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

Forrest G. Hall and Sara K. Conrad, Editors

Volume 219

BOREAS TGB-1 NSA CH₄ and CO₂
Chamber Flux Data

Patrick Crill and Ruth K. Varner
University of New Hampshire, Durham

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000
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Patrick M. Crill, Ruth K. Varner

Summary

The BOREAS TGB-1 team made methane (CH₄) and carbon dioxide (CO₂) dark chamber flux measurements at the NSA-OJP, NSA-OBS, NSA-BP, and NSA-YJP sites from 16-May-1994 through 13-Sep-1994. Gas samples were extracted approximately every 7 days from dark chambers and analyzed at the NSA lab facility. The data are provided in tabular ASCII files.

Table of Contents

1) Data Set Overview
2) Investigator(s)
3) Theory of Measurements
4) Equipment
5) Data Acquisition Methods
6) Observations
7) Data Description
8) Data Organization
9) Data Manipulations
10) Errors
11) Notes
12) Application of the Data Set
13) Future Modifications and Plans
14) Software
15) Data Access
16) Output Products and Availability
17) References
18) Glossary of Terms
19) List of Acronyms
20) Document Information

1. Data Set Overview

1.1 Data Set Identification
BOREAS TGB-01 NSA CH₄ and CO₂ Chamber Flux Data

1.2 Data Set Introduction
Chamber flux measurements were taken at the Northern Study Area (NSA) Old Jack Pine (OJP), Young Jack Pine (YJP), Old Black Spruce (OBS), and Beaver Pond (BP) sites during the summer of 1994 by the BOREal Ecosystem-Atmosphere Study (BOREAS) Trace Gas Biogeochemistry (TGB)-01 team. The values represent the average/mean flux from five values taken at 20-minute intervals.

1.3 Objective/Purpose
The purpose of these measurements was to examine the trace gas exchange between the atmosphere and the boreal soils.
1.4 Summary of Parameters
CH$_4$ and CO$_2$ chamber fluxes were measured at the NSA OJP, YJP, OBS, and BP sites. Temperatures of the chamber, 1-cm soil depth, and 10-cm soil depth were recorded at the OJP, YJP, and OBS (Patrick Crill) sites. At the OBS (Dean Moosavi) and BP sites, temperatures at 5-, 10-, and 20-cm soil depths were recorded.

1.5 Discussion
The chamber flux data are provided in American Standard Code for Information Interchange (ASCII) comma-delimited text files. The data are a compilation of measurements from the aluminum chamber and collar sites at OJP, YJP, and OBS (Patrick Crill) and the plastic chamber and collar sites at OBS (Dean Moosavi) and BP sites. Another part of the data is a diurnal study completed 08-Jul-1994 and 09-Jul-1994 at the BP plastic collar and chamber sites.

1.6 Related Data Sets
BOREAS TGB-01 CH4 Tower flux data over NSA
BOREAS TGB-01 Soil CH4 and CO2 concentration data over the NSA

2. Investigator(s)

2.1 Investigator(s) Name and Title
Dr. Patrick M. Crill
Research Associate Professor
University of New Hampshire

2.2 Title of Investigation
Magnitude and Control of Trace Gas Exchange in Boreal Ecosystems

2.3 Contact Information

Contact 1:
Dr. Patrick M. Crill
Institute for the Study of Earth, Oceans, and Space
Complex Systems Research Center
University of New Hampshire
Durham, NH 03824
(603) 862-3519
(603) 862-0188 (fax)

Contact 2:
Sadredin C. Moosavi
Graduate Student
Institute for the Study of Earth, Oceans, and Space
Complex Systems Research Center
University of New Hampshire
Durham, NH 03824
(603) 862-2927
(603) 862-0188 (fax)
3. Theory of Measurements

Chamber fluxes measure the changes in the mixing ratio of trace gases (CO₂ and CH₄) 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

CH₄ was quantified with a Shimadzu GC-14A Gas Chromatograph (GC) or a Shimadzu GC-MINI2 with a flame ionization detector (FID) operated at 125 °C after separation on a HayeSepQ column at 40 °C using ultrapure (99.999%) N₂ as a carrier gas flowing at 30 mL/min. CO₂ was quantified with a Shimadzu GC-14A with a thermal conductivity detector (TCD) operated at 70 °C after separation on a HayeSepQ column at 40 °C using ultrapure (99.999%) He as a carrier gas flowing at 30 mL/min. The oven temperature during sample analysis was run at 130 °C and the detector at 300 °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 and designed by Patrick Crill.

4.1.1 Collection Environment

The chamber fluxes were collected under ambient conditions. The GC analysis was completed at the Hayes Road Lab in Thompson, Manitoba.

4.1.2 Source/Platform

Ground.

4.1.3 Source/Platform Mission Objectives

The mission objective was to determine the soil-surface exchange rates of CH₄ and CO₂ at the NSA OJP, YJP, OBS, and BP sites.
4.1.4 Key Variables

The key variables measured during the sampling period were CH$_4$ and CO$_2$ fluxes. The OBS site was divided into two different sets of data. In the SITE_COLLAR, a C denotes the OBS site where Patrick Crill measured fluxes with aluminum chambers and collars. An M denotes the OBS site where Dean Moosavi measured fluxes with plastic chambers and collars. Plastic chambers and collars were also used at the BP site. Soil profile temperatures were also recorded.

4.1.5 Principles of Operation

The Shimadzu GC-14A GC is equipped with a hydrogen FID and a TCD. The FID is used to detect CH$_4$, while the TCD is used to detect CO$_2$. 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, which is amplified and then measured as the output signal.

The TCD detects CO$_2$ 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). The GC-MINI2 was equipped with a FID and operated in the same manner as the GC-14A FID.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

Manufacturer of GC-14A FID/TCD, GC-MINI2, and GC-8A ECD
Shimadzu Scientific Instruments, Inc.
7102 Riverwood Drive
Columbia, MD 21046
(410) 381-1227

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

The sensitivity of the TCD is approximately 6000 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

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 CO$_2$/CH$_4$ 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%.
5. Data Acquisition Methods

The chamber fluxes are determined by analysis of concentrations of methane (CH₄) and carbon dioxide (CO₂) in a time series of grab samples of headspace over the ground surface enclosed by a dark aluminum chamber. The volumes of the two aluminum chambers were 0.071 and 0.120 m³ over an area of 0.397 m². The aluminum chamber was placed on the trough of an aluminum collar embedded in the ground. Water was added to the trough of the collar to create an airtight seal. The volume of the plastic chambers was 0.028 m³ over an area of 0.078 m². The seal between chamber and collar was made using weather stripping or water as appropriate. Five 60-mL samples were removed from the headspace with polypropylene syringes and polycarbonate/nylon stopcocks at 4-minute intervals for 20 minutes (five samples). Samples were returned to the Hayes Road lab and analyzed for CO₂ and CH₄ using gas chromatography within 12 hours after collection.

6. Observations

6.1 Data Notes

None given.

6.2 Field Notes

For data collected by Patrick Crill:

- 25-May-94- Fans in chambers not working at OBS. Can't use the data.
- 29-May-94- Fan in chamber not working after 20 minutes in OJPA2 flux; no fan for the OJPM2 flux; no fan for the OJP1 and 2 fluxes.
- 01-Jun-94- No fan for OBS12 flux.
- 10-Jul-94- One chamber had been filled with water and therefore the fan and temperature probe aren't working. Used it with collars YJP1, OJP1A1, OJP1L2, OJPM1, and OJPM2.
- 16-Jul-94- No temperature still in one chamber at OJP and YJP.
- 23-Jul-94- No temperature still in one chamber at OJP and YJP; Collar YJP2 syringe number 4 lost its stopcock.
- 30-Jul-94- No temperature still in one chamber at OJP and YJP.
- 01-Aug-94- Very hot, using silver mylar to reflect sun on half of the flux chambers to see if it effects temperature change in chamber...it doesn't heat up as much as chambers without cover by about 10 °C.
- 07-Aug-94- Fixed chamber thermometer for first few fluxes; then it went bad again.
- 08-Aug-94- No fan for collar OBS10 flux; no temperatures for OBS8, OBS6, OBS11, OBS4, and OBS2.
- 12-Aug-94- No temperature still in one chamber at OJP and YJP.
- 19-Aug-94- No temperature still in one chamber at OJP and YJP.

For data taken by Dean Moosavi:

- 19-May-94- Experiments halted due to chamber hardware problems.
- 20-May-94- Screw missing in chamber for flux at collar OBS1; therefore, there was a hole in chamber during the flux. Fixed with duct tape.
- 26-May-94- Problems with collar at collar BP29.
- 04-Jun-94- Water levels in the fen have dropped 5-10 cm from season beginning at OBS.
- 10-Jun-94- Carex and other vegetation have sprouted. Larch are out.
- 20-Jun-94- Temperature probe dead!
- 21-Jun-94- Fans did not work for collars 19 and 20 at BP.
- 30-Jun-94- BP- Bear attack on equipment! Collar 23 pulled up and moved 5 yards. Minor tooth damage. Collar 18 destroyed. Lichen thermocouple uprooted and destroyed. Pond and dam level have dropped 10 cm leaving collars above the water level.
- 02-Aug-94- BP- Moose stepped in collar 24!
- 21-Aug-94- Senescence beginning.
- 24-Aug-94- Due to problems with yesterday's samples. BP and dam were resampled off collar in vicinity of site.
- 31-Aug-94- BP and dam fluxes taken next to (NOT on) collars.
- 13-Sep-94- BP collars 25-32 fluxes taken near (not on) collars.
- 14-Sep-94- All collars and chambers removed!

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

Descriptions of the sites and their North American Datum of 1983 (NAD83) coordinates are:

- The collars at the OJP tower site and profile sampling sites were located on moss plots that were approximately northwest of the tower, while the profile corral was located a few meters south of the collars (55°55'43.2'' N, 98°37'29.4'' W).
- The collars at the OJP site located on lichen plots were due west of the tower; the profile trench was located about 1 m southeast of the collars (55°55'40.9'' N, 98°37'29.3'' W).
- The collars at the YJP tower site were located southeast of the tower; the gas profile corral was located approximately 1 m west of the collars (55°53'42.8'' N, 98°17'12.7'' W).
- The collars at the OBS tower site were located along a low to high moisture gradient from the lichen to the feathermoss, the fen rim, and ending at the fen site. The lichen and the feather moss collars were located along the boardwalk approximately 200 m northeast of the tower. The fen rim and fen site collars were located due east of the lichen and feather moss sites about 150 m and 200 m respectively.

For data collected by Dean Moosavi:

- The collars and profile sampling sites near the OBS tower were located as follows: the OBS sampling collars were located along a moisture gradient from feathermoss and lichen sites to the fen rim site and ending with the fen sites. The transect ran approximately east to west and was located about 200 m northeast of the tower at the OBS site.
- The collars and profile sampling sites at the BP tower site were located as follows: the BP sampling sites were located along a low to high moisture gradient that began with the upland lichen site, then the sphagnum moss site, the mire site, and ending at the pond site. The transect ran approximately north to south and was about 60 m from the BP tower.

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

Four collars were placed in the ground for each biome type. They were approximately 1 to 2 m apart depending on the site specifics. In Section 7.3.3, the cover type refers to the predominant vegetation in the collar. These are point source measurements at the locations given in Section 7.1.1.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics
7.2.1 Temporal Coverage
Chamber fluxes were measured from 16-May-1994 through 13-Sep-1994. One diurnal study was conducted at eight collars on 08- and 09-Jul-1994 at the BP site.

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
The chamber fluxes were measured approximately every 7 days from 23-May-1994 to 20-Sep-1994.

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>
<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, or TRN; 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 subsite by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the subsite instrument (e.g., HYD06 or STAFF), and IIIII is the identifier for the subsite, (often this will</td>
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<tr>
<td>DATE_OBS</td>
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<tr>
<td>TIME_OBS</td>
<td></td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td></td>
</tr>
<tr>
<td>CH4_FLUX</td>
<td></td>
</tr>
<tr>
<td>COVER_TYPE</td>
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</tr>
<tr>
<td>SOIL_TEMP_1CM</td>
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<td>SOIL_TEMP_5CM</td>
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<td>SOIL_TEMP_10CM</td>
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<td>CRTFCN_CODE</td>
<td></td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td></td>
</tr>
</tbody>
</table>
DATE_OBS  The date on which the data were collected.
TIME_OBS  The Greenwich Mean Time (GMT) when the data were collected.
CO2_FLUX  Carbon dioxide flux.
CH4_FLUX  Methane flux.
COVER_TYPE  The dominant species, vegetation, or type of land cover that exists at the location.
SOIL_TEMP_1CM  Soil temperature at 1-cm depth.
SOIL_TEMP_5CM  Soil temperature at 5-cm depth.
SOIL_TEMP_10CM  Soil temperature at 10-cm depth.
SOIL_TEMP_20CM  Soil temperature at 20-cm depth.
COLLAR_ID  A TGB-01 designation for the chamber collar sites, in the form of A-BBB-##, where A = C or M (Crill or Moosavi), BBB denotes the site and possibly microtopographic designation, and ## is a sequention collar number.
CO2_CONC  CO2 concentration.
CO2_CONC_2  CO2 concentration.
CH4_CONC  CH4 concentration.
CH4_CONC_2  CH4 concentration.
CRTFCN_CODE  The BOREAS certification level of the data. Examples are Checked by PI (CPI), Certified by Group (CGR), Preliminary (PRE), and CPI but questionable (CPI-???)
REVISION_DATE  The most recent date that the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement
The measurement units for the parameters contained in the data files on the CD-ROM are:

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<th>Column Name</th>
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<td>SUB_SITE</td>
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<tr>
<td>DATE_OBS</td>
<td>[DD-MON-YY]</td>
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<tr>
<td>TIME_OBS</td>
<td>[HHMM GMT]</td>
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<tr>
<td>CH4_CONC</td>
<td>[parts per million]</td>
</tr>
<tr>
<td>CH4_CONC_2</td>
<td>[parts per million]</td>
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### 7.3.4 Data Source

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

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<td>SUB_SITE</td>
<td>Not applicable</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>Investigator</td>
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<tr>
<td>TIME_OBS</td>
<td>Investigator</td>
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<td>CH4_FLUX</td>
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### 7.3.5 Data Range

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

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<th>Unrelated Data Value</th>
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<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SOIL_TEMP_20CM</td>
<td>-1.9</td>
<td>99.7</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>COLLAR_ID</td>
<td>C-OBS-01</td>
<td>M-OBS-w-16</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CO2_CONC</td>
<td>363.5</td>
<td>472.5</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CO2_CONC_2</td>
<td>364</td>
<td>504.3</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CH4_CONC</td>
<td>1.945</td>
<td>2.319</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CH4_CONC_2</td>
<td>2.066</td>
<td>2.262</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>PRE</td>
<td>CPI</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>23-AUG-96</td>
<td>14-JAN-97</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
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel deemed the value to be unreliable.

Below Detect Limit -- The value that indicates parameter values below the instrument's 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 Clcld -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BOREAS Information System (BORIS) staff 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 data records from a sample data file on the CD-ROM.

```
'SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,CO2_FLUX,CH4_FLUX,COVER_TYPE,SOIL_TEMP_1CM,
SOIL_TEMP_5CM,SOIL_TEMP_10CM,SOIL_TEMP_20CM,COLLAR_ID,CO2_CONC,CO2_CONC_2,
CH4_CONC,CH4_CONC_2,CRTFCN_CODE,REVISION_DATE
'NSA-BVP-FLXTR', 'TGBOI-FLXOI', 'O2-AUG-94', '1716', '-888', '-888', 'Mire', '16.4', '15.6', '14.3',
'M-BP-mc-26', 'CPI', '13-JAN-97
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data is the CO₂ and CH₄ fluxes measured on a particular date at a particular site.

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

\[ R_f = \frac{C_{\text{std}}}{A_{\text{std}}} \]
\[ C_s = R_f \times A_s \]

Where:
- \( R_f \) = Response factor
- \( A_{\text{std}} \) = Average of 10 standard peak areas
- \( C_{\text{std}} \) = Concentration of the standard
- \( C_s \) = Concentration of the sample
- \( A_s \) = Peak area of sample

CH4 and CO2 concentrations were calculated from the average of 10 peak areas of known CH4 and CO2 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. Fitting a regression curve to the time series of CH4 and CO2 concentrations made the flux calculations. The flux rate of a gas is calculated using the following equation:

\[ F = \frac{\text{ppmv/min} \times (P/R \times MW) \times 1/T \times V_c/A_c \times C}{A_c \times C} \]

Where:
- \( F \) = flux (mg/m²/d)
- \( P \) = Chamber pressure (atm)
- \( R = 8.2054 \times 10^5 \) m³ atm/mol/K
- \( MW \) = Molecular weight of the analyte
- \( T \) = Chamber temperature (K)
- \( V_c \) = Chamber volume (m³)
- \( A_c \) = Chamber area (m²)
- \( C = (1000 \text{ mg/g} \times 1440 \text{ min/d}) \)

Gases:
- CH4 = 16 g/mol
- CO2 = 44 g/mol

At sites where oxidation of CH4 occurs, the flux starts at or near ambient CH4 concentrations and is depleted below ambient concentrations. If the correlation coefficients were not significantly high, the flux was determined to be below the detection limit and was regarded as a zero flux rate. If there was an efflux of CH4 was measured at any of these sites, those data were eliminated.

For sites where CH4 and CO2 were known to have a positive flux (from the soil into the atmosphere) the regressions of the time series were expected to have an \( r^2 \) of greater than 0.85.

If -888 is present in the data set, it indicates that a measurement was taken but discarded for some reason. If -999 is present, then no data were taken.

9.1.1 Derivation Techniques and Algorithms
Not applicable.

9.2 Data Processing Sequence
Not applicable.

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 by the formulas in Section 9.1. The spreadsheets then automatically calculate the flux using the formulas.
9.2.2 Processing Changes
None given.

9.3 Calculations
Not applicable.

9.3.1 Special Corrections/Adjustments
Not applicable.

9.3.2 Calculated Variables
Not applicable.

9.4 Graphs and Plots
None.

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.
- Placing the chamber down with much force can change the pressure inside the chamber to other than ambient and can affect the mechanisms and processes producing/taking up CH₄ and CO₂.

Errors such as these would have been written down in the lab/field books, and those data therefore would have been edited out. The analytical precision of the GCs is 0.2% for CH₄ and 1% for CO₂.

10.2 Quality Assessment

10.2.1 Data Validation by Source
None given.

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 CH₄ and 1% for CO₂.

10.2.4 Additional Quality Assessments
Not applicable.

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

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data
See notes under Section 6.

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. The soil profile data can be used in comparison with the flux data to determine controls on the fluxes for a certain biome.

13. Future Modifications and Plans
None.

14. Software

14.1 Software Description
HP ChemStation.

14.2 Software Access
HP ChemStation can be purchased from Hewlett Packard.

15. Data Access
The TGB-01 NSA CH₄ and CO₂ chamber 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: ornl_daac@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

17.2 Journal Articles and Study Reports


17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

AES - Atmospheric Environment Services
ASCII - American Standard Codes for Information
BOREAS - BOReal Ecosystem-Atmosphere Study
BORIS - BOREAS Information System
BP - Beaver Pond site, NSA
CD-ROM - Compact Disk-Read-Only Memory
CGR - Certified by Group
CMDL - Climate Monitoring and Diagnostics Laboratory
CPI - Certified by PI
CPI-??? - Certified but questionable
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
GMT - Greenwich Mean Time
GSFC - Goddard Space Flight Center
HP - Hewlett Packard
HTML - HyperText Markup Language
NAD83 - North American Datum of 1983
NASA - National Aeronautics and Space Administration
NOAA - National Oceanic and Atmospheric Administration
NSA - Northern Study Area
OBS - Old Black Spruce
OJP - Old Jack Pine
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
PRE - Preliminary
SSA - Southern Study Area
TCD - Thermal Conductivity Detector
TGB - Trace Gas Biogeochemistry
URL - Uniform Resource Locator
YJP - Young Jack Pine site, NSA
20. Document Information

20.1 Document Revision Dates
Written:
Last Updated: 08-Jun-1999

20.2 Document Review Dates
Science Review:

20.3 Document ID

20.4 Citation
When using these data, please contact the investigators listed in Section 2.3 and cite any relevant papers in Section 17.2.

If using data from the BOREAS CD-ROM series, also reference the data as:

Also, cite the BOREAS CD-ROM set as:

20.5 Document Curator

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

BOREAS TGB-1 NSA CH₄ and CO₂ Chamber Flux Data

Patrick Crill and Ruth K. Varner
Forrest G. Hall and Sara K. Conrad, Editors

Goddard Space Flight Center
Greenbelt, Maryland 20771

National Aeronautics and Space Administration
Washington, DC 20546-0001

The BOREAS TGB-1 team made methane (CH₄) and carbon dioxide (CO₂) dark chamber flux measurements at the NSA-OJP, NSA-OBS, NSA-BP, and NSA-YJP sites from 16-May-1994 through 13-Sep-1994. Gas samples were extracted approximately every 7 days from dark chambers and analyzed at the NSA lab facility. The data are provided in tabular ASCII files.