989 burn site. Gas samples were extracted from chambers and analyzed at the NSA lab facility approximately every 7 days during May to September 1994 and June to October 1996. The data are provided in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TGB-03 CH\textsubscript{4} and CO\textsubscript{2} Chamber Flux Data over NSA Upland Sites

1.2 Data Set Introduction

The Trace Gas Biogeochemistry (TGB)-03 team took chamber flux measurements at upland sites in the BOREal Ecosystem Atmosphere Study (BOREAS) Northern Study Area (NSA) from late May to early September 1994 and early June to late October 1996.

1.3 Objective/Purpose

The objectives of these measurements were:
- To examine the trace gas exchange between the atmosphere and the boreal upland soils.
- To identify environmental controls on CH\textsubscript{4} and CO\textsubscript{2} flux and the spatial and temporal variability associated with those controls in order to improve the process models that describe exchanges of trace gases between the boreal ecosystem and the atmosphere.
1.4 Summary of Parameters

In the 1994 sampling season, CH₄ and CO₂ chamber flux measurements were taken from 11 sites. These sites were designated as 1989 burn moss, 1989 burn spruce, palsa moss, palsa birch, Gillam aspen, Gillam pine, Gillam spruce, Young Jack Pine (YJP) wet, YJP dry, Old Black Spruce (OBS) aspen, OBS spruce.

In the 1996 sampling season, CH₄ and CO₂ chamber fluxes were measured at YJP wet, YJP dry, OBS aspen, OBS spruce, Old Jack Pine (OJP) moss, OJP aspen, and OJP pine (note OJP sites sampled by Patrick Crill in 1994).

1.5 Discussion

In 1994, CH₄ and CO₂ chamber flux measurements were taken at the 11 sites within the NSA to determine the soil surface exchange rate of CH₄ and CO₂ at these locations. The locations represent both a hydraulic and disturbance gradient. The sampling collars were installed in the spring of 1994 by the McGill researchers (TGB-03), and measurements of CH₄ and CO₂ flux were made during and between the 1994 and 1996 Intensive Field Campaigns (IFCs).

1.6 Related Data Sets

BOREAS TGB-01 NSA CH4 and CO2 Chamber Flux Data
BOREAS TGB-01 CH4 Concentration and Flux Data from NSA Tower Sites
BOREAS TGB-01/TGB-03 CH4 Chamber Flux Data over the NSA Fen

2. Investigator(s)

2.1 Investigator(s) Name and Title
Dr. Tim R. Moore
Professor
McGill University

Kathleen Savage
McGill University

2.2 Title of Investigation
Environmental Controls on Methane Consumption and Carbon Dioxide Emissions in Upland Boreal Forest Soil

2.3 Contact Information

Contact 1:
Dr. Tim R. Moore
Geography Department
McGill University
805 Sherbrooke St. W.
Montreal, Quebec H3A 2K6
Canada
(514) 398-4961
(514) 398-7437 (fax)
moore@felix.geog.mcgill.ca
3. Theory of Measurements

Chamber fluxes measure the changes in mixing ratio of trace gases (CH4 and CO2) in a closed headspace over a period of time. This headspace is isolated from the atmosphere; therefore, the exchange of material between the covered soil and the headspace can be quantified.

4. Equipment

4.1 Sensor/Instrument Description

The CH4 and CO2 flux measurements were taken with PVC collars (26 cm in diameter) and chambers made from polycarbonate bottles (26 cm in diameter; 40 cm tall; area of exposure 0.053 m2; Moore and Roulet, 1991). Bottles were covered with aluminum foil to reduce heating. The neck of each bottle was sealed with a rubber stopper that contained a glass tube with a rubber septum with a 1-m length of Tygon tubing attached to the top to minimize disturbance. Syringes were made of polypropylene.

CH4 and CO2 were quantified with a Shimadzu 14A Gas Chromatograph (GC) equipped with a flame ionization detector (FID) for CH4 and thermal conductivity Detector (TCD) for CO2. A HayeSepQ column was used, the GC temperature was set at 40 °C, and ultra-pure (99.999%) N2 was used as the carrier gas flowing at 30 mL/min. The detectors were operated at 125 °C. Analog signals (0-1 V) from the detectors were digitized at 10 Hz with a Hewlett Packard (HP) 35000D A/D board and quantified and logged using HP ChemStation software.

Chamber fluxes were accomplished with aluminum chambers manufactured at the University of New Hampshire (UNH) and designed by Patrick Crill.

4.1.1 Collection Environment

The chamber fluxes were collected under ambient environmental conditions.

4.1.2 Source/Platform

Ground.

4.1.3 Source/Platform Mission Objectives

The ground supported the collars and chambers.
4.1.4 Key Variables
The key variable measured during the sampling period was CH₄ and CO₂ flux. Soil temperature, moisture, and soil gas profile concentrations were also measured.

4.1.5 Principles of Operation
The Shimadzu GC-14A is equipped with a FID and a TCD. The FID is used to detect CH₄; the TCD is used to detect CO₂. The FID uses a hydrogen flame in an air atmosphere to burn components as they exit the column. In the flame, carbon-carbon bonds are fragmented so that various organic ions and free electrons exist. Application of a voltage across a collector electrode over the flame causes an ion current to flow that is amplified and then measured as the output signal. The TCD detects CO₂ by passing a sample in a helium carrier gas past metallic filaments with current flowing through them. The sample components with lower thermal conductivity than the helium carrier gas raise the filament temperature when they pass through. The signal output from the TCD is a measurement of the change in filament resistance caused by the temperature rise. The signal output from both the FID and TCD is for a data processor, integrator, recorder, or computer (Instruction Manual: GC-14A; Shimadzu Corporation, Kyoto, Japan).

4.1.6 Sensor/Instrument Measurement Geometry
Not applicable.

4.1.7 Manufacturer of Sensor/Instrument
The investigator manufactured collar and chambers.

Manufacturer of GC-14A FID/TCD and GC-MINI2:
Shimadzu Scientific Instruments, Inc.
7102 Riverwood Drive
Columbia, MD 21046
(410) 381-1227

4.2 Calibration

4.2.1 Specifications
Analyses were conducted with a Shimadzu GC with a FID (FID-GC) using a Porapak Q column. Nitrogen was used as the carrier gas, and CH₄ standards of 2.349 ppmv were used to calibrate. Precision of the analysis (standard deviation as percent of the mean of 10-15 daily repetitions of the standard) was less than 1% of the standards. Fluxes between 0.1 and -0.1 mg/m²/d were not detectable.

Signal peaks from the detectors were quantified with working standards calibrated against Canadian Atmospheric Environment Services (AES) certified primary standards acquired by the BOREAS project and a CO₂/CH₄ standard of Niwot Ridge air prepared by the National Oceanic and Atmospheric Administration (NOAA) Climate Monitoring and Diagnostics Laboratory (CMDL). Uncertainty in the standards’ analyses on a given day ranged from 0.1 to 0.2%.

4.2.1.1 Tolerance
The sensitivity of the TCD is approximately 6,000 mV mL/mg. The FID’s maximum sensitivity is 3 x 10⁻¹² g/s for diphenyl.

4.2.2 Frequency of Calibration
The instrument is calibrated on a daily basis. Standards are run generally before and after samples on a given day of analysis.

4.2.3 Other Calibration Information
None given.
5. Data Acquisition Methods

A total of 66 PVC collars were placed along the moisture and disturbance gradients in the NSA and sampled in 1994. CH4 and CO2 were sampled at each of the collars once a week from early May through mid-September 1994 using a static chamber technique (Crill et al., 1988). Water was added to the groove in each collar before inserting the chamber in order to make an airtight seal. Air samples were obtained from each chamber by inserting a polypropylene syringe into the Tygon tubing equipped with a three-way stopcock and pumping the piston four or five times to mix air in the chamber before a 60-mL sample was drawn. A 10-mL sample was taken from the 60-mL syringe using the three-way stopcock. Four 10-mL samples were taken at 5-minute intervals over a 20-minute period. Samples were returned to a laboratory in Thompson and analyzed for CH4 and CO2 within 4-6 hours of collection.

6. Observations

6.1 Data Notes
None given.

6.2 Field Notes
None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage
The North American Datum of 1983 (NAD83) coordinates for the sites are:

|----------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
These are point source data made from the enclosed areas.
7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
CH₄ and CO₂ flux, temperature, moisture, and profile concentration measurements were made from mid-May through mid-September 1994.

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
CH₄ and CO₂ flux measurements were made once a week at each of the 66 collars throughout the season.

7.3 Data Characteristics

7.3.1 Parameter/Variable
The parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
</tr>
<tr>
<td>SUB_SITE</td>
</tr>
<tr>
<td>DATE_OBS</td>
</tr>
<tr>
<td>COLLAR_ID</td>
</tr>
<tr>
<td>AIR_TEMP</td>
</tr>
<tr>
<td>CO₂ FLUX</td>
</tr>
<tr>
<td>CH₄ FLUX</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
</tr>
<tr>
<td>REVISION_DATE</td>
</tr>
</tbody>
</table>

7.3.2 Variable Description/Definition
The descriptions of the parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.</td>
</tr>
</tbody>
</table>
7.3.3 Unit of Measurement
The measurement units for the parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>[none]</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>[none]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>COLLAR_ID</td>
<td>[none]</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>[degrees Celsius]</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>[micromoles][meter^-2][second^-1]</td>
</tr>
<tr>
<td>CH4_FLUX</td>
<td>[micromoles][meter^-2][second^-1]</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>[none]</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>[DD-MON-YY]</td>
</tr>
</tbody>
</table>

7.3.4 Data Source
The sources of the parameter values contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>Assigned by BORIS</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>Assigned by BORIS</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>Investigator</td>
</tr>
<tr>
<td>COLLAR_ID</td>
<td>Investigator</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>[PLEASE COMPLETE]</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>Shimadzu GC</td>
</tr>
<tr>
<td>CH4_FLUX</td>
<td>Shimadzu GC</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>Assigned by BORIS</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>Assigned by BORIS</td>
</tr>
</tbody>
</table>

7.3.5 Data Range
The following table gives information about the parameter values found in the data files on the CD-ROM.

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Minimum Data Value</th>
<th>Maximum Data Value</th>
<th>Missing Data Value</th>
<th>Unrel Data Value</th>
<th>Below Data Value</th>
<th>Detect Not Collectd</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>NSA-9BS-T03BS</td>
<td>NSA-YJP-T03JP</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>TGB03-FLX01</td>
<td>TGB03-FYJPW</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>16-MAY-94</td>
<td>22-OCT-96</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>COLLAR_ID</td>
<td>BM-01</td>
<td>YJPW-06</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>-1</td>
<td>33</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>-39.547454</td>
<td>257.517361</td>
<td>-999</td>
<td>-888</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
<td>------------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td>CH4_FLUX</td>
<td>-.00683</td>
<td>.10096956</td>
<td>-999</td>
<td>-888</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>CPI</td>
<td>CPI</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>14-APR-97</td>
<td>17-APR-98</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missing Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.
Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A -- Indicates that the value is not applicable to the respective column.
None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record

The following are wrapped versions of sample data records from a selected file on the CD-ROM:

```plaintext
SITE_NAME, SUB_SITE, DATE_OBS, COLLAR_ID, AIR_TEMP, CO2_FLUX, CH4_FLUX, CRTFCN_CODE, REVISION_DATE
'NSA-9BS-T03BS', 'TGB03-FLXBM', 07-JUN-94, 'BM-04', 84.834838, -00242, 'CPI', 16-APR-98
'NSA-9BS-T03BS', 'TGB03-FLXBM', 07-JUN-94, 'BM-05', 9.04900463, 0, 'CPI', 16-APR-98
```

8. Data Organization

8.1 Data Granularity

The smallest set of CH4 and CO2 flux measurements tracked by BOREAS was the data collected at a given site on a given day.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.
Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

\[ R_f = \frac{C_{std}}{A_{std}} \]
\[ C_s = R_f \times A_s \]
\[ R_f = \text{Response factor} \]
\[ A_{std} = \text{Standard peak area} \]
\[ C_{std} = \text{Concentration of the standard} \]
\[ C_s = \text{Concentration of the sample} \]
\[ A_s = \text{Peak area of sample} \]

CH₄ concentrations were calculated from the average of 10 peak areas of known CH₄ standards. The response factor was calculated as the concentration of the known standard divided by the average of 10 standard peak areas. The peak area of the unknown sample was multiplied by the response factor.

The flux calculations were made by fitting a regression curve to the time series of CH₄ concentrations. The flux rate of a gas is calculated using the following equation:

\[ \text{Flux(mg/m}^2/\text{d}) = \text{ppmv/min} \times (\frac{P}{R} \times \text{g/mol of the gas}) \times (\frac{1}{T}) \times \frac{V_c}{A_c} \times (1000 \text{mg/g} \times 1440 \text{min/d}) \]

where:
\[ P = \text{pressure in atmospheres} \]
\[ R = 8.2054 \times 10^{-5} \text{ m}^3 \text{ atm/mol/K} \]

gases:
\[ \text{CH}_4 = 16 \text{ g/mol} \]
\[ T = \text{degrees K of the chamber} \]
\[ V_c = \text{chamber volume in m}^3 \]
\[ A_c = \text{chamber area in m}^2 \]

\[ V_c = ((E/100 \times 0.047 \times 1000) + V_t) \]

\[ V_c = \text{volume of the chamber} \]
\[ V_t = \text{volume of the top narrow part of chamber} = 1.4 \]
\[ E = \text{height of cylindrical part of chamber in cm} \]

9.2 Data Processing Sequence
9.2.1 Processing Steps
The peak areas were taken directly from the HP ChemStation reports from the GC. They were entered into spreadsheets, and the concentrations were calculated using the formulas in Section 9.1. The spreadsheets then automatically calculated the flux using the formulas in Section 9.1.
The flux equation included the slope of the regression line of the five samples the height and volume of the chamber and air temperature (see above). Fluxes were calculated by linear regression of the concentration change in the five samples. If one sample deviated from the line, the flux was recalculated without the outlier. The correlation coefficient of the regression had to be significant to the 95% confidence limit for n=4 or 5 ($r^2 = 0.95$ or 0.87); otherwise, the sample was rejected. Sites with ebullition were kept in the data set even if a large increase was observed between two of the samples as long as the correlation coefficient was still significant at $p < 0.05$.

9.2.2 Processing Changes
None given.

9.3 Calculations
Not applicable.

9.3.2 Calculated Variables
Refer to Section 9.1.1.

9.4 Graphs and Plots
None given.

10. Errors

10.1 Sources of Error
Field sampling error could account for some error in the concentration of the syringe samples:
- Not flushing the sampling line from the chamber before sampling could cause dilution of the sample with air from the last sampling time.
- Not completely closing the syringes or allowing them to come open during transport will cause dilution from ambient air.

Errors such as these would have been written down in the lab/field books, and these data have been edited out. The analytical precision of the GCs is 0.2% for CH$_4$.

10.2 Quality Assessment

10.2.1 Data Validation by Source
Each flux measurement has been verified by checking the calculations in the spreadsheets and assessing the slope and intercept for the linear regression.

10.2.2 Confidence Level/Accuracy Judgment
None given.

10.2.3 Measurement Error for Parameters
The analytical precision of the GCs is 0.2% for CH$_4$.

10.2.4 Additional Quality Assessments
None given.

10.2.5 Data Verification by Data Center
Data were examined for general consistency and clarity.
11. Notes

11.1 Limitations of the Data
The analytical precision of the GCs is 0.2% for CH₄.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
None given.

11.4 Other Relevant Information
None given.

12. Application of the Data Set
The chamber flux data can be used in connection with the tower flux data to determine the CH₄ and CO₂ exchange between the atmosphere and the boreal soils.

13. Future Modifications and Plans
None given.

14. Software

14.1 Software Description
None given.

14.2 Software Access
None given.

15. Data Access
The TGB-03 upland flux data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information
For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov
15.2 Data Center Identification
Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data
Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans
The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products
None.

16.2 Film Products
None.

16.3 Other Products
These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation
None given.

17.2 Journal Articles and Study Reports


17.3 Archive/DBMS Usage Documentation
None given.

18. Glossary of Terms
None given.

19. List of Acronyms

AES - Atmospheric Environment Services, Canada
ASCII - American Standard Code for Information Interchange
BOREAS - BOReal Ecosystem-Atmosphere Study
BORIS - BOREAS Information System
CD-ROM - Compact Disk-Read-Only Memory
CMDL - Climate Monitoring and Diagnostics Laboratory
DAAC - Distributed Active Archive Center
ECD - Electron Capture Detector
EOS - Earth Observing System
EOSDIS - EOS Data and Information System
FID - Flame Ionization Detector
GC - Gas Chromatograph
GIS - Geographic Information System
GSFC - Goddard Space Flight Center
HP - Hewlett Packard
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The BOREAS TGB-3 team collected methane and carbon dioxide (CH₄, CO₂) chamber flux measurements at the NSA Fen, OBS, YJP, and auxiliary sites along Gillam Road and the 1989 burn site. Gas samples were extracted from chambers and analyzed at the NSA lab facility approximately every 7 days during May to September 1994 and June to October 1996. The data are provided in tabular ASCII files.

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