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BOREAS TE-4 Branch Bag Data from Boreal Tree Species

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BOREAS TE-4 Branch Bag Data from Boreal Tree Species

Joseph A. Berry, John Gamon, Wei Fu, Art Fredeen

Summary

The BOREAS TE-4 team collected continuous records of gas exchange under ambient conditions from intact boreal forest trees in the BOREAS NSA from 23-Jul-1996 until 14-Aug-1996. These measurements can be used to test models of photosynthesis, stomatal conductance, and leaf respiration, such as SiB2 (Sellers et al., 1996) or the leaf model (Collatz et al., 1991), and programs can be obtained from the investigators. The data are stored in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-04 Branch Bag Data from Boreal Tree Species

1.2 Data Set Introduction

These data are summaries of steady-state gas exchange measurements conducted under field conditions from 23-Jul-1996 until 14-Aug-1996 in the BOREal Ecosystem-Atmosphere Study (BOREAS).

1.3 Objective/Purpose

These studies were conducted to provide a basis for calibrating models of stomatal conductance, photosynthesis, and respiration used in simulating boreal ecosystem-atmosphere interactions.

1.4 Summary of Parameters

The parameters provided in each data set are intended to provide a sufficient description of the micro-environment of the leaf to permit the observations to be used for model validation. A complete list of the parameters is given in Section 4.1.1. The key measurements are the rates of net CO₂ exchange, the rate of evaporation of water from the leaf, the stomatal conductance to water vapor, and the intercellular CO₂ concentration.

1.5 Discussion

The branch bag (described in Section 4.1) was installed at the top of the canopy with an attached tree crown inside. The bag was connected to an MPH-1000 steady-state gas exchange system. A heat exchanger was used to eliminate the difference between bag air temperature and ambient temperature; thus, the conditions inside the bag were very close to those outside. The measurements were made in a short interval (about 5 min) and could be used to check the photosynthesis model and the stomatal model. Parameters from fitting leaf model to leaf gas exchange data have been used to simulate these data. The simulation is still ongoing. Tree species measured were black spruce (*Picea mariana*) at the Old Black Spruce (OBS) site in the Northern Study Area (NSA) and jack pine (*Pinus banksiana*) at the Old Jack Pine (OJP) site and the Young Jack Pine (YJP) site in the NSA.

1.6 Related Data Sets

BOREAS TE-02 Foliage Respiration Data

BOREAS TE-04 Gas Exchange Data from Boreal Tree Species

BOREAS TE-05 Leaf Gas Exchange Data

BOREAS TE-05 Surface Meteorological and Radiation Data

BOREAS TE-09 In Situ Diurnal Gas Exchange of NSA Boreal Forest Stands

BOREAS TF-03 NSA-OBS Tower Flux, Meteorological, and Soil Temperature Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Joseph A. Berry

Dr. John Gamon

Dr. Wei Fu

Dr. Art Fredee

2.2 Title of Investigation

Measurement and Prediction of CO₂ and H₂O Exchange from Boreal Forest Tree Species

2.3 Contact Information

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3. Theory of Measurements

The measurements reported here were made by generally accepted procedures for laboratory gas exchange. Branches were enclosed in a branch bag that was set up to trace ambient environmental conditions. Net exchange of CO₂ and H₂O was determined by infrared gas analysis of the air flowing through the stirred cuvette.

4. Equipment

4.1 Sensor/Instrument

- Branch Bag (cylindrical openflow transparent bag, diameter 0.8 m, length 1 m)
- Gas Exchange System (Model MPH-1000; Campbell Scientific, Logan UT)
- Infrared Gas Analyzer (IRGA) (Model 6262; LICOR Inc., Lincoln, NB)
- Dew Point Mirror (Model Dew-10; General Eastern, Woburn, MA)

4.1.1 Collection Environment

All experiments were conducted with intact attached crowns of trees (top 0.9 m) in the NSA of BOREAS. For specific weather conditions on experiment days, see meteorological data files.

4.1.2 Source/Platform

Branch bags were suspended from the canopy access towers. Other equipment was on the same towers.

4.1.3 Source/Platform Mission Objectives

The experiments were conducted to validate models of photosynthesis, stomatal regulation, and respiration at an intermediate level.

4.1.4 Key Variables

P0 atmospheric pressure (Pa)
rbw boundary layer resistance (m² s/mol)
ea ambient water vapor pressure (Pa)
Ca ambient CO₂ concentration (μmol/mol)
Ta ambient temperature (°C)
PFD flux density of PAR (μmol/m² s)
SW short wave radiation (W/m²)
LW long wave radiation (W/m²)
Tl leaf temperature (°C)
Cs CO₂ concentration at leaf surface (μmol/mol)
Hs relative humidity at leaf surface (%)
Ci CO₂ concentration in intercellular air spaces (μmol/mol)
Pn net photosynthetic rate (μmol/m² s)

Gsw stomatal conductance ($\text{mol/m}^2 \text{ s}$)
E transpiration rate ($\text{mmol/m}^2 \text{ s}$)

4.1.5 Principles of Operation

Temperature, CO_2 concentration, and H_2O vapor pressure were determined with appropriate sensors. Net CO_2 and H_2O exchange was determined by mass balance analysis of the air flowing through the cuvette. Gas exchange parameters, C_i , and Gsw were calculated. The hemisurface leaf area used in these measurements was 1.0 to 3.9 m^2 on a given tree. The projected area of the crown was estimated by analysis photographs.

4.1.6 Sensor Instrument Measurement Geometry

Leaves/needles were enclosed in a cuvette. All measurements are expressed on a leaf area basis; for the conifers, this is reported as the hemisurface area of the needles (half of the total surface area) as determined by fresh weight calibrated to volume displacement (J. Norman, personal communication).

4.1.7 Manufacturer of Sensor/Instrument

- Gas exchange system (Model MPH-1000; Campbell Scientific, Logan, UT)
- IRGA (Model 6262; LICOR Inc., Lincoln, NE)
- Dew Point Mirror (Model Dew-10; General Eastern, Woburn, MA)

4.2 Calibration

CO_2 concentration was referenced to standard CO_2 tanks provided by BOREAS, H_2O vapor was referenced to a dew point mirror instrument, air flow was calibrated by volume displacement, and photosynthetically active radiation (PAR) flux was referenced to a LI-COR quantum probe.

4.2.1 Specifications

There are no published specifications for the complete system of instruments used in this study.

4.2.1.1 Tolerance

All calibrations are better than $\pm 1\%$.

4.2.2 Frequency of Calibration

Calibration and instrument zeros were checked daily. Checks against the BOREAS gas standards were made every week or two.

4.2.3 Other Calibration Information

No significant adjustments or drift of calibration occurred over the interval of these measurements.

5. Data Acquisition Methods

In each branch bag experiment, only flow rate was controlled. A plastic bag buffered air flow and gave stable CO_2 supply. A heat exchanger was used to eliminate the temperature differences between bag air and ambient air. Conditions in the branch bag tracked those of the ambient. The hemisurface leaf area used in these measurements was 1.0 to 3.9 m^2 on a given tree. The projected area of the crown was estimated by analysis photographs.

6. Observations

6.1 Data Notes

These experiments were conducted from 23-Jul-1996 until 14-Aug-1996, spending a few consecutive days at each site. The studies were conducted with the top 0.8-0.9 m of a single crown at each site. We believe that these measurements are representative of the trees at the site, but it was not possible to obtain a statistically representative sample. Measurements conducted with a LI-COR 6400 photosynthesis system on needles from an adjacent tree can be used to determine the photosynthetic capacities at these sites.

6.2 Field Notes

None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

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

- NSA-OBS, site id T3R8T, Lat/Long: 55.88007°N, 98.48139°W, Universal Transverse Mercator (UTM) Zone 14, N: 6,192,853.4, E: 532,444.5.
- NSA-OJP, site id T7Q8T, Lat/Long: 55.92842°N, 98.62396°W, UTM Zone 14, N: 6,198,176.3, E: 523,496.2.
- NSA-YJP, site id T8S9T, Lat/Long: 55.89575°N, 98.28706°W, UTM Zone 14, N: 6,194,706.9, E: 544,583.9.

7.1.3 Spatial Resolution

These data are point measurements taken from trees near the given locations.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

These measurements were coupled with the ambient environment. There is direct correspondence between the temperature, light intensity, or other environmental conditions in the branch bag during these experiments and the ambient environmental conditions at the site of the measurements. However, air temperature in the bag could be 2-4 °C above ambient during midday. Data presented here were collected under the conditions in the bag.

7.2.1 Temporal Coverage

Data were collected from 23-Jul-1996 until 14-Aug-1996.

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

Data were collected every 5 minutes over each site for several consecutive days.

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
ATMOSPHERIC_PRESS
BOUND_LAYER_RESIST
AMB_WATER_VAPOR_PRESS
AMB_CO2_CONC
AMB_AIR_TEMP
DOWN_PPFD
DOWN_SHORTWAVE_RAD
DOWN_LONGWAVE_RAD
LEAF_TEMP
CO2_CONC_LEAF_SURF
REL_HUM_LEAF_SURF
INTERCELL_CO2_CONC
PHOTOSYNTHETIC_RATE
STOMATAL_MOLAR_CONDUCT_CO2
TRANSPIRATION_RATE
SPECIES
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-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_OBS	The Greenwich Mean Time (GMT) when the data were collected.
ATMOSPHERIC_PRESS	The atmospheric pressure.
BOUND_LAYER_RESIST	Boundary layer resistance
AMB_WATER_VAPOR_PRESS	Ambient water vapor pressure

AMB_CO2_CONC	Ambient CO2 concentration.
AMB_AIR_TEMP	Ambient air temperature.
DOWN_PPFD	The downward photosynthetic photon flux density.
DOWN_SHORTWAVE_RAD	The total downward shortwave (solar) radiation.
DOWN_LONGWAVE_RAD	The total downward longwave radiation.
LEAF_TEMP	The leaf or shoot temperature
CO2_CONC_LEAF_SURF	CO2 concentration at leaf surface.
REL_HUM_LEAF_SURF	Relative humidity at leaf surface.
INTERCELL_CO2_CONC	Intercellular CO2 concentration
PHOTOSYNTHETIC_RATE	Measured Net Photosynthesis
STOMATAL_MOLAR_CONDUCT_CO2	Stomatal conductance of CO2
TRANSPIRATION_RATE	Transpiration rate
SPECIES	Botanical (Latin) name of the species (Genus species).
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]
ATMOSPHERIC_PRESS	[kiloPascals]
BOUND_LAYER_RESIST	[meters ²][second][mole ⁻¹]
AMB_WATER_VAPOR_PRESS	[Pascals]
AMB_CO2_CONC	[micromoles CO2][mole ⁻¹]
AMB_AIR_TEMP	[degrees Celsius]
DOWN_PPFD	[micromoles][meter ⁻²][second ⁻¹]
DOWN_SHORTWAVE_RAD	[Watts][meter ⁻²]
DOWN_LONGWAVE_RAD	[Watts][meter ⁻²]
LEAF_TEMP	[degrees Celsius]
CO2_CONC_LEAF_SURF	[micromoles CO2][mole ⁻¹]
REL_HUM_LEAF_SURF	[percent]
INTERCELL_CO2_CONC	[parts per million]
PHOTOSYNTHETIC_RATE	[micromoles CO2][meter ⁻²][second ⁻¹]
STOMATAL_MOLAR_CONDUCT_CO2	[millimoles CO2][meter ⁻²][second ⁻¹]
TRANSPIRATION_RATE	[millimoles H2O][meter ⁻²][second ⁻¹]
SPECIES	[none]
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]
ATMOSPHERIC_PRESS	[Laboratory Equipment]
BOUND_LAYER_RESIST	[Laboratory Equipment]
AMB_WATER_VAPOR_PRESS	[Laboratory Equipment]
AMB_CO2_CONC	[Laboratory Equipment]
AMB_AIR_TEMP	[Thermometer]
DOWN_PPFD	[Laboratory Equipment]
DOWN_SHORTWAVE_RAD	[Laboratory Equipment]
DOWN_LONGWAVE_RAD	[Laboratory Equipment]
LEAF_TEMP	[Thermometer]
CO2_CONC_LEAF_SURF	[Laboratory Equipment]
REL_HUM_LEAF_SURF	[Laboratory Equipment]
INTERCELL_CO2_CONC	[Laboratory Equipment]
PHOTOSYNTHETIC_RATE	[Laboratory Equipment]
STOMATAL_MOLAR_CONDUCT_CO2	[Laboratory Equipment]
TRANSPIRATION_RATE	[Laboratory Equipment]
SPECIES	[Human Observer]
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-OBS-FLXTR	NSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TE04-BAG01	9TE04-BAG01	None	None	None	None
DATE_OBS	23-JUL-96	14-AUG-96	None	None	None	None
TIME_OBS	0	2357	None	None	None	None
ATMOSPHERIC_PRESS	97.79	101.3	None	None	None	None
BOUND_LAYER_RESIST	.29	.29	None	None	None	None
AMB_WATER_VAPOR_ PRESS	624.87	4371.21	None	None	None	None
AMB_CO2_CONC	0	501.5	-999	None	None	None
AMB_AIR_TEMP	-53.6	37.56	None	None	None	None
DOWN_PPFD	0	1973.4	None	None	None	None
DOWN_SHORTWAVE_RAD	0	841.17	None	None	None	None
DOWN_LONGWAVE_RAD	131.75	528.55	None	None	None	None
LEAF_TEMP	3.59	36.1	None	None	None	None
CO2_CONC_LEAF_SURF	-14.3	506.7	-999	None	None	None
REL_HUM_LEAF_SURF	0	99.92	-999	None	None	None
INTERCELL_CO2_CONC	-87879	99999	-999	None	None	None
PHOTOSYNTHETIC_RATE	-2.771	14.012	-999	None	None	None
STOMATAL_MOLAR_	12.6	6560.9	-999	None	None	None

CONDUCT_CO2						
TRANSPIRATION_RATE	-.0033	4.67	-999	None	None	None
SPECIES	N/A	N/A	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	03-FEB-99	03-FEB-99	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,ATMOSPHERIC_PRESS,BOUND_LAYER_RESIST,
AMB_WATER_VAPOR_PRESS,AMB_CO2_CONC,AMB_AIR_TEMP,DOWN_PPF,DOWN_SHORTWAVE_RAD,
DOWN_LONGWAVE_RAD,LEAF_TEMP,CO2_CONC_LEAF_SURF,REL_HUM_LEAF_SURF,
INTERCELL_CO2_CONC,PHOTOSYNTHETIC_RATE,STOMATAL_MOLAR_CONDUCT_CO2,
TRANSPIRATION_RATE,SPECIES,CRTFCN_CODE,REVISION_DATE
'NSA-OJP-FLXTR','9TE04-BAG01',23-JUL-96,1730,101.3,.29,1661.32,347.3,20.2,1433.8,
611.16,420.01,22.34,344.4,62.87,252.35,7.46,131.9,1.3878,'Pinus banksiana','CPI',
03-FEB-99
'NSA-OJP-FLXTR','9TE04-BAG01',23-JUL-96,1731,101.3,.29,1681.58,351.5,20.6,1472.1,
627.49,422.27,22.98,349.2,61.26,265.19,5.648,111.4,1.2641,'Pinus
banksiana','CPI',
03-FEB-99

```

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

Calculation of gas exchange parameters were conducted essentially as described by Ball (1987).

9.1.1 Derivation Techniques and Algorithms

See Section 9.1.

9.2 Data Processing Sequence

Data were logged by a laptop computer, and calculations were made concurrent with the measurements. All of the primary data are archived.

9.2.1 Processing Steps

No averaging.

9.2.2 Processing Changes

9.3 Calculations

The calculations are as described by Ball (1987).

9.4 Graphs and Plots

Plots of these experiments are available as PostScript files by anonymous ftp to biosphere.stanford.edu. Some of these may be found in the directory /submissions/Boreas_data/PS_files or <http://biosphere.stanford.edu/> [Internet Link].

10. Errors

10.1 Sources of Error

Uncertainty in these experiments arises from instrument noise and systematic calibration errors, and because the leaf experiences somewhat different conditions (e.g., high temperature and Vapor Pressure Deficit (VPD)) than do leaves in natural environments.

10.2 Quality Assessment

10.2.1 Data Validation by Source

The data sets are being checked against calibrated equipment.

10.2.2 Confidence Level/Accuracy Judgment

These data have been carefully checked and are equal in quality to measurements conducted under laboratory conditions.

10.2.3 Measurement Error for Parameters

- Gsw, stomatal conductance, +/- 5 mmol/m²s A
- net CO₂ exchange, +/- 0.1 micromole/m²s Ci
- intercellular CO₂, +/- 5 micromole/mol

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data

Unknown.

11.2 Known Problems with the Data

Light interception by the enclosed crown varied with the ratio of direct to diffuse radiation intercepted, and was calculated from measurements of the projected area and geometric model of light interception.

11.3 Usage Guidance

Calibrated data sets and models for simulation or analysis of these data can be obtained from J. Berry.

11.4. Other Relevant Information

None.

12. Application of the Data Set

The data set has been simulated with a leaf version of the Land-Surface Parameterization Model (SiB2) combining some special treatments of radiation absorption. Preliminary estimates can be obtained from J. Berry.

13. Future Modification and Plans

None.

14. Software

14.1 Software Description

SiB2 is in FORTRAN and runs in a workstation environment. The Collatz et al. (1991) model is in C and can be run on PCs or workstations.

14.2 Software Access

Copies of SiB2 or the Collatz et al. (1991) model can be obtained from J. Berry.

15. Data Access

The boreal tree species branch bag 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 ProductsNone.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

Ball, J.T. 1987. Calculations related to gas exchange. In: E. Zeiger, G.D. Farquhar and I.R. Cowan (Eds.), *Stomatal Function*, Stanford University Press, Stanford. 446-476.

Collatz, G.J., J.T. Ball, C. Grivet, and J.A. Berry. 1991. Physiological and environmental regulation of stomatal conductance, photosynthesis and transpiration: a model that includes a laminar boundary layer. *Agricultural and Forest Meteorology*, 54, 107-36.

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.

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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

SiB2 - Land-Surface Parameterization Model

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
DOY	- Julian Day of Year
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 Wood
NAD83	- North American Datum of 1983
NASA	- National Aeronautics and Space Administration
NOAA	- National Oceanic and Atmospheric Administration
NSA	- Northern Study Area
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
PAR	- Photosynthetically Active Radiation
OA	- Old Aspen
OBS	- Old Black Spruce
OJP	- Old Jack Pine
ORNL	- Oak Ridge National Laboratory
SSA	- Southern Study Area
TE	- Terrestrial Ecology
TF	- Tower Flux
URL	- Uniform Resource Locator
UTM	- Universal Transverse Mercator
VPD	- Vapor Pressure Deficit
YA	- Young Aspen Site
YJP	- Young Jack Pine

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