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

Forrest G. Hall and Andrea Papagno, Editors

**Volume 129
BOREAS TE- 2 Wood
Respiration Data**

M.G. Ryan and M. Lavigne

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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BOREAS TE-2 Wood Respiration Data

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BOREAS TE-2 Wood Respiration Data

Michael G. Ryan, Michael Lavigne

Summary

The BOREAS TE-2 team collected several data sets in support of its efforts to characterize and interpret information on the respiration of the foliage, roots, and wood of boreal vegetation. This data set contains measurements of wood respiration conducted in the NSA during the growing season of 1994. The data are stored in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-02 Wood Respiration Data

1.2 Data Set Introduction

Field studies of wood respiration were conducted on tree stems at the BOREal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA) in 1994. This data set includes the measurements of wood respiration measured from May 1994 to late September 1994 at the Old Black Spruce (OBS), Old Jack Pine (OJP), Young Jack Pine (YJP), and Old Aspen (OA) study sites in the NSA. Characteristics of the stem (growth, sapwood volume, etc.) for samples measured for wood respiration on tree stems were sampled after the end of the 1994 growth season at the end of September 1994 and given in another file. TIME_OBS times of -999 in the data were times not reported by the Terrestrial Ecology (TE)-02 team.

1.3 Objectives/Purpose

The objectives of the work were to: Determine whether respiratory parameters vary among three boreal tree species (black spruce, jack pine, and trembling aspen). Compare respiration parameters from the cold northern sites with those from the warmer, southern sites. Provide estimates of respiratory parameters for ecosystem process models. Use our estimates of wood respiration, estimates of wood biomass, and wood temperature throughout the year to estimate the annual carbon cost for wood respiration.

1.4 Summary of Parameters

Each data record includes the air temperature, sapwood temperature, concentration of CO₂ in chamber during measurement, area of chamber, area of the segment, respiration for the chamber at the sapwood temperature, respiration for the chamber at 15 °C, and respiration for the segment at 15 °C.

1.5 Discussion

In the NSA, we measured wood respiration rates for OA (*Populus tremuloides*), OBS (*Picea mariana*), and OJP (*Pinus banksiana*) in 1994 during June, July, and August, corresponding with the BOREAS Intensive Field Campaigns (IFCs), and in September, after IFC-3.

1.6 Related Data Sets

BOREAS TE-02 Foliage Respiration Data
BOREAS TE-02 Root Respiration Data
BOREAS TE-02 Stem Growth Sapwood Data
BOREAS TE-02 Continuous Wood Respiration Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Michael G. Ryan
Dr. Michael Lavigne

2.2 Title of Investigation

Autotrophic Respiration in Boreal Ecosystems

2.3 Contact Information

Contact 1:

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Fredericton, New Brunswick E3B 5P7
Canada

Contact 3:

Andrea Papagno
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NASA GSFC
Code 923
Greenbelt, MD 20771
(301) 286-3134
(301) 286-0239 (fax)
Andrea.Papagno@gsfc.nasa.gov

3. Theory of Measurements

Respiration requires oxygen and oxidizes sugars, producing energy, water, and CO₂. In most plant cells, the ratio between the oxygen absorbed and CO₂ produced in respiration is close to one. Therefore, because small changes in CO₂ concentration in the air are easier to measure than small changes in the oxygen content of the air, respiration is typically measured as CO₂ evolution from plant tissues. CO₂ evolution is typically measured with an infrared gas analyzer (IRGA), operating in one of three modes: open, closed, or differential. The system that we used to measure stem wood respiration was an open system, which estimates molar flux of CO₂ from plant tissue respiration as the difference between the CO₂ concentration entering and exiting the chamber times the molar flow rate of air through the chamber (Field et al., 1991). Respiration of woody tissues is estimated as the CO₂ efflux at the boundary of the bark-air interface. Respiration rates are typically expressed as moles CO₂ per m² bark area per second. Respiration of woody tissues will vary with temperature and sapwood volume, and perhaps with sapwood nitrogen, phosphorus, or carbohydrate content. Sampling for nitrogen, phosphorus, or carbohydrate content or determining sapwood cross-sectional area of a stem involves destructive measurements. Therefore, samples are generally taken after the respiration measurements have been completed. These characteristics are stored in TE-02 Stem Growth Sapwood.

4. Equipment

4.1 Instrument Description

4.1.1 Collection Environment

Respiration measurements were made in the field. All other measurements took place under laboratory conditions.

4.1.2 Source/Platform

The measured trees and ground supported the needed equipment.

4.1.3 Source/Platform Mission Objectives

Not applicable.

4.1.4 Key Variables

Air temperature, sapwood temperature, CO₂ in chamber during measurement, area of chamber, area of segment, respiration for chamber at sap temperature, respiration for chamber at 15 °C, and respiration for segment at 15 °C. To further explain these two terms, area of chamber is the surface area (m²) of bark physically covered by the chamber. Area of segment is the surface area (m²) of a cylinder of stem with height equal to chamber height centered on the chamber.

4.1.5 Principles of Operation

The system that we used to measure stem wood respiration was an open system, which estimates molar flux of CO₂ from plant tissue respiration as the difference between the CO₂ concentration entering and exiting the chamber times the molar flow rate of air through the chamber (Field et al., 1991).

4.1.6 Sensor/Instrument Measurement Geometry

None.

4.1.7 Manufacturer of Instrument

CR-21X Datalogger
Campbell Scientific, Inc.
815 West 1800 North
Logan, UT 84321-1784
(435) 753-2342
(435) 750-9540 (fax)
support@campbellsci.com

IRGA
LCA3 or LCA4
Analytical Development Company (ADC)
Hoddeston, Herts., UK
Distributed by:
Dynamax, Inc.
10808 Fallstone
Suite 350
Houston, TX 77099 USA
(281) 564-5100

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

We calibrated the IRGA to a concentration standard supplied by BOREAS prior to a measurement period and every 48 hours during measurements. Typically, the analyzer drifted less than 1% between calibrations.

4.2.3 Other Calibration Information

We calibrated the molar flow of ideal gas roughly every month with a bubble column. We used standard meteorological pressure (reported at Thompson), corrected for elevation, and temperature from a copper-constantan thermocouple to calculate molar flow from the volume flow for this calculation.

5. Data Acquisition Methods

Stem respiration was measured on 20 trees in the NSA at the OJP, OBS, and OA sites, and 10 trees at YJP; tree diameters spanned the range of the stand. At the OJP, OBS, and OA sites, aluminum chamber plates with an external neoprene gasket were attached to the north side of the tree with putty; loose bark was removed before attaching the chamber plate. Chambers were at 1.2 to 1.4 m height; on four trees per stand, additional chambers were placed at 6 m. For CO₂ efflux measurements, a Plexiglas chamber was sealed to the chamber plate with an elastic cord. Chamber area for OA, OBS, and OJP was 110 cm². That is counting 1/2 of the plate area (assuming 1/2 of the flux under the plate goes into the chamber and 1/2 does not). The area inside the chamber is 80.5 cm². For measurements at YJP, split Plexiglas chambers (23 cm) enclosed the entire stem, with neoprene gaskets creating a seal. A small fan mixed the air in each chamber, and chambers were removed between measurements. Temperatures were measured only on trees 1 to 4 at OA, OJP, and OBS and on all trees at YJP. At OA, OJP, and OBS, we averaged the temperatures from the position 1 chambers from trees 1-4 for chambers on trees 4-20. Coefficient of variation (CV) for sapwood temperatures on trees 1-4 were 1-5%. Measurements were taken in late afternoon, when temperature had been relatively stable for a few hours, to help overcome the problem of flux lagging sapwood temperature.

Two types of measurements were made in 1994. (1) Each IFC at the OJP, OBS, and OA sites, CO₂ efflux was measured once per hour for 3-6 days on eight chambers (four trees at 1.3 and 6 m) to determine temperature response; at YJP, continuous measurements were made for six trees only during the midsummer IFC. These data are in file: wood_respiration_continuous_nsa.csv. (2) Point measurements of CO₂ flux were made every 2-3 weeks at all sites for all chambers (this file). The continuous measurements were made using a manifold and an open system (Field et al., 1991), controlled with a CR-21X datalogger (Campbell Scientific, Logan, UT, USA). The manifold system had two separate gas circuits: when CO₂ efflux was being measured, inlet air was drawn through a 20-L mixing chamber (to provide a stable reference CO₂ concentration), passed through the chamber at 270 µmol/s, and returned to the CO₂ analyzer (ADC LCA2, ADC, Hoddeston, UK). Otherwise, inlet air was pushed through the chambers at 3.5 mmol/s, to keep CO₂ concentration in the chamber at < 5 µmol/mol above ambient. The point measurements were made with an open system (Field et al., 1991) and an ADC LCA3 or LCA4 gas analyzer with an air flow of 270 µmol/s. Methods are similar to those described in Ryan et al. (1995) and are more fully described in Lavigne and Ryan (1997).

6. Observations

6.1 Data Notes

TIME_OBS times of -999 in the data indicate that times were not provided by TE-02.

6.2 Field Notes

None.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The measurement sites and associated North American Datum of 1983 (NAD83) coordinates are:

- NSA-OA canopy access, operational grid site id T2Q6A, Lat/Long: 55.88691°N, 98.67479°W, Universal Transverse Mercator (UTM) Zone 14, N: 6,193,540.7, E: 520,342
- NSA-OBS canopy access tower, operational grid site id T3R8T, Lat/Long: 55.88007°N, 98.48139°W, UTM Zone 14, N: 6,192,853.4, E: 532,444.5

- NSA-OJP, operational grid site id T7Q8T, Lat/Long: 55.92842°N, 98.62396°W, UTM Zone 14, N: 6,198,176.3, E: 523,496.2

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

These data are point source measurements 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

Measurements were made during June, July, August, and September of 1994.

7.2.2 Temporal Coverage Map

None given.

7.2.3 Temporal Resolution

Measurements were made every 10-20 days. Each sample represents flux for that particular chamber for 5-10 minutes. TIME_OBS times of -999 in the data indicate that times were not provided by TE-02.

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_OBS
SPECIES
SAMPLE_ID
CHAMBER_HEIGHT
AIR_TEMP
SAP_TEMP
CO2_CONC_CHAMBER
STEM_AREA_CHAMBER
TOTAL_STEM_AREA
STEM_RESP_CHAMBER_SAP_TEMP
STEM_RESP_CHAMBER_15C
STEM_SEGMENT_RESP_CHAMBER_15C
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 BOREAS, in the format GGGGG-III III, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and III III is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
SPECIES	Botanical (Latin) name of the species (Genus species).
SAMPLE_ID	The sample identifier used by data collectors (see documentation for a detailed description).
CHAMBER_HEIGHT	The height above the ground at which the chamber was placed.
AIR_TEMP	The air temperature.
SAP_TEMP	The sapwood temperature.
CO2_CONC_CHAMBER	The CO2 concentration of the air in the chamber.
STEM_AREA_CHAMBER	The surface area of bark physically covered by the chamber.
TOTAL_STEM_AREA	The total surface area of a cylinder with height equal to the length of the chamber and circumference proportional to the radius of the measured stem.
STEM_RESP_CHAMBER_SAP_TEMP	The CO2 respiration of the stem covered by the chamber at the sapwood temperature.
STEM_RESP_CHAMBER_15C	The CO2 respiration of the stem covered by the chamber at 15 degrees Celsius.
STEM_SEGMENT_RESP_CHAMBER_15C	The CO2 respiration of the stem segment at 15 degrees Celsius.
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_OBS	[HHMM GMT]
SPECIES	[none]
SAMPLE_ID	[none]
CHAMBER_HEIGHT	[meters]
AIR_TEMP	[degrees Celsius]
SAP_TEMP	[degrees Celsius]
CO2_CONC_CHAMBER	[parts per million]
STEM_AREA_CHAMBER	[meters^2]
TOTAL_STEM_AREA	[meters^2]
STEM_RESP_CHAMBER_SAP_TEMP	[nanomoles CO2][second^-1]
STEM_RESP_CHAMBER_15C	[nanomoles CO2][second^-1]
STEM_SEGMENT_RESP_CHAMBER_15C	[nanomoles CO2][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_OBS	[Human Observer]
SPECIES	[Human Observer]
SAMPLE_ID	[Human Observer]
CHAMBER_HEIGHT	[Human Observer]
AIR_TEMP	[Thermometer]
SAP_TEMP	[Thermometer]
CO2_CONC_CHAMBER	[Laboratory Equipment]
STEM_AREA_CHAMBER	[Laboratory Equipment]
TOTAL_STEM_AREA	[Laboratory Equipment]
STEM_RESP_CHAMBER_SAP_TEMP	[Laboratory Equipment]
STEM_RESP_CHAMBER_15C	[Laboratory Equipment]
STEM_SEGMENT_RESP_CHAMBER_15C	[Laboratory 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 Clctd
SITE_NAME	NSA-90A-9TETR	NSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TE02-WDR01	9TE02-WDR01	None	None	None	None
DATE_OBS	01-JUN-94	25-SEP-94	None	None	None	None
TIME_OBS	0	2357	-999	None	None	None
SPECIES	N/A	N/A	None	None	None	None
SAMPLE_ID	N/A	N/A	None	None	None	None
CHAMBER_HEIGHT	1.3	6	None	None	None	None
AIR_TEMP	8	26.5	-999	None	None	None
SAP_TEMP	7.6	30.3	-999	None	None	None
CO2_CONC_CHAMBER	348	733	-999	None	None	None
STEM_AREA_CHAMBER	.011	.048	None	None	None	None
TOTAL_STEM_AREA	.0203	.0976	None	None	None	None
STEM_RESP_CHAMBER_	0	145.65	-999	None	None	None
SAP_TEMP						
STEM_RESP_CHAMBER_	0	72.84	-999	None	None	None
15C						
STEM_SEGMENT_RESP_	0	178.24	-999	None	None	None
CHAMBER_15C						
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	26-OCT-98	26-OCT-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 Clctd -- 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_OBS,SPECIES,SAMPLE_ID,CHAMBER_HEIGHT,AIR_TEMP,  
SAP_TEMP,CO2_CONC_CHAMBER,STEM_AREA_CHAMBER,TOTAL_STEM_AREA,  
STEM_RESP_CHAMBER_SAP_TEMP,STEM_RESP_CHAMBER_15C,STEM_SEGMENT_RESP_CHAMBER_15C,  
CRTFCN_CODE,REVISION_DATE  
'NSA-90A-9TETR','9TE02-WDR01',15-JUN-94,-999,'Populus tremuloides','20',1.3,  
-999.0,8.8,382.0,.011,.0882,4.24,6.54,52.46,'CPI',26-OCT-98  
'NSA-90A-9TETR','9TE02-WDR01',15-JUN-94,2103,'Populus tremuloides','3',1.3,8.3,  
7.6,447.0,.011,.0768,5.96,10.01,69.87,'CPI',26-OCT-98
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data collected at a given site on a given date.

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.

9.1.1 Derivation Techniques and Algorithms

None.

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

Not applicable.

9.3.2 Calculated Variables

Not applicable.

9.4 Graphs and Plots

Not applicable.

10. Errors

10.1 Sources of Error

Sample trees were selected to represent the range of variability in respiration rates, as well as provide an estimate of mean per stem area respiration rates. Because the IRGAs could typically resolve a difference in concentration of CO₂ of one $\mu\text{mol/mol}$, lower respiration rates have more uncertainty in the measurement.

10.2 Quality Assessment

Flux rates of CO₂ are likely estimated for the sample within +/- 5 percent.

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

Flux rates of CO₂ are likely estimated for the sample within +/- 5 percent.

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

TIME_OBS times of -999 in the data indicate that times were not provided by TE-02.

12. Application of the Data Set

These data can be used to study wood respiration rates of boreal vegetation.

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 wood 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 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.

17.2 Journal Articles and Study Reports

Field, C.B., J.T. Ball, and J.A. Berry. 1991. Photosynthesis: principles and field techniques. In *Plant Physiological Ecology*, edited by R.W. Pearcy, J. Ehleringer, H.A. Mooney, and P.W. Rundel, Chapman and Hall, London, pp. 206-253.

Lavigne, M.B. and M.G. Ryan. 1997. Growth and maintenance respiration rates of aspen, black spruce and jack pine stems at northern and southern BOREAS sites. *Tree Physiol.*, BOREAS Special Issue, 17: 543-551.

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.

Ryan, M.G., S.T. Gower, R.M. Hubbard, R.H. Waring, H.L. Gholz, W.P. Cropper, and S.W. Running. 1995. Woody tissue maintenance respiration of four conifers in contrasting climates. *Oecologia* 101: 133-140.

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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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

ADC	- Analytical Development Company
ASCII	- American Standard Code for Information Interchange
BOREAS	- BOREal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
CD-ROM	- Compact Disk-Read-Only Memory
CO ₂	- Carbon Dioxide
CV	- Coefficient of variation
DAAC	- Distributed Active Archive Center
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
GIS	- Geographic Information System
GSFC	- Goddard Space Flight Center
HTML	- Hypertext Markup Language
IFC	- Intensive Field Campaign
IRGA	- Infrared Gas Analyzer
MIX	- Mixed
NAD83	- North American Datum of 1983
NIR	- Near Infrared Radiation
NOAA	- National Oceanic and Atmospheric 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
PAR	- Photosynthetically Active Radiation
PPFD	- Photosynthetic Photon Flux Density
SSA	- Southern Study Area
TE	- Terrestrial Ecology
TF	- Tower Flux site
URL	- Uniform Resource Locator
UTM	- Universal Transverse Mercator
YA	- Young Aspen
YJP	- Young Jack Pine

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