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

Forrest G. Hall and Sara Conrad, Editors

Volume 196

BOREAS TF-3 Automated Chamber CO$_2$ Flux Data from the NSA-OBS

Michael L. Goulden, University of California, Irvine
Patrick M. Crill, University of New Hampshire, Durham

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

October 2000
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Summary

The BOREAS TF-3 and TGB-1 teams collected automated CO₂ chamber flux data in their efforts to fully describe the CO₂ flux at the NSA-OBS site. This data set contains fluxes of CO₂ at the NSA-OBS site measured using automated chambers. In addition to reporting the CO₂ flux, it reports chamber air temperature, moss temperature, and light levels during each measurement. The data set covers the period from 23-Sep-1995 through 26-Oct-1995 and from 28-May-1996 through 21-Oct-1996. The data are stored 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 TF-03 Automated Chamber CO₂ Flux Data from the NSA-OBS

1.2 Data Set Introduction
This data set contains fluxes of carbon dioxide (CO₂) at the BOReal Ecosystem-Atmosphere Study (BOREAL) Northern Study Area (NSA) Old Black Spruce (OBS) site measured using automated chambers. In addition to reporting the CO₂ flux, it reports chamber air temperature, moss temperature, and light levels during each measurement. The data set covers the period from 23-Sep-1995 through 26-Oct-1995 and from 28-May-1996 through 21-Oct-1996. The data are stored in tabular American Standard Code for Information Interchange (ASCII) files.
1.3 Objective/Purpose
Black spruce forests with a continuous carpet of feather moss in shaded dry areas and sphagnum moss in open wet areas dominate much of the North American boreal zone. The exchange of CO₂ between these forests and the atmosphere is complex, with important contributions by five physiological processes: black spruce photosynthesis, black spruce respiration, moss photosynthesis, moss respiration, and heterotrophic respiration. Information on the rates of and controls on each of these processes is needed to improve understanding of the current and future carbon balance of boreal forests. An automated, multiplexing gas-exchange system was used to make continuous, unattended measurements of the net exchange of CO₂ at the moss surface at the NSA-OBS site.

1.4 Summary of Parameters
The primary focus is on the net fluxes of CO₂ measured. The data set also includes chamber air temperature, moss temperature, and light levels during each measurement.

1.5 Discussion
Measurements were made at the NSA-OBS site. The system operated continuously and was visited every 2 weeks. The site was heterogeneous with large changes in vegetation over small gradients in elevation. Upland areas were dominated by dense, 10-m-tall, 120-year-old black spruce, with a minor shrub layer and continuous feather moss. Lower areas were dominated by sparse, 1- to 6-m-tall spruce and continuous sphagnum moss. For 1994, chambers 1-3 were placed in an upland area of well-developed feather moss, while chambers 8-10 were placed in a lower area dominated by sphagnum moss. The other chambers were placed at intermediate or lichen-covered locations.

1.6 Related Data Sets
BOREAS TGB-01/TGB-03 CH4 Chamber Flux Data over the NSA Fen
BOREAS TGB-03 Plant Species Composition Data over the NSA Fen
BOREAS TGB-01/TGB-03 NEE Data over the NSA Fen
BOREAS TGB-03 CH4 and CO₂ Chamber Flux Data over NSA Upland Sites
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 NSA SF6 Chamber Flux Data

2. Investigator(s)
2.1 Investigator(s) Name and Title
Dr. Michael L. Goulden
University of California

Dr. Patrick M. Crill
Research Associate Professor
University of New Hampshire

2.2 Title of Investigation
Automated Measurements of CO₂ Exchange at the Moss Surface of a Black Spruce Forest
2.3 Contact Information

Contact 1:
Dr. Michael L. Goulden
Earth System Science
203 Physical Sciences Research Facility
University of California
Irvine, CA 92717-3100
(714) 824-1983 (office)
(714) 824-8794 (department)
(714) 824-3256 (fax)
mgoulden@uci.edu

Contact 2:
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)
patrick.crill@unh.edu

Contact 3:
Jeffrey A. Newcomer
Raytheon ITSS
Code 923
NASA GSFC
Greenbelt, MD 20771
(301) 286-7858
(301) 286-0239 (fax)
Jeffrey.Newcomer@gsfc.nasa.gov

3. Theory of Measurements

Net exchange of CO₂ above the moss surface reflects the sum of moss photosynthesis and moss, root, and heterotrophic respiration during daylight, and moss, root, and heterotrophic respiration at night. Long-term in situ measurements of CO₂ exchange over diel courses should allow partial separation of these processes and permit an analysis of the associated environmental controls. However, investigations of this type have been limited by the difficulty of obtaining reliable field measurements in remote, inclement regions.

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment
Data were collected under all environmental conditions.

4.1.2 Source/Platform
Ground.
4.1.3 **Source/Platform Mission Objectives**
Support investigators and chambers.

4.1.4 **Key Variables**
CO₂ flux.

4.1.5 **Principles of Operation**
Data were recorded and the system was managed with a datalogger. The raw CO₂ and H₂O signals were sampled every 2 seconds and averaged every minute. The other signals were sampled every 2 seconds and averaged every 9 minutes.

4.1.6 **Sensor/Instrument Measurement Geometry**
Not applicable.

4.1.7 **Manufacturer of Sensor/Instrument**
The chambers were 38- x 38.5- x 25-cm boxes built of clear lexan and aluminum angle.

Thermocouple
Omega Engineering
Stamford, CT

Datalogger
Campbell Scientific
Logan, UT

Infrared gas analyzer (IRGA)
IRGA, Model 6262
LI-COR, Inc
Lincoln, NE

4.2 **Calibration**

4.2.1 **Specifications**
None given.

4.2.1.1 **Tolerance**
None given.

4.2.2 **Frequency of Calibration**
Each chamber was calibrated at least once a day by standard addition. Every 21 hours, the system added 0.08 cm³/sec of 10% CO₂ to the return flow throughout a 3-hour circuit.

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

Measurements were made at the NSA-OBS site. The system operated continuously and was visited every 2 weeks. The site was heterogeneous with large changes in vegetation over small gradients in elevation. Upland areas were dominated by dense, 10-m-tall, 120-year-old black spruce, with a minor shrub layer and continuous feather moss. Lower areas were dominated by sparse, 1- to 6-m-tall spruce and continuous sphagnum moss. For 1994, chambers 1-3 were placed in an upland area of well-developed feather moss, while chambers 8-10 were placed in a lower area dominated by sphagnum moss. The other chambers were placed at intermediate or lichen-covered locations.

Measurements of CO2 exchange above moss surfaces are sensitive to errors that are not usually encountered when working above bare soil. Moss is extremely porous, creating uncertainty in chamber volume and also increasing the risk of mass flow. Transient changes in moss physiology and in the direction of CO2 movement may confound dark respiration measurements made by shading during daytime. Because the physiological activity of moss is sensitive to water content, chambers that remain in place for extended periods must not alter evaporation or precipitation. Finally, the CO2 exchange above moss is complex, and therefore many measurements may be required to separate the environmental controls on photosynthesis and respiration. As a result of these and other uncertainties, discrepancies among methods used to measure moss-surface exchange in BOREAS have been large, and it is unclear which, if any, chamber design provides accurate results.

The Tower Flux (TF)-03 team designed an automated gas-exchange system to circumvent most of these problems. The system sequentially sampled 10 clear, closed-type chambers, completing a circuit every 3 hours. Power consumption was less than 300 W at 115 VAC. The system was shipped and operated in three weather-tight boxes that sat on the forest floor within 15 m of the chambers.

The tubing and mixing volume were flushed and allowed to equilibrate during the first 8 minutes of each run. The selected chamber was then closed slowly, and the change in CO2 monitored for the next 10 minutes. Chamber closure had no discernible effect on the temperature within a chamber during the fall of 1995. Subsequent measurements in midsummer 1996 revealed some warming (1-2 °C), which occasionally resulted in condensation on the walls of chambers exposed to direct sun.

Air was drawn from the chamber throughout the run and passed through a CO2 and H2O IRGA operated in absolute mode. The flow through the IRGA was controlled at 80 cm³/second. The pressure of the sample flow was measured with a pressure transducer immediately after it had exited the IRGA and was assumed equal to the pressure in the sample cell.

Soil temperature at 5 cm beneath the moss surface and air temperature were measured in each chamber with type-T thermocouples. Horizontal photosynthetically active photon flux density (PPFD) was measured at each chamber with a gallium arsenide phosphide photodiode.

Data were recorded and the system managed with a datalogger. The raw CO2 and H2O signals were sampled every 2 seconds and averaged every minute. The other signals were sampled every 2 seconds and averaged every 9 minutes. The solenoids used for chamber selection, chamber closure, and calibration were controlled with a pair of 16-channel control modules. The set points for the mass flow controllers were provided by a four-channel analog output module. The signals from the thermocouples and light sensors were multiplexed with a thermally insulated 32-channel multiplexer. The data were transferred to a storage module every 3 hours and subsequently transferred to a computer every 2 weeks.

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
All measurements were made at the NSA-OBS site. The North American Datum of 1983 (NAD83) coordinates at the site are 55.8798° N, 98.4848° W.

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
These are point measurements made at the given locations.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
The CO₂ and H₂O signals were sampled every 2 seconds and averaged every minute.

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>TIME_OBS</td>
</tr>
<tr>
<td>CHAMBER_NUM</td>
</tr>
<tr>
<td>CO2_FLUX</td>
</tr>
<tr>
<td>CALIBRATION</td>
</tr>
<tr>
<td>MOSS_TEMP</td>
</tr>
<tr>
<td>AIR_TEMP</td>
</tr>
<tr>
<td>DOWN_PPFD_CHAMBER</td>
</tr>
<tr>
<td>REVISION_DATE</td>
</tr>
<tr>
<td>CRTFCN_CODE</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>
<tr>
<td>DATE_OBS</td>
<td>The date on which the data were collected.</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>The Greenwich Mean Time (GMT) when the data were collected.</td>
</tr>
<tr>
<td>CHAMBER_NUM</td>
<td>Identifier assigned to the chamber measured.</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>Carbon Dioxide flux.</td>
</tr>
<tr>
<td>CALIBRATION</td>
<td>Binary code to indicate whether the system is calibrating. If a 1 is present then the system is calibrating.</td>
</tr>
<tr>
<td>MOSS_TEMP</td>
<td>Temperature of the moss within the chamber.</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>The air temperature.</td>
</tr>
<tr>
<td>DOWN_PPFD_CHAMBER</td>
<td>The incoming photosynthetic photon flux density measured in the chamber.</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>The most recent date when the information in the referenced data base table record was revised.</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).</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>TIME_OBS</td>
<td>[HHMM GMT]</td>
</tr>
<tr>
<td>CHAMBER_NUM</td>
<td>[unitless]</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>[micromoles][meter^-2][second^-1]</td>
</tr>
<tr>
<td>CALIBRATION</td>
<td>[none]</td>
</tr>
<tr>
<td>MOSS_TEMP</td>
<td>[degrees Celsius]</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>[degrees Celsius]</td>
</tr>
<tr>
<td>DOWN_PPFD_CHAMBER</td>
<td>[micromoles][meters^-2][second^-1]</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>[none]</td>
</tr>
</tbody>
</table>
7.3.4 Data Source

The source 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 Staff]</td>
</tr>
<tr>
<td>SUB SITE</td>
<td>[Assigned by BORIS Staff]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[Investigator]</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>[Investigator]</td>
</tr>
<tr>
<td>CHAMBER_NUM</td>
<td>[Investigator]</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>[IRGA]</td>
</tr>
<tr>
<td>CALIBRATION</td>
<td>[Investigator]</td>
</tr>
<tr>
<td>MOSS_TEMP</td>
<td>[type-T thermocouples]</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>[type-T thermocouples]</td>
</tr>
<tr>
<td>DOWN_PPFD_CHAMBER</td>
<td>[Investigator]</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>[Assigned by BORIS Staff]</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>[Assigned by BORIS Staff]</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>Missng Data Value</th>
<th>Unrel Data Value</th>
<th>Below Detect Limit</th>
<th>Data Not Cllctd</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>NSA-OBS-FLXTR</td>
<td>NSA-OBS-FLXTR</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>9TF03-FLX10</td>
<td>9TF03-FLX9</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>23-SEP-95</td>
<td>21-OCT-96</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>14</td>
<td>2356</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CHAMBER_NUM</td>
<td>1</td>
<td>10</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CO2_FLUX</td>
<td>-26.18502</td>
<td>206.2905</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CALIBRATION</td>
<td>0</td>
<td>1</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>MOSS_TEMP</td>
<td>-11.10693</td>
<td>51.89928</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>-12.46</td>
<td>46.67</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DOWN_PPFD_CHAMBER</td>
<td>-.72</td>
<td>1853.657</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>09-OCT-98</td>
<td>09-OCT-98</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>CPI</td>
<td>CPI</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.
Missng 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 that 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 data record from a sample data file on the CD-ROM.

<table>
<thead>
<tr>
<th>SITE_NAME</th>
<th>SUB_SITE</th>
<th>DATE_OBS</th>
<th>TIME_OBS</th>
<th>CHAMBER_NUM</th>
<th>CO2_FLUX</th>
<th>CALIBRATION</th>
<th>MOSS_TEMP</th>
<th>AIR_TEMP</th>
<th>DOWN_PPFD_CHAMBER</th>
<th>REVISION_DATE</th>
<th>CRTFCN_CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>'NSA-OBS-FLXTR', '9TF03-FLX10', 23-SEP-95, 2356, 10, 5.16147, 1, 6.55583, 8.14, -.72, 09-OCT-98, 'CPI'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'NSA-OBS-FLXTR', '9TF03-FLX10', 24-SEP-95, 256, 10, 1.009062, 0, 6.74634, 7.98, -.72, 09-OCT-98, 'CPI'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

8. Data Organization

8.1 Data Granularity
The smallest unit of data tracked by the BOREAS Information System (BORIS) is the measurement(s) made for a given site during 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
None given.

9.2 Data Processing Sequence

9.2.1 Processing Steps
None given
9.2.2 Processing Changes
None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments
None given.

9.3.2 Calculated Variables
None given.

9.4 Graphs and Plots
None given.

10. Errors

10.1 Sources of Error
Measurements of CO₂ exchange above moss surfaces are sensitive to errors that are not usually encountered when working above bare soil. Moss is extremely porous, creating uncertainty in chamber volume and also increasing the risk of mass flow. Transient changes in moss physiology and in the direction of CO₂ movement may confound dark respiration measurements made by shading during daytime. Because the physiological activity of moss is sensitive to water content, chambers that remain in place for extended periods must not alter evaporation or precipitation. Finally, the CO₂ exchange above moss is complex, and therefore many measurements may be required to separate the environmental controls on photosynthesis and respiration. As a result of these and other uncertainties, discrepancies among methods used to measure moss-surface exchange in BOREAS have been large, and it is unclear which, if any, chamber design provides accurate results.

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
None given.

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
None given.

11.2 Known Problems with the Data
See Section 10.1.
11.3 Usage Guidance
   See Section 10.1.

11.4 Other Relevant Information
   None given.

12. Application of the Data Set
   None given.

13. Future Modifications and Plans
   None given.

14. Software

14.1 Software Description
   None given.

14.2 Software Access
   Not applicable.

15. Data Access

The NSA-OBS automated chamber CO₂ 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.
18. Glossary of Terms

None.

19. List of Acronyms

ASCII - American Standard Code for Information Interchange
BORAS - BOREAS Information System
BORAS - BOReal Ecosystem-Atmosphere Study
CD-ROM - Compact Disk-Read-Only Memory
DAAC - Distributed Active Archive Center
eos - Earth Observing System
EOSDIS - EOS Data and Information System
GIS - Geographic Information System
GMT - Greenwich Mean Time
GSFC - Goddard Space Flight Center
HTML - HyperText Markup Language
IRGA - Infrared Gas Analyzer
NAD83 - North American Datum of 1983
NASA - National Aeronautics and Space Administration
NSA - Northern Study Area
OBS - Old Black Spruce
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
PPFD - Photosynthetically Active Photon Flux Density
SSA - Southern Study Area
T - Tower Flux
TGB - Trace Gas Biochemistry
URL - Uniform Resource Locator

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### BOREAS TF-3 Automated Chamber CO₂ Flux Data from the NSA-OBS

### Authors
- Michael L. Goulden and Patrick M. Crill
- Forrest G. Hall and Sara Conrad, Editors

### Performing Organization Name(s) and Address(es)
- Goddard Space Flight Center
  - Greenbelt, Maryland 20771

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### Abstract
The BOREAS TF-3 and TGB-1 teams collected automated CO₂ chamber flux data in their efforts to fully describe the CO₂ flux at the NSA-OBS site. This data set contains fluxes of CO₂ at the NSA-OBS site measured using automated chambers. In addition to reporting the CO₂ flux, it reports chamber air temperature, moss temperature, and light levels during each measurement. The data set covers the period from 23-Sep-1995 through 26-Oct-1995 and from 28-May-1996 through 21-Oct-1996. The data are stored in tabular ASCII files.

### Subject Terms
- BOREAS, tower flux.