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

Forrest G. Hall and Shelaine Curd, Editors

Volume 139
BOREAS TE-5 Soil Respiration Data

J. Ehleriinger, J.R. Brooks, and L. Flanagan

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

October 2000

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BOREAS TE-5 Soil Respiration Data

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BOREAS TE-5 Soil Respiration Data

Jim Ehleringer, J.Renee Brooks, Larry Flanagan

Summary

The BOREAS TE-5 team collected measurements in the NSA and SSA on gas exchange, gas composition, and tree growth. Soil respiration data were collected from 26-May-94 to 07-Sep-94 in the BOREAS NSA and SSA to compare the soil respiration rates in different forest sites using a LI-COR 6200 soil respiration chamber (model 6299). The data are stored in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-05 Soil Respiration Data

1.2 Data Set Introduction

Soil respiration data were collected in the field in the BOReal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA) and Southern Study Area (SSA) using a LI-COR 6200 portable photosynthesis system and a LI-COR soil respiration chamber (model 6299).

1.3 Objective/Purpose

The data were collected to compare the soil respiration rates in different forest sites in the BOREAS NSA and SSA.

1.4 Summary of Parameters

- CO_2 flux (positive respiration)
- soil temperature
- chamber CO_2 concentration
- chamber air temperature
- chamber vapor pressure

1.5 Discussion

In the SSA, measurements were collected at the Old Jack Pine (OJP), Old Black Spruce (OBS), and Old Aspen (OA) sites. In the NSA, measurements were collected at the OJP, T6R5S TE Upland Black Spruce (UBS), and OA sites.

1.6 Related Data Sets

BOREAS TE-05 Leaf Gas Exchange Data
BOREAS TE-05 Leaf Carbon Isotope Data
BOREAS TE-05 Surface Meteorological and Radiation Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

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University of Utah
Department of Biology

L.B. Flanagan
Carleton University
Department of Biology

2.2 Title of Investigation

Vegetation-Atmosphere CO_2 and H_2O Exchange Processes: Stable Isotope Analyses

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3. Theory of Measurements

Measurements were made using a LI-COR soil respiration chamber (model 6299) attached to a LI-COR 6200 portable photosynthesis system, an instrument that uses a dynamic, closed chamber technique. Theoretical details of the measurements and instruments can be obtained from the manufacturer: LI-COR, Inc., P.O. Box 4425 Superior Street, Lincoln, NE 68504, USA. Toll-free telephone 1-800-447-3576 (USA and Canada), telephone (402) 467-2819.

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

The equipment operated under ambient environmental conditions during the measurement periods. Please see BOREAS TE-05 Surface Meteorological and Radiation Data for specifics.

4.1.2 Source/Platform

None given.

4.1.3 Source/Platform Mission Objectives

The data were collected to compare the soil respiration rates in different forest sites.

4.1.4 Key Variables

CO_2 Flux
Vapor Pressure
Soil Temperature
Air Temperature

4.1.5 Principles of Operation

Measurements were made using a LI-COR soil respiration chamber (model 6299) attached to a LI-COR 6200 portable photosynthesis system, an instrument that uses a dynamic, closed chamber technique.

4.1.6 Sensor/Instrument Measurement Geometry

None given.

4.1.7 Manufacturer of Sensor/Instrument

LI-COR, Inc.
P.O. Box 4425 Superior Street
Lincoln, NE 68504, USA
1 (800) 447-3576 (US & Canada)
(402) 467-2819

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

None given.

4.2.3 Other Calibration Information

The infrared gas analyzer of the LI-COR 6200 portable photosynthesis system was calibrated using primary standard gas mixtures from Matheson Gas. These gas mixtures were compared to BOREAS project calibration standards.

5. Data Acquisition Methods

None given.

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

Samples were collected at NSA OJP, SSA OJP, SSA OBS, and NSA UBS in 1993 and all the sites in 1994. The North American Datum of 1983 (NAD83) coordinates for the sites are:

- NSA OJP flux tower site: Lat/Long=55.927°N, 98.62°W, Universal Transverse Mercator (UTM) Zone 14, N:6,197,997 E:523,501.
- SSA OJP flux tower site: Lat/Long=53.916°N, 104.69°W, UTM Zone 13, N:5,951,000 E:479,400.
- NSA OA canopy access tower site (auxiliary site number T2Q6A, BOREAS Experiment Plan, Version 3), Lat/Long = 55.88°N, 98.67°W.

- SSA OA flux tower site: Lat/Long=53.629°N, 106.197°W, UTM Zone 13, N:5,942,688 E:420,874.
- NSA UBS canopy access tower site (auxiliary site number T6R5S, BOREAS Experiment Plan, Version 3), Lat/Long = 55.70°N, 98.51°W.
- SSA OBS flux tower site: Lat/Long = 53.985°N, 105.122°W, UTM Zone 13, N:5,981,904 E:492,000.

7.1.2 Spatial Coverage Map
Not available.

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

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
These data were collected over the period of 26-May-94 to 07-Sep-94.

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
Each site was visited multiple times during the 1994 growing season.

7.3 Data Characteristics

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

```
         Column Name
------------------------------
SITE_NAME
SUB_SITE
DATE_OBS
TIME
SOIL_TEMP_10CM
VAPOR_PRESS_CHAMBER
AIR_TEMP_CHAMBER
CO2_CONC_CHAMBER
CO2_FLUX_CHAMBER
CRTFCN_CODE
REVISION_DATE
```

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	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.
SUB_SITE	The identifier assigned to the sub-site by BOREA 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.
DATE_OBS	The date on which the data were collected.
TIME	The Greenwich Mean Time (GMT) when the data were collected.
SOIL_TEMP_10CM	Soil temperature at 10 cm depth.
VAPOR_PRESS_CHAMBER	Vapor pressure of the air in the chamber.
AIR_TEMP_CHAMBER	The temperature of the air in the chamber.
CO2_CONC_CHAMBER	The CO2 concentration in the chamber.
CO2_FLUX_CHAMBER	The chamber CO2 flux.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when 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:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME	[HHMMSS GMT]
SOIL_TEMP_10CM	[degrees Celsius]
VAPOR_PRESS_CHAMBER	[millibars]
AIR_TEMP_CHAMBER	[degrees Celsius]
CO2_CONC_CHAMBER	[parts per million]
CO2_FLUX_CHAMBER	[micromoles][meter^-2][second^-1]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

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

Column Name	Data Source
SITE_NAME	[BORIS Designation]
SUB_SITE	[BORIS Designation]
DATE_OBS	[Human Observer]
TIME	[Human Observer]
SOIL_TEMP_10CM	[Thermometer]
VAPOR_PRESS_CHAMBER	[Field Equipment]
AIR_TEMP_CHAMBER	[Thermometer]
CO2_CONC_CHAMBER	[Field Equipment]
CO2_FLUX_CHAMBER	[Field Equipment]
CRTFCN_CODE	[BORIS Designation]
REVISION_DATE	[BORIS Designation]

7.3.5 Data Range

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

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-9BS-9TETR	SSA-OJP-FLXTR	None	None	None	None
SUB_SITE	9TE05-SXC01	9TE05-SXC01	None	None	None	None
DATE_OBS	26-MAY-94	07-SEP-94	None	None	None	None
TIME	2142	225023	None	None	None	None
SOIL_TEMP_10CM	.08	15	None	None	None	None
VAPOR_PRESS_CHAMBER	4.882	21.61	None	None	None	None
AIR_TEMP_CHAMBER	12.98	31.34	None	None	None	None
CO2_CONC_CHAMBER	260.1	451.4	None	None	None	None
CO2_FLUX_CHAMBER	.522	9.854	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	16-MAR-98	16-MAR-98	None	None	None	None

```
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 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.

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME,SOIL_TEMP_10CM,VAPOR_PRESS_CHAMBER,
AIR_TEMP_CHAMBER,CO2_CONC_CHAMBER,CO2_FLUX_CHAMBER,CRTFCN_CODE,REVISION_DATE
'NSA-9BS-9TETR','9TE05-SXC01',03-JUN-94,171234,.33,11.0,13.98,260.1,3.068,'CPI',
16-MAR-98
'NSA-9BS-9TETR','9TE05-SXC01',03-JUN-94,171617,.24,10.58,13.84,367.0,2.797,'CPI',
16-MAR-98
```

8. Data Organization

8.1 Data Granularity

The smallest unit of orderable data is data collected on one day at one 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

None given.

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.

9.3.2 Calculated Variables
None.

9.4 Graphs and Plots
None.

10. Errors

10.1 Sources of error
All known errors have been removed from the data.

10.2 Quality Assessment
None given.

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
None given.

11.3 Usage Guidance
None given.

11.4 Other Relevant Information
None given.

12. Application of the Data Set

These data can be used to compare soil respiration rates in different forest sites in the NSA and SSA.

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 soil respiration 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

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.

17.2 Journal Articles

Brooks, J.R., L.B. Flanagan, G.T. Varney, and J.R. Ehleringer. 1997. Vertical gradients in photosynthetic gas exchange characteristics and refixation of respired CO_2 within boreal forest canopies. Tree Physiology 17: 1-12.

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

```
ASCII   - American Standard Code for Information Interchange
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
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
GSFC    - Goddard Space Flight Center
HSA     - Hemi-surface area
HTML    - HyperText Markup Language
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
OA      - Old Aspen
OBS     - Old Black Spruce
OJP     - Old Jack Pine
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
SSA     - Southern Study Area
TE      - Terrestrial Ecology
TLA     - Total Leaf Area
UBS     - Upland Black Spruce
URL     - Uniform Resource Locator
UTM     - Universal Transverse Mercator
```

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13. ABSTRACT *(Maximum 200 words)*

The BOREAS TE-5 team collected measurements in the NSA and SSA on gas exchange, gas composition, and tree growth. Soil respiration data were collected from 26-May-94 to 07-Sep-94 in the BOREAS NSA and SSA to compare the soil respiration rates in different forest sites using a LI-COR 6200 soil respiration chamber (model 6299). The data are stored in tabular ASCII files.

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BOREAS, terrestrial ecology, soil respiration.

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