NASA/TM—2000–209891, Vol. 149

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

Forrest G. Hall and Andrea Papagno, Editors

Volume 149

BOREAS TE-7 Dendrology Data

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October 2000

Available from:

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7121 Standard Drive
Hanover, MD 21076-1320
Price Code: A17

National Technical Information Service
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BOREAS TE-7 Dendrology Data

T.M.L. Varem-Sanders, I.D. Campbell

Summary

The BOREAS TE-7 team collected data sets in support of its efforts to characterize and interpret information on the sapflow and dendrology of boreal vegetation. This data set contains dendrology measurements, consisting of tree ring width and density taken at several points within each ring. Measurements were taken near the TE towers at the OJP and OBS sites in NSA. In the SSA, measurements were taken near the TE towers at the MIX, OBS, and OJP sites; at the AIM-13 and BMH-9 sites; and near the TF-YJP site. All data were collected during the summer of 1994.

Note that the TE-7 dendrology data are not contained on the BOREAS CD-ROM series. An inventory listing is supplied on the CD-ROM set to inform users of the data that were collected. See Section 15 for information about how to acquire actual data files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-07 Dendrology Data

1.2 Data Set Introduction

Field studies of X-ray densitometry analysis of samples were taken by the Terrestrial Ecology (TE)-07 team as part of the BOReal Ecosystem-Atmosphere Study (BOREAS) during the summer of 1994.

1.3 Objective/Purpose

The objective of this research was to perform densitometry analysis as part of the BOREAS allometry program, which was aimed at developing allometric equations for tree volume increment for use in forest growth models.

1.4 Summary of Parameters

Tree Summary Data on the BOREAS Compact Disk-Read Only Memory (CD-ROM): Each record includes the tree id, plot id, species, tree diameter taken at breast height, height from the ground to the base of the crown, tree height, basic density factor, and image condition.

TIFF Images on the Canadian Forest Service (CFS) CD-ROM: Each image file is a series of X-ray images of a particular tree.

Report Files on the CFS CD-ROM: Density and Width Summary includes year of the ring, fresh ring width, relative latewood width, maximum ring density, minimum ring density, average ring density. Raw Profile includes density of each pixel and the year of the ring.

1.5 Discussion

Samples were collected from tower sites used for gas flux experiments. In the Northern Study Area (NSA), the TE towers at the Old Jack Pine (OJP) and Old Black Spruce (OBS) sites were visited. In the Southern Study Area (SSA), samples were collected from the TE tower at Mixed wood (MIX), Aspen Immature Medium (AIM)-13, Tower Flux (TF) Young Jack Pine (YJP), and the TE towers at black spruce mature high (BMH)-9 and at OJP. Detailed information about each site can be found in Halliwell and Apps (1997a,b,c). Dendrology data were collected from 75 trees. The trees ranged from 1.85 m to 18.3 m in height and included 29 jack pine (Pinus banksiana), 33 black spruce (Picea mariana), 8 white spruce (Picea glauca), and 10 trembling aspen (Populus tremuloides). The samples used here are replicates of samples used by Gower et al. (1997) for the development of volume allometric equations. Not all samples used by Gower have been included, due to the magnitude of the project; some samples were lost in transit, destroyed in processing, or received with illegible or incorrect labels. Every effort has been made to ensure the accuracy of the data included in this data set.

The images and report files are stored on the CD-ROM provided free of charge by the CFS at this address:

Natural Resources Canada
Canadian Forest Service
Northern Forest Centre
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

1.6 Related Data Sets

BOREAS TE-06 Allometry Data
BOREAS TE-06 Biomass and Foilage Area Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

T.M.L. Varem-Sanders
I.D. Campbell

2.2 Title of Investigation

Climate Change Effects on Net Primary Productivity of Productivity of Aspen and Jack Pine at the Southern Limit of the Boreal Forest

2.3 Contact Information

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Andrea.Papagno@gsfc.nasa.gov

3. Theory of Measurements

X-ray densitometry enables the simultaneous measurement of ring width and density at several points within each ring. Ring width data are required to calculate volume increment, while wood density is a critical variable affecting wood quality (Jozsa and Middleton, 1994). Biomass increment calculations also require both ring width and density data.

Tree ring widths have often been used to determine the sensitivity of tree growth to climate and other environmental factors (Fritts, 1976). Similarly, tree density has been shown to be highly sensitive to climate and other factors, and in closed boreal forest stands, where ring width is often only weakly sensitive to climate, ring density has been shown to be much more strongly linked to climate (Jozsa et al., 1984).

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

TE and TF towers were used to access the trees. Disks were cut from selected trees at the base of the tree, at breast height, at the base of the live crown, and at regular 2-m intervals along the entire stem.

4.1.2 Source/Platform

An optical gray-scale desktop scanner was used under laboratory conditions.

4.1.3 Source/Platform Mission Objectives

None given.

4.1.4 Key Variables

Tree Summary Data on the BOREAS CD-ROM: The overall summary data includes the tree id, plot id, species, tree diameter taken at breast height, height from the ground to the base of the crown, tree height, basic density factor, and image condition.

TIFF Images on the CFS CD-ROM: Each image file is a series of X-ray images of a particular tree.

Report Files on the CFS CD-ROM: Density and Width Summary includes year of the ring, fresh ring width, relative latewood width, maximum ring density, minimum ring density, average ring density. Raw Profile includes density of each pixel and the year of the ring.

4.1.5 Principles of Operation

The images were photographically enlarged by a factor of 2x, and the prints were scanned using a 600-dots per inch (dpi) (optical) gray-scale desktop scanner. After further analysis (explained in Section 5), the images provided were rescanned from the original negatives using a 2000-dpi (optical) desktop scanner.

4.1.6 Sensor/Instrument Measurement Geometry

None given.

4.1.7 Manufacturer of Sensor/Instrument

None given.

4.2 Calibration

4.2.1 Specifications

The calibration wedge specifications are:

Thickness at the thick end:	0.3797 cm
Thickness at the thin end (inside the wire):	0.0290 cm
Length (to the inside of the wire):	5.194 cm
Calibration constant:	0.7438 g/cm^3
Corrected calibration constant:	0.7069 g/cm^3

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

None given.

4.2.3 Other Calibration Information

Not applicable.

5. Data Acquisition Methods

Sampling was conducted during the summer of 1994. Disks were cut from selected trees at selected sites, at the base of the tree, at breast height, at the base of the live crown, and at regular 2-m intervals along the entire stem.

These disks were measured in the field to obtain a fresh (or green) diameter. On arrival in Edmonton, they were air-dried and remeasured. The disks were then reduced to sticks about 5 cm wide and 3 cm thick, passing through the pith and thus including two complete radii at 180° from each other.

The sticks were then further reduced to thin slivers about 6 mm wide and 1.5 mm thick. One of the two slivers from each disk included the pith; the other did not. In some cases, particularly for small-diameter disks or disks that had cracked extensively on drying, only one sliver was obtained. The thickness of each sliver was measured at several points using calipers. These slivers were then wrapped in cloth and subjected to extraction of volatiles by repeated soaking in water and in a mixture of cyclohexane and ethanol. After removal from the extraction, the slivers were pressed into a slight curve, to accommodate the parallax in the X-ray chamber.

The slivers were arranged in sets in the X-ray chamber; each set was accompanied by the same calibrated precision-cut plastic wedge. This wedge is of sufficient thickness at one end to intercept more X-rays than the densest 2-mm-thick wood samples, and tapers to a nearly perfect knife-edge. A thin wire is attached to the thin end to mark it on the X-ray images. See Section 4.2.1 for the specifications for this wedge. This method enables researchers to calculate density from the gray-value of the X-ray image at any point yielding the same gray-value as the point in the wood for which the density is desired. The thickness of the wedge at this point is determined by interpolation from the position of this point between the thick end of the wedge and the inside of the wire. If the wood is assumed to be completely dry, the thickness of the wedge at this point is multiplied by the calibration constant to obtain the mass of the wood per cm^2 at that point. This number is then divided by the thickness of the wood sample:

$$\text{Wood density} = \frac{\text{wedge thickness} * \text{calibration constant}}{\text{wood thickness}} \qquad (1)$$

In practice, most wood samples are believed to have been processed with about 6% moisture content; thus, a calibration constant corrected for humidity should be used. The corrected calibration constant used for 6% wood moisture content was 0.7069 g/cm^3.

The images were photographically enlarged by a factor of 2x, and the prints were scanned using a 600-dpi (optical) gray-scale desktop scanner. DendroScan, the software written for the analysis of X-ray images of tree rings (Varem-Sanders and Campbell, 1996), was used to analyze the resulting digital files.

Each sliver was then cross-dated, first with the other sliver from the same disk, with other samples from the same tree, then with other samples from the same site, and ultimately with samples from other sites, to ensure the proper identification of ring boundaries. From the approximately 1,000 disks received at the Northern Forest Centre, an estimated 1,500 slivers were processed, representing 938 disks from 75 trees.

The images provided on the CFS CD-ROM were rescanned from the original negatives using a 2000-dpi (optical) desktop scanner. Due to space constraints, not all were scanned at 2000 dpi; samples with wide rings were often scanned at a lower resolution. The images are stored on the CD-ROM provided free of charge by CFS at this address:

Natural Resources Canada
Canadian Forest Service
Northern Forest Centre
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

6. Observations

6.1 Data Notes
None given.

6.2 Field Notes
None given.

7. Data Description

7.1 Spatial Characteristics
None given.

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

- MIX TE tower site, site id D9I1M, Lat/Long: 53.7254 N, 105.20643 W, Universal Transverse Mercator (UTM) Zone: 13, N: 5952989.7, E: 486379.7.
- OBS TE tower site, site id G8I4T, Lat/Long: 53.98717 N, 105.11779 W, UTM Zone: 13, N: 5982100.5, E: 492276.5.
- OJP TE tower site, site id G2L3T, Lat/Long: 53.91634 N, 104.69203 W, UTM Zone: 13, N: 5974257.5, E: 520227.7.
- AIM-13 site, site id B9B7A, Lat/Long: 53.59098 N, 106.18693 W, UTM Zone: 13, N: 5938447.2, E: 421469.8.
- BMH-9 site, site id G6K8S, Lat/Long: 53.94446 N, 104.759 W, UTM Zone: 13, N: 5977146.9, E: 515847.9.
- YJP TF tower site, site id F8L6T, Lat/Long: 53.87581 N, 104.64529 W, UTM Zone: 13, N: 5969762.5, E: 523320.2.
- OJP TE tower site, site id T7Q8T, Lat/Long: 55.92842 N, 98.62396 W, UTM Zone 14, N:6198176.3, E:523496.2.
- OBS TE tower site, site id T3R8T, Lat/Long: 55.88007 N, 98.48139 W, UTM Zone 14, N:6192853.4, E:532444.5.

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
Not applicable.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
These data include information about all of the tree rings present in the samples (collected during the summer of 1994). This encompasses all of the years that the trees lived until 1994.

7.2.2 Temporal Coverage Map
None given.

7.2.3 Temporal Resolution

Yearly data from tree ring analyses.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the inventory file on the BOREAS CD-ROM are:

Column Name
SITE_NAME
SUB_SITE
MEASUREMENT_YEAR
TREE_ID
PLOT_ID
SPECIES
TREE_DIAMETER_BREAST_HT
HEIGHT_TO_CROWN_BASE
TREE_HEIGHT
BASIC_DENSITY_FACTOR
IMAGE_CONDITION
CRTFCN_CODE
REVISION_DATE

The TIFF images on the CFS CD-ROM contain a series of X-ray images of a particular tree. The report files on the CFS CD-ROM are: Density and Width Summary includes year of the ring, fresh ring width, relative latewood width, maximum ring density, minimum ring density, average ring density. Raw Profile includes density of each pixel and the year of the ring.

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the inventory file on the BOREAS 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.
MEASUREMENT_YEAR	The year in which the data were collected.
TREE_ID	Identifier of the mapped tree or plant stem.
PLOT_ID	The identifier for the plot from which the measurement came.
SPECIES	Botanical (Latin) name of the species (Genus species).
TREE_DIAMETER_BREAST_HT	The diameter of the tree at breast height (137 cm) above the ground.
HEIGHT_TO_CROWN_BASE	The height from the ground to the base of the

	live tree crown.
TREE_HEIGHT	The height of the tree.
BASIC_DENSITY_FACTOR	The factor used to convert oven-dry wood density to basic wood density. Oven-dry density is oven-dry mass (less than 0.1% water) per oven-dry volume. Basic density represents dry mass per fresh volume.
IMAGE_CONDITION	A qualitative assessment of the image contained in the associated TIFF file.
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 inventory file on the BOREAS CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
MEASUREMENT_YEAR	[unitless]
TREE_ID	[none]
PLOT_ID	[none]
SPECIES	[none]
TREE_DIAMETER_BREAST_HT	[meters]
HEIGHT_TO_CROWN_BASE	[meters]
TREE_HEIGHT	[meters]
BASIC_DENSITY_FACTOR	[unitless]
IMAGE_CONDITION	[none]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the inventory file onthe BOREAS CD-ROM are:

Column Name	Data Source
SITE_NAME	[BORIS Designation]
SUB_SITE	[BORIS Designation]
MEASUREMENT_YEAR	[Human Observer]
TREE_ID	[Human Observer]
PLOT_ID	[Human Observer]
SPECIES	[Human Observer]
TREE_DIAMETER_BREAST_HT	[Laboratory Equipment]
HEIGHT_TO_CROWN_BASE	[Laboratory Equipment]
TREE_HEIGHT	[Laboratory Equipment]
BASIC_DENSITY_FACTOR	[Laboratory Equipment]
IMAGE_CONDITION	[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 inventory file on the BOREAS 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-OBS-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TE07-TRE01	9TE07-TRE01	None	None	None	None
MEASUREMENT_YEAR	94	94	None	None	None	None
TREE_ID	1	80	None	None	None	None
PLOT_ID	N/A	N/A	None	None	None	None
SPECIES	N/A	N/A	None	None	None	None
TREE_DIAMETER_BREAST_HT	.008	.206	None	None	None	None
HEIGHT_TO_CROWN_BASE	0	12.7	None	None	None	None
TREE_HEIGHT	1.85	19.09	None	None	None	None
BASIC_DENSITY_FACTOR	.822	.951	None	None	None	None
IMAGE_CONDITION	N/A	N/A	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	09-FEB-99	09-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 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 BOREAS CD-ROM.

```
SITE_NAME,SUB_SITE,MEASUREMENT_YEAR,TREE_ID,PLOT_ID,SPECIES,
TREE_DIAMETER_BREAST_HT,HEIGHT_TO_CROWN_BASE,TREE_HEIGHT,BASIC_DENSITY_FACTOR,
IMAGE_CONDITION,CRTFCN_CODE,REVISION_DATE
'NSA-OJP-FLXTR','9TE07-TRE01',94,1,'NSA-OJP-TF','Pinus banksiana',0.104,3.35,
9.53,0.9,'High confidence in the width and density numbers reported.','CPI',
9-Feb-99
'NSA-OJP-FLXTR','9TE07-TRE01',94,2,'NSA-OJP-TF','Pinus banksiana',0.121,2.5,
10.12,0.916,'High confidence in the width and density numbers reported.','CPI',
9-Feb-99
```

8. Data Organization

8.1 Data Granularity

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

The images and report files stored on the CFS CD-ROM can be obtained free of charge at this address:

Natural Resources Canada
Canadian Forest Service
Northern Forest Centre
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

8.2 Data Format(s)

The CD-ROM inventory listing file consists of 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.

TIFF Images: The CFS CD-ROM contains compressed TIFF images of tree ring scans that can be decompressed using PKUNZIP, WINZIP, or other ZIP software. This software is not provided on the CD-ROM, but it can be obtained as shareware from many sites on the internet.

Report files: The CFS CD-ROM contains report files which are extracted using a menu driven utility provided on the CD-ROM. There are two types of report files: Density and Width Summary and Raw Profile. These files are stored on the CD-ROM in DendroScan format, which is a special binary format. After running the extraction utility provided, the files can be opened using spreadsheet software.

9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

If the wood is assumed to be completely dry, the thickness of the wedge at this point can be multiplied by the calibration constant to obtain the mass of the wood per cm^2 at that point. This number is then divided by the thickness of the wood sample:

$$\text{Wood density} = \frac{\text{wedge thickness} * \text{calibration constant}}{\text{wood thickness}} \quad (1)$$

In practice, most wood samples are believed to have been processed with about 6% moisture content; thus, a calibration constant corrected for humidity should be used (See Section 5).

9.2 Data Processing Sequence

9.2.1 Processing Steps

- Sample collection
- Thin slicing
- Extraction
- X-ray
- Scanning and marking
- DendroScan
- Reports and graphs

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

Several trees were sampled in a way that was not conducive to X-ray densitometry analysis. As the X-rays pass through the sample, it is important that the parallax be minimized to avoid blurring of the final image. This is accomplished by cutting the disk at a right angle to the stem, ensuring that the structure of the tree rings is perpendicular to the plane of the disk. Of the 80 trees sampled, several were found to have been cut at a distinct angle to this ideal orientation. Although in many cases it was possible to correct this in the laboratory using the thickness of the disk to adjust the angle, there were five trees for which the disks were too thin to make this correction.

The X-ray densitometry laboratory and our techniques were under continual development during the processing of these samples. Although many samples have been at least partly reprocessed to compensate for this evolution, it should be noted that the relative humidity control in the X-ray laboratory was not adequate during the time most of these samples were processed. Although this does not affect the relative densities within the samples on the individual X-ray images, the absolute density values may have as much as a 5% error due to humidity variations in the laboratory between X-ray sessions. This does not affect the density of the calibration wedge, which is a nonhygroscopic plastic.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Not all samples used by Gower have been included, due to the magnitude of the project; some samples were lost in transit, destroyed in processing, or received with illegible or incorrect labels. Every effort has been made to ensure the accuracy of the data included in this data set and on the CD-ROM provided by CFS.

10.2.2 Confidence Level/Accuracy Judgment

See Section 10.1.

10.2.3 Measurement Error for Parameters

See Section 10.1.

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

The data are provided freely for general use. Researchers intending to make extensive use of the data or encountering difficulties with the material on the CFS CD-ROM are asked to contact the authors.

11.4 Other Relevant Information

The images and report files are stored on the CD-ROM provided free of charge by CFS at this address:

Natural Resources Canada
Canadian Forest Service
Northern Forest Centre
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

12. Application of the Data Set

This data set can be used to study the dendrology of the boreal forest.

13. Future Modifications and Plans

None given.

14. Software

14.1 Software Description

DendroScan, the software written for the analysis of X-ray images of tree rings (Varem-Sanders and Campbell, 1996), was used to analyze the resulting digital files.

14.2 Software Access

None given.

15. Data Access

The dendrology 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.

The images and report files stored on the CFS CD-ROM are provided free of charge by CFS at this address:

Natural Resources Canada
Canadian Forest Service
Northern Forest Centre
5320 - 122 Street
Edmonton, Alberta T6H 3S5

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
TIFF images and DendroScan files containing the report files.

Although the inventory is contained on the BOREAS CD-ROM set, the actual dendrology data are not. See Section 15 for information about how to obtain the data.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation
None given.

17.2 Journal Articles and Study Reports
Fritts, H.C. 1976. Tree Rings and Climate. Academic Press, New York, New York.

Gower, S.T., J.G. Vogel, J.M. Norman, C.J. Kucharik, S.J. Steele, and T.K. Stow. 1997. Carbon distribution and aboveground net primary production in aspen, jack pine, and black spruce stands in Saskatchewan and Manitoba, Canada. Journal of Geophysical Research 102(D24): 29,029-29,041.

Halliwell, D.H. and M.J. Apps. 1997a. BOReal Ecosystem-Atmosphere Study (BOREAS) Biometry and Auxiliary Sites: Locations and Descriptions. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Halliwell, D.H. and M.J. Apps. 1997b. BOReal Ecosystem-Atmosphere Study (BOREAS) Biometry and Auxiliary Sites: Overstory and Understory Data. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Halliwell, D.H. and M.J. Apps. 1997c. BOReal Ecosystem-Atmosphere Study (BOREAS) Biometry and Auxiliary Sites: Soils and Detritus Data. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta.

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

AIM - Aspen Immature Medium
ASCII - American Standard Code for Information Interchange
BFTCS - Boreal Forest Transect Case Study
BMH - Black Spruce Mature High
BOREAS - BOReal Ecosystem-Atmosphere Study
BORIS - BOREAS Information System
CD-ROM - Compact Disk-Read Only memory
CFS - Canadian Forest Service
DAAC - Distributed Active Archive Center
DOY - Julian Day of Year
DPI - Dots Per Inch
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
IFC - Intensive Field Campaign
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
OA - Old Aspen
OBS - Old Black Spruce
OJP - Old Jack Pine
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
RSS - Remote Sensing Science
S - Sap Flux Density
SSA - Southern Study Area
TE - Terrestrial Ecology
TF - Tower Flux
URL - Uniform Resource Locator
UTM - Universal Transverse Mercator
VPD - Vapor Pressure Deficit
YJP - Young Jack Pine

20. Document Information

20.1 Document Revision Date

Written: 07-Dec-1998
Last Updated: 30-Aug-1999

20.2 Document Review Date(s)

BORIS Review: 22-Dec-1998
Science Review:

20.3 Document ID

20.4 Citation

When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

T.M.L. Varem-Sanders and I.D. Campbell, both of the Canadian Forest Service at the Northern Forestry Centre.

Also, cite the BOREAS CD-ROM set as:

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. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 2000	Technical Memorandum

4. TITLE AND SUBTITLE
Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)
BOREAS TE-7 Dendrology Data

5. FUNDING NUMBERS
923
RTOP: 923-462-33-01

6. AUTHOR(S)
T.M.L. Varem-Sanders and I.D. Campbell
Forrest G. Hall and Andrea Papagno, Editors

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES)
Goddard Space Flight Center
Greenbelt, Maryland 20771

8. PEFORMING ORGANIZATION REPORT NUMBER
2000-03136-0

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES)
National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
TM—2000–209891
Vol. 149

11. SUPPLEMENTARY NOTES
T.M.L. Varem-Sanders and I.D. Campbell: Canadian Forest Service, Edmonton, Alberta, Canada;
A. Papagno: Raytheon ITSS, NASA Goddard Space Flight Center, Greenbelt, Maryland

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unclassified–Unlimited
Subject Category: 43
Report available from the NASA Center for AeroSpace Information,
7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The BOREAS TE-7 team collected data sets in support of its efforts to characterize and interpret information on the sapflow and dendrology of boreal vegetation. This data set contains dendrology measurements, consisting of tree ring width and density taken at several points within each ring. Measurements were taken near the TE towers at the OJP and OBS sites in NSA. In the SSA, measurements were taken near the TE towers at the MIX, OBS, and OJP sites; at the AIM-13 and BMH-9 sites; and near the TF-YJP site. All data were collected during the summer of 1994.

14. SUBJECT TERMS
BOREAS, terrestrial ecology, dendrology.

15. NUMBER OF PAGES
16

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL