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

Forrest G. Hall and Jaime Nickeson, Editors

Volume 71

BOREAS RSS-17 Stem, Soil, and Air Temperature Data

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National Aeronautics and
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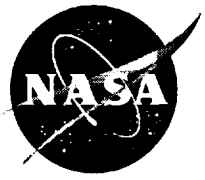

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BOREAS RSS-17 Stem, Soil, and Air Temperature Data

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BOREAS RSS-17 Stem, Soil, and Air Temperature Data

Kyle McDonald, Reiner Zimmermann, JoBea Way

Summary

The BOREAS RSS-17 team collected several data sets in support of its research in monitoring and analyzing environmental and phenological states using radar data. This data set consists of tree bole and soil temperature measurements from various BOREAS flux tower sites. Temperatures were measured with thermistors implanted in the hydroconductive tissue of the trunks of several trees at each site and at various depths in the soil. Data were stored on a data logger at intervals of either 1 or 2 hours. The majority of the data were acquired between early 1994 and early 1995. The primary product of this data set is the diurnal stem temperature measurements acquired for selected trees at five BOREAS tower sites. The data are provided in tabular ASCII format.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS RSS-17 Stem, Soil, and Air Temperature Data

1.2 Data Set Introduction

This documentation file describes tree bole and soil temperature data acquired during the BOReal Ecosystem-Atmosphere Study (BOREAS) field experiment at five of the BOREAS tower sites. The tree bole data were collected in separate but representative trees at each of the tower sites. Data were collected from the Southern Study Area (SSA) at the Old Black Spruce (OBS), Old Jack Pine (OJP), Old Aspen (OA), and Young Jack Pine (YJP) sites. Data were also collected at the Northern Study Area (NSA) OBS site. The majority of the data were acquired between early 1994 and early 1995.

All of the temperature data were collected with 3-mm x 3-mm x 1-mm thermistors. Data were postprocessed to derive temperature values (in Celsius) from the raw data taken (in kOhms) by

resistance measurements from nonlinear response-type thermistors. Thermistors were implanted in the hydroconductive tissues of selected tree trunks and at various depths in the soil. Measurements were recorded automatically on a data logger at 1- or 2-hour intervals.

1.3 Objective/Purpose

These measurements were taken to assist with the interpretation of radar backscatter measurements obtained with the Earth Resource Satellite-1 (ERS-1) Synthetic Aperture Radar (SAR). Data were used to assess the freeze/thaw state of the soil and vegetation to aid interpretation of the radar images.

1.4 Summary of Parameters and Variables

The primary measured parameter is diurnal vegetation temperature. Some soil and air temperatures were collected at a subset of sites.

1.5 Discussion

Temperature measurements were used to quantify freeze/thaw transitions in the soil and vegetation. Landscape freeze/thaw transitions are readily observable with imaging radar. Thus, radar may be applied to assess growing season length in boreal landscapes.

1.6 Related Data Sets

BOREAS RSS-17 Dielectric Constant Profile Measurements
BOREAS RSS-17 Xylem Flux Density Measurements at the SSA-OBS Site
BOREAS RSS-17 1994 ERS-1 Level-3 Backscatter Change Images

2. Investigator(s)

2.1 Investigator(s) Name and Title

Principal Investigator
Dr. JoBea Way Scientist

Co-Investigators
Dr. Kyle McDonald Scientist
Dr. Reiner Zimmermann Scientist

2.2 Title of Investigation

Monitoring Environmental and Phenologic State and Duration of State with SAR as Input to Improved CO_2 Flux Models

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3. Theory of Measurements

Thermistor sensors are variable resistors that change their electrical resistance to a direct current (DC) in a predictable manner depending on the ambient temperature. This study used Siemens-841-3K type thermistors that have a nonlinear decrease of resistance with increasing temperature and a negligible hysteresis. The small resistor size ensures a fast response to temperature changes in the measured environment (tree boles/soil/air).

The temperature response of each sensor is better than the desired temperature resolution of 0.25 °C. Temperatures were calculated from the measured resistance and a conversion algorithm. The algorithm was derived using the manufacturer's resistance-temperature conversion table. Sensor response was checked under controlled temperature conditions against 1) table values for electrical resistance and 2) calculated temperature values when using the conversion algorithm. Deviation of the calculated temperature from the manufacturer's temperature table was less than 0.2 degrees between -40 and +40 °C.

Approximately 8 to 12 trees were monitored at each installation to verify similar or uniform behavior of the freeze/thaw state of the tree trunks.

4. Equipment

4.1 Sensor/Instrument Description

Thermistors were connected to stranded and insulated cables with a screen cover (computer signal cable type).

4.1.1 Collection Environment

Soil temperatures were collected with capsuled soil thermistors inserted into holes drilled in the soil and then backfilled. Tree bole temperatures were collected using insulated thermistors that were inserted into 4- to 5-mm holes drilled into the tree boles. The holes were closed with silicone after insertion of the thermistor.

4.1.2 Source/Platform

The tree temperature sensors were mounted directly in the trees being monitored. Soil sensors were inserted to depths between 5 cm and 50 cm, as noted in the data files.

4.1.3 Source/Platform Mission Objectives

The objective of these measurements was to support interpretation of radar remote sensing observations, especially during the spring thaw and autumn freeze-up periods.

4.1.4 Key Variables

The key variables being measured were stem, soil, and air temperatures. The measurements were converted to °C.

4.1.5 Principles of Operation

Thermistor sensors are variable resistors that change their electrical resistance to a DC in a predictable manner depending on the ambient temperature. By monitoring the DC resistance of a thermistor, one may infer the ambient temperature in the medium surrounding the device.

4.1.6 Sensor/Instrument Measurement Geometry

Thermistors were implanted in the tree trunks at appropriately 1.8 meters above the soil. Sensors were inserted to depths between 5 and 20 mm, as noted in the data files. Soil sensors were inserted to depths between 5 and 50 cm, as noted in the data files. Measurement accuracy of the thermistors was determined to be +/- 0.2 °C, as based on laboratory testing.

4.1.7 Manufacturer of Sensor/Instrument

Sensor units were constructed in the field at BOREAS. Thermistors were manufactured by Siemens, Germany, and are available from numerous U.S. electronic supply houses. The thermistor type was Siemens Heissleiter M841 / 3 K / a1.

4.2 Calibration

4.2.1 Calibration Specifications

Temperature was calculated from the measured resistance and a conversion algorithm. The algorithm was based on the manufacturer's resistance-temperature conversion table. Sensor response was checked under controlled temperature conditions against 1) table values for electrical resistance and 2) calculated temperature values when using the conversion algorithm. Deviation of the calculated from the manufacturer's temperature table was less than 0.2 degrees between -40 and +40 °C.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

Further calibration of these instruments was not performed.

4.2.3 Other Calibration Information

None given.

5. Data Acquisition Methods

Soil temperatures were collected with capsuled soil thermistors inserted into holes drilled in the soil and then backfilled. Tree bole temperatures were collected using insulated thermistors that were inserted into 4- to 5-mm holes drilled into the tree boles. The holes were closed with silicone after insertion of the thermistor.

Measurements were processed and stored with a Delta-T data logger (DL-2), which is manufactured in England. The time interval for the data storage varied during the observation period. Data were measured every minute and averaged by the logger for the indicated time interval. Data storage occurred at the end of the time interval averaged.

A constant current source of 20 microAmperes provided by the logger was used to measure the DC resistance of each thermistor.

Data were stored in the data logger and downloaded by laptop during site visits.

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

The tree stem temperature data submitted to the BOREAS Information system (BORIS) were collected at five general sites:

- NSA-OBS
- SSA-OBS
- SSA-OJP
- SSA-OA
- SSA-YJP

The stem temperature data were collected at every site visited, in a minimum of 4 and a maximum of 11 different trees. The number of trees from which stem temperature data were collected varied by site. The minimum numbers of trees measured was 4 and the maximum number of trees measured was 11. The air temperature data were measured at one location at each of two sites (SSA-OJP and SSA-OA). Air temperature measurements were not made at the three remaining sites. Soil temperature data were measured at three depths at the NSA-OBS site and at four depths at the SSA-YJP site. Soil temperature measurements were not made at the remaining three sites. The North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) coordinates for the sites are:

Site	UTM Zone	UTM Northing	UTM Easting	stem	soil	air
NSA-OBS	14	6192853.4	532444.5	x	x	
SSA-YJP	13	5969762.5	523320.2	x	x	
SSA-OJP	13	5974257.5	520227.7	x		x
SSA-OBS	13	5982100.5	492276.5	x		
SSA-OA	13	5942899.9	420790.5	x		x

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
The air, soil, and stem temperature measurements taken by the Remote Sensing Science (RSS)-17 team are directly representative only of the medium into which the thermistors were inserted at the sites listed.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
The data were continuously collected over the various sites during the period from 25-Oct-1993 to 27-Apr-1995. A more detailed breakdown by site is given in section 7.2.2.

7.2.2 Temporal Coverage Map

Site	Dates of data collection
NSA-OBS	13-Apr-1994 to 30-Oct-1994
SSA-OBS	25-Oct-1993 to 27-Apr-1995
SSA-OA	16-Feb-1994 to 25-Apr-1995
SSA-OJP	19-Feb-1994 to 26-Apr-1995
SSA-YJP	15-Jul-1994 to 26-Apr-1995

7.2.3 Temporal Resolution
The time interval between actual temperature measurements was 1 minute. These observations were then averaged over time periods ranging from 10 minutes to 1 hour. The averaged values are the temperatures given in the data files.

7.3 Data Characteristics

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

For NSA-OBS site:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
SOIL_TEMP_50MM
SOIL_TEMP_250MM
SOIL_TEMP_450MM
BS1_STEM_TEMP_H1800_D5_N
BS1_STEM_TEMP_H1800_D20_N
BS2_STEM_TEMP_H1800_D5_N
BS2_STEM_TEMP_H1800_D20_N
BS3_STEM_TEMP_H1800_D5_N
BS3_STEM_TEMP_H1800_D20_N
CRTFCN_CODE
REVISION_DATE

For SSA-OBS site:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
JP1_STEM_TEMP_H1400_D5_E
JP1_STEM_TEMP_H1400_D20_E
T1_STEM_TEMP_H1000_D5_NE
T1_STEM_TEMP_H1000_D20_NE
BS1_STEM_TEMP_H1000_D5_NE
BS1_STEM_TEMP_H1000_D20_NE
BS1_STEM_TEMP_H800_D5_NE
BS1_STEM_TEMP_H800_D20_NE
CRTFCN_CODE
REVISION_DATE

For SSA-OA site:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
AIR_TEMP_6600MM
ASP1_STEM_TEMP_H2000_D5
ASP1_STEM_TEMP_H2000_D20
ASP1_STEM_TEMP_H2000_D20_N
ASP1_STEM_TEMP_H2000_D20_W
ASP2_STEM_TEMP_H2000_D5
CRTFCN_CODE
REVISION_DATE

For SSA-OJP site:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
AIR_TEMP_2000MM
JP1_STEM_TEMP_H1700_D20_SW
JP1_STEM_TEMP_H1700_D20_N
JP1_STEM_TEMP_H1700_D40_NW
JP1_STEM_TEMP_H1700_D20_SE
JP1_STEM_TEMP_H1700_D40_SE
JP1_STEM_TEMP_H1700_D50_N
JP1_STEM_TEMP_H1700_D50_S
JP1_STEM_TEMP_H1700_D20_NW
JP1_STEM_TEMP_H1700_D20_NE
JP2_STEM_TEMP_H1700_D20_SE
JP2_STEM_TEMP_H1700_D20_NW
CRTFCN_CODE
REVISION_DATE

For SSA-YJP site:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
SOIL_TEMP_50MM
SOIL_TEMP_150MM
SOIL_TEMP_250MM
SOIL_TEMP_400MM
JP1_STEM_TEMP_H600_D5_NE
JP1_STEM_TEMP_H600_D20_NE
JP2_STEM_TEMP_H600_D5_NE
JP2_STEM_TEMP_H600_D20_NE
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:

For NSA-OBS site:

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) at the end of the period when the data were collected.
SOIL_TEMP_50MM	Soil temperature measured at a depth of 50 mm from the top of the moss layer (NSA-OBS) or soil surface (SSA-YJP). Sensor at NSA-OBS was in decomposing moss.
SOIL_TEMP_250MM	Soil temperature measured at a depth of 250 mm below the top of the moss layer (NSA-OBS) or the soil surface (SSA-YJP). Sensor was in mineral soil.
SOIL_TEMP_450MM	Soil temperature measured at a depth of 450 mm below the top the moss layer. The probe was in mineral soil.
BS1_STEM_TEMP_H1800_D5_N	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure.
BS1_STEM_TEMP_H1800_D20_N	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure.
BS2_STEM_TEMP_H1800_D5_N	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a second Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure.
BS2_STEM_TEMP_H1800_D20_N	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure.
BS3_STEM_TEMP_H1800_D5_N	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a third Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure.
BS3_STEM_TEMP_H1800_D20_N	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Black Spruce tree at a height of 1800 mm above the moss layer with a north-facing exposure.
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.

For SSA-OBS site:

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) at the end of the period when the data were collected.
JP1_STEM_TEMP_H1400_D5_E	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Jack Pine tree at a height of 1400 mm above the soil surface with an east-facing exposure (dbh=220mm).
JP1_STEM_TEMP_H1400_D20_E	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1400 mm above the soil surface with an east-facing exposure (dbh=220mm).
T1_STEM_TEMP_H1000_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Tamarack tree at a height of 1000 mm above the soil surface with a northeast-facing exposure (dbh=150mm).
T1_STEM_TEMP_H1000_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Tamarack tree at a height of 1000 mm above the soil surface with a northeast-facing exposure (dbh=150mm).
BS1_STEM_TEMP_H1000_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Black Spruce tree at 1000 mm above the soil surface with a northeast-facing exposure.
BS1_STEM_TEMP_H1000_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Black Spruce tree at a height of 1000 mm above the soil surface with a northeast-facing exposure.
BS1_STEM_TEMP_H800_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a Black Spruce tree at a height of 800 mm above the soil surface with a northeast-facing exposure.
BS1_STEM_TEMP_H800_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a

	Black Spruce tree at a height of 800 mm above the soil surface with a northeast-facing exposure.
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.

For SSA-OA site:

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) at the end of the period when the data were collected.
AIR_TEMP_6600MM	Air temperature measurements collected at a height of 6.6 meters above the ground.
ASP1_STEM_TEMP_H2000_D5	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil surface. The exposure is unknown.
ASP1_STEM_TEMP_H2000_D20	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil surface. The exposure is unknown.
ASP1_STEM_TEMP_H2000_D20_N	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil surface with a north-facing exposure.
ASP1_STEM_TEMP_H2000_D20_W	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil surface with a west-facing exposure.
ASP2_STEM_TEMP_H2000_D5	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of an Aspen tree at a height of 2000 mm above the soil surface. The exposure is unknown.
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.

For SSA-OJP site:

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) at the end of the period when the data were collected.
AIR_TEMP_2000MM	Air temperature measured at a height of 2 meters above the ground.
JP1_STEM_TEMP_H1700_D20_SW	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a southwest-facing exposure.
JP1_STEM_TEMP_H1700_D20_N	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a north-facing exposure.
JP1_STEM_TEMP_H1700_D40_NW	Stem temperature measurements from a probe inserted to a depth of 40 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a northwest-facing exposure.
JP1_STEM_TEMP_H1700_D20_SE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a southeast-facing exposure.
JP1_STEM_TEMP_H1700_D40_SE	Stem temperature measurements from a probe inserted to a depth of 40 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a southeast-facing exposure.
JP1_STEM_TEMP_H1700_D50_N	Stem temperature measurements from a probe inserted to a depth of 50 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a north-facing exposure.
JP1_STEM_TEMP_H1700_D50_S	Stem temperature measurements from a probe inserted to a depth of 50 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a south-facing exposure.
JP1_STEM_TEMP_H1700_D20_NW	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a

	Jack Pine tree at a height of 1700 mm above the soil surface with a northwest-facing exposure.
JP1_STEM_TEMP_H1700_D20_NE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a Jack Pine tree at a height of 1700 mm above the soil surface with a northeast-facing exposure.
JP2_STEM_TEMP_H1700_D20_SE	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Jack Pine tree at a height of 1700 mm above the soil surface with a southeast-facing exposure.
JP2_STEM_TEMP_H1700_D20_NW	Stem temperature measurements from a probe inserted to a depth of 20 mm into the xylem of a second Jack Pine tree at a height of 1700 mm above the soil surface with a northwest-facing exposure.
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.

For SSA-YJP site:

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) at the end of the period when the data were collected.
SOIL_TEMP_50MM	Soil temperature measured at a depth of 50 mm from the top of the moss layer (NSA-OBS) or soil surface (SSA-YJP). Sensor at NSA-OBS was in decomposing moss.
SOIL_TEMP_150MM	Soil temperature measured at a depth of 150 mm below the soil surface.
SOIL_TEMP_250MM	Soil temperature measured at a depth of 250 mm below the top of the moss layer (NSA-OBS) or the soil surface (SSA-YJP). Sensor was in mineral soil.
SOIL_TEMP_400MM	Soil temperature measured at a depth of 400 mm below the soil surface.

JP1_STEM_TEMP_H600_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=35mm).
JP1_STEM_TEMP_H600_D10_NE	Stem temperature measurements from a probe inserted to a depth of 10 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=35mm).
JP2_STEM_TEMP_H600_D5_NE	Stem temperature measurements from a probe inserted to a depth of 5 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=38mm).
JP2_STEM_TEMP_H600_D10_NE	Stem temperature measurements from a probe inserted to a depth of 10 mm into the xylem of a 3.6 m tall Jack Pine tree at a height of 600 mm above the soil surface with a northeast-facing exposure (dbh=38mm).
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:

For NSA-OBS site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
SOIL_TEMP_50MM	[degrees Celsius]
SOIL_TEMP_250MM	[degrees Celsius]
SOIL_TEMP_450MM	[degrees Celsius]
BS1_STEM_TEMP_H1800_D5_N	[degrees Celsius]
BS1_STEM_TEMP_H1800_D20_N	[degrees Celsius]
BS2_STEM_TEMP_H1800_D5_N	[degrees Celsius]
BS2_STEM_TEMP_H1800_D20_N	[degrees Celsius]
BS3_STEM_TEMP_H1800_D5_N	[degrees Celsius]
BS3_STEM_TEMP_H1800_D20_N	[degrees Celsius]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

For SSA-OBS site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
JP1_STEM_TEMP_H1400_D5_E	[degrees Celsius]
JP1_STEM_TEMP_H1400_D20_E	[degrees Celsius]
T1_STEM_TEMP_H1000_D5_NE	[degrees Celsius]
T1_STEM_TEMP_H1000_D20_NE	[degrees Celsius]
BS1_STEM_TEMP_H1000_D5_NE	[degrees Celsius]
BS1_STEM_TEMP_H1000_D20_NE	[degrees Celsius]
BS1_STEM_TEMP_H800_D5_NE	[degrees Celsius]
BS1_STEM_TEMP_H800_D20_NE	[degrees Celsius]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

For SSA-OA site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
AIR_TEMP_6600MM	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D5	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D20	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D20_N	[degrees Celsius]
ASP1_STEM_TEMP_H2000_D20_W	[unitless]
ASP2_STEM_TEMP_H2000_D5	[degrees Celsius]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

For SSA-OJP site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
AIR_TEMP_2000MM	[degrees Celsius]
JP1_STEM_TEMP_H1700_D20_SW	[degrees Celsius]
JP1_STEM_TEMP_H1700_D20_N	[degrees Celsius]
JP1_STEM_TEMP_H1700_D40_NW	[degrees Celsius]
JP1_STEM_TEMP_H1700_D20_SE	[degrees Celsius]
JP1_STEM_TEMP_H1700_D40_SE	[degrees Celsius]
JP1_STEM_TEMP_H1700_D50_N	[degrees Celsius]
JP1_STEM_TEMP_H1700_D50_S	[degrees Celsius]
JP1_STEM_TEMP_H1700_D20_NW	[degrees Celsius]
JP1_STEM_TEMP_H1700_D20_NE	[degrees Celsius]
JP2_STEM_TEMP_H1700_D20_SE	[degrees Celsius]
JP2_STEM_TEMP_H1700_D20_NW	[degrees Celsius]
CRTFCN_CODE	[none]

REVISION_DATE	[DD-MON-YY]

For SSA-YJP site:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
SOIL_TEMP_50MM	[degrees Celsius]
SOIL_TEMP_150MM	[degrees Celsius]
SOIL_TEMP_250MM	[degrees Celsius]
SOIL_TEMP_400MM	[degrees Celsius]
JP1_STEM_TEMP_H600_D5_NE	[degrees Celsius]
JP1_STEM_TEMP_H600_D10_NE	[degrees Celsius]
JP2_STEM_TEMP_H600_D5_NE	[degrees Celsius]
JP2_STEM_TEMP_H600_D10_NE	[degrees Celsius]
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:

For NSA-OBS site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
SOIL_TEMP_50MM	[Capsuled soil thermistor]
SOIL_TEMP_250MM	[Capsuled soil thermistor]
SOIL_TEMP_450MM	[Capsuled soil thermistor]
BS1_STEM_TEMP_H1800_D5_N	[Insulated thermistor]
BS1_STEM_TEMP_H1800_D20_N	[Insulated thermistor]
BS2_STEM_TEMP_H1800_D5_N	[Insulated thermistor]
BS2_STEM_TEMP_H1800_D20_N	[Insulated thermistor]
BS3_STEM_TEMP_H1800_D5_N	[Insulated thermistor]
BS3_STEM_TEMP_H1800_D20_N	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

For SSA-OBS site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
JP1_STEM_TEMP_H1400_D5_E	[Insulated thermistor]
JP1_STEM_TEMP_H1400_D20_E	[Insulated thermistor]
T1_STEM_TEMP_H1000_D5_NE	[Insulated thermistor]
T1_STEM_TEMP_H1000_D20_NE	[Insulated thermistor]
BS1_STEM_TEMP_H1000_D5_NE	[Insulated thermistor]

BS1_STEM_TEMP_H1000_D20_NE	[Insulated thermistor]
BS1_STEM_TEMP_H800_D5_NE	[Insulated thermistor]
BS1_STEM_TEMP_H800_D20_NE	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

For SSA-OA site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
AIR_TEMP_6600MM	[Ambient temperature sensor]
ASP1_STEM_TEMP_H2000_D5	[Insulated thermistor]
ASP1_STEM_TEMP_H2000_D20	[Insulated thermistor]
ASP1_STEM_TEMP_H2000_D20_N	[Insulated thermistor]
ASP1_STEM_TEMP_H2000_D20_W	[Insulated thermistor]
ASP2_STEM_TEMP_H2000_D5	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

For SSA-OJP site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
AIR_TEMP_2000MM	[Ambient temperature sensor]
JP1_STEM_TEMP_H1700_D20_SW	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_N	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D40_NW	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_SE	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D40_SE	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D50_N	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D50_S	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_NW	[Insulated thermistor]
JP1_STEM_TEMP_H1700_D20_NE	[Insulated thermistor]
JP2_STEM_TEMP_H1700_D20_SE	[Insulated thermistor]
JP2_STEM_TEMP_H1700_D20_NW	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

For SSA-YJP site:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Data logger]
TIME_OBS	[Data logger]
SOIL_TEMP_50MM	[Capsuled soil thermistor]
SOIL_TEMP_150MM	[Capsuled soil thermistor]
SOIL_TEMP_250MM	[Capsuled soil thermistor]

SOIL_TEMP_400MM	[Capsuled soil thermistor]
JP1_STEM_TEMP_H600_D5_NE	[Insulated thermistor]
JP1_STEM_TEMP_H600_D10_NE	[Insulated thermistor]
JP2_STEM_TEMP_H600_D5_NE	[Insulated thermistor]
JP2_STEM_TEMP_H600_D10_NE	[Insulated thermistor]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

7.3.5 Data Range

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

For NSA-OBS site:

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	NSA-OBS-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	13-APR-94	30-OCT-94	None	None	None	None
TIME_OBS	0	2330	None	None	None	None
SOIL_TEMP_50MM	-11.19	37.03	None	None	None	None
SOIL_TEMP_250MM	-.7	9.84	None	None	None	None
SOIL_TEMP_450MM	-1.18	1.82	-999	None	None	None
BS1_STEM_TEMP_H1800_D5_N	-13.5	23.39	None	None	None	None
BS1_STEM_TEMP_H1800_D20_N	-12.27	23.96	None	None	None	None
BS2_STEM_TEMP_H1800_D5_N	-13.36	23.44	None	None	None	None
BS2_STEM_TEMP_H1800_D20_N	-13.33	24.19	None	None	None	None
BS3_STEM_TEMP_H1800_D5_N	-12.48	23.5	None	None	None	None
BS3_STEM_TEMP_H1800_D20_N	-13.04	24.3	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	21-AUG-97	21-AUG-97	None	None	None	None

For SSA-OBS site:

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-OBS-FLXTR	SSA-OBS-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	25-OCT-93	27-APR-95	None	None	None	None
TIME_OBS	0	2350	None	None	None	None
JP1_STEM_TEMP_H1400_D5_E	-37	30.3	None	None	None	None
JP1_STEM_TEMP_H1400_D20_E	-36.8	28.67	None	None	None	None
T1_STEM_TEMP_H1000_	-39.37	24.45	None	None	None	None

D5_NE						
T1_STEM_TEMP_H1000_	-40.73	21.44	None	None	None	None
D20_NE						
BS1_STEM_TEMP_H1000_	-39.43	26.47	None	None	None	None
D5_NE						
BS1_STEM_TEMP_H1000_	-39.36	26.31	None	None	None	None
D20_NE						
BS1_STEM_TEMP_H800_	-39.72	31.6	-999	None	None	None
D5_NE						
BS1_STEM_TEMP_H800_	-40.05	32.2	-999	None	None	None
D20_NE						
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	23-JUL-98	23-JUL-98	None	None	None	None

For SSA-OA site:

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-9OA-FLXTR	SSA-9OA-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	16-FEB-94	25-APR-95	None	None	None	None
TIME_OBS	0	2330	None	None	None	None
AIR_TEMP_6600MM	-19.9	28.41	-999	None	None	None
ASP1_STEM_TEMP_H2000_ D5	-29.45	27.1	-999	-888	None	None
ASP1_STEM_TEMP_H2000_ D20	-31.58	26.9	-999	None	None	None
ASP1_STEM_TEMP_H2000_ D20_N	-32.28	26.27	-999	None	None	None
ASP1_STEM_TEMP_H2000_ D20_W	-32.56	26.15	-999	None	None	None
ASP2_STEM_TEMP_H2000_ D5	-33.05	29.49	-999	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	10-JUL-98	10-JUL-98	None	None	None	None

For SSA-OJP site:

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-OJP-FLXTR	SSA-OJP-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	19-FEB-94	26-APR-95	None	None	None	None
TIME_OBS	0	2350	None	None	None	None
AIR_TEMP_2000MM	-38.16	32.07	-999	None	None	None
JP1_STEM_TEMP_H1700_ D20_SW	-36.13	29.49	-999	None	None	None
JP1_STEM_TEMP_H1700_ D20_N	-36.01	27.78	-999	None	None	None
JP1_STEM_TEMP_H1700_	-35.88	16.67	-999	None	None	None

D40_NW						
JP1_STEM_TEMP_H1700_	-36.12	16.95	-999	None	None	None
D20_SE						
JP1_STEM_TEMP_H1700_	-36.14	16.79	-999	None	None	None
D40_SE						
JP1_STEM_TEMP_H1700_	-36.34	16.41	-999	None	None	None
D50_N						
JP1_STEM_TEMP_H1700_	-36.64	16.85	-999	None	None	None
D50_S						
JP1_STEM_TEMP_H1700_	-36.47	16.77	-999	None	None	None
D20_NW						
JP1_STEM_TEMP_H1700_	-36.5	18.2	-999	None	None	None
D20_NE						
JP2_STEM_TEMP_H1700_	-36.31	19.28	-999	None	None	None
D20_SE						
JP2_STEM_TEMP_H1700_	-32.97	16.73	-999	None	None	None
D20_NW						
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	21-AUG-97	21-AUG-97	None	None	None	None

For SSA-YJP site:

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-YJP-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	RSS17-SST01	RSS17-SST01	None	None	None	None
DATE_OBS	15-JUL-94	26-APR-95	None	None	None	None
TIME_OBS	0	2350	None	None	None	None
SOIL_TEMP_50MM	-9.34	21.83	None	None	None	None
SOIL_TEMP_150MM	-8.75	18.22	None	None	None	None
SOIL_TEMP_250MM	-11.22	17.88	None	None	None	None
SOIL_TEMP_400MM	-5.52	16.57	None	None	None	None
JP1_STEM_TEMP_H600_	-45.71	35.96	-999	None	None	None
D5_NE						
JP1_STEM_TEMP_H600_	-46.19	37.9	-999	None	None	None
D10_NE						
JP2_STEM_TEMP_H600_	-46.03	34.84	-999	None	None	None
D5_NE						
JP2_STEM_TEMP_H600_	-45.46	35.23	-999	None	None	None
D10_NE						
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	20-AUG-97	20-AUG-97	None	None	None	None

For ALL sites:

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 is a sample of the first few records from the data table on the CD-ROM (records may wrap here if longer than 80 characters):

For NSA-OBS site:

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,SOIL_TEMP_50MM,SOIL_TEMP_250MM,
SOIL_TEMP_450MM,BS1_STEM_TEMP_H1800_D5_N,BS1_STEM_TEMP_H1800_D20_N,
BS2_STEM_TEMP_H1800_D5_N,BS2_STEM_TEMP_H1800_D20_N,BS3_STEM_TEMP_H1800_D5_N,
BS3_STEM_TEMP_H1800_D20_N,CRTFCN_CODE,REVISION_DATE
'NSA-OBS-FLXTR','RSS17-SST01',01-AUG-94,0,20.79,5.88,.34,13.85,13.65,13.94,14.23,
13.58,14.25,'CPI',21-AUG-97
'NSA-OBS-FLXTR','RSS17-SST01',01-AUG-94,100,19.23,5.92,.34,13.48,13.65,13.65,
13.99,13.48,14.06,'CPI',21-AUG-97
'NSA-OBS-FLXTR','RSS17-SST01',01-AUG-94,200,16.71,5.91,.33,12.75,13.43,13.0,
13.43,12.98,13.61,'CPI',21-AUG-97
```

For SSA-OBS site:

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,JP1_STEM_TEMP_H1400_D5_E,
JP1_STEM_TEMP_H1400_D20_E,T1_STEM_TEMP_H1000_D5_NE,T1_STEM_TEMP_H1000_D20_NE,
BS1_STEM_TEMP_H1000_D5_NE,BS1_STEM_TEMP_H1000_D20_NE,BS1_STEM_TEMP_H800_D5_NE,
BS1_STEM_TEMP_H800_D20_ NE,CRTFCN_CODE,REVISION_DATE
'SSA-OBS-FLXTR','RSS17-SST01',01-JUL-94,30,12.54,12.42,11.47,2.1,11.1,11.43,8.81,
13.48,'CPI',23-JUL-98
'SSA-OBS-FLXTR','RSS17-SST01',01-JUL-94,130,12.5,12.43,11.53,2.04,11.17,11.56,
8.63,12.98,'CPI',23-JUL-98
'SSA-OBS-FLXTR','RSS17-SST01',01-JUL-94,230,12.2,12.34,11.38,2.1,10.71,11.53,
7.81,12.04,'CPI',23-JUL-98
```

For SSA-OA site:

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,AIR_TEMP_6600MM,ASP1_STEM_TEMP_H2000_D5,
ASP1_STEM_TEMP_H2000_D20,ASP1_STEM_TEMP_H2000_D20_N,ASP1_STEM_TEMP_H2000_D20_W,
ASP2_STEM_TEMP_H2000_D5,CRTFCN_CODE,REVISION_DATE
'SSA-90A-FLXTR','RSS17-SST01',01-AUG-94,0,25.55,17.15,20.79,22.46,23.11,23.28,
'CPI',10-JUL-98
'SSA-90A-FLXTR','RSS17-SST01',01-AUG-94,30,25.16,16.99,20.82,22.4,23.05,23.3,
'CPI',10-JUL-98
```

```
'SSA-90A-FLXTR','RSS17-SST01',01-AUG-94,100,24.87,16.83,20.87,22.35,23.03,23.3,
'CPI',10-JUL-98
```

For SSA-OJP site:

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,AIR_TEMP_2000MM,JP1_STEM_TEMP_H1700_D20_SW,
JP1_STEM_TEMP_H1700_D20_N,JP1_STEM_TEMP_H1700_D40_NW,JP1_STEM_TEMP_H1700_D20_SE,
JP1_STEM_TEMP_H1700_D40_SE,JP1_STEM_TEMP_H1700_D50_N,JP1_STEM_TEMP_H1700_D50_S,
JP1_STEM_TEMP_H1700_D20_NW,JP1_STEM_TEMP_H1700_D20_NE,JP2_STEM_TEMP_H1700_D20_SE,
JP2_STEM_TEMP_H1700_D20_NW,CRTFCN_CODE,REVISION_DATE
'SSA-OJP-FLXTR','RSS17-SST01',01-APR-94,0,8.64,10.62,7.18,6.42,10.84,10.9,4.1,
10.95,6.8,4.99,10.74,11.66,'CPI',21-AUG-97
'SSA-OJP-FLXTR','RSS17-SST01',01-APR-94,30,7.5,10.22,7.18,6.67,10.32,10.45,4.77,
10.32,6.79,5.3,10.33,11.12,'CPI',21-AUG-97
'SSA-OJP-FLXTR','RSS17-SST01',01-APR-94,100,6.64,9.82,7.09,6.75,9.8,10.0,5.0,
10.05,6.75,5.43,9.89,10.59,'CPI',21-AUG-97
```

For SSA-YJP site:

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,SOIL_TEMP_50MM,SOIL_TEMP_150MM,
SOIL_TEMP_250MM,SOIL_TEMP_400MM,JP1_STEM_TEMP_H600_D5_NE,
JP1_STEM_TEMP_H600_D10_NE,JP2_STEM_ TEMP_H600_D5_NE,JP2_STEM_TEMP_H600_D10_NE,
CRTFCN_CODE,REVISION_DATE
'SSA-YJP-FLXTR','RSS17-SST01',01-AUG-94,0,20.84,17.46,17.11,15.95,28.71,29.15,
28.24,28.71,'CPI',20-AUG-97
'SSA-YJP-FLXTR','RSS17-SST01',01-AUG-94,30,20.87,17.54,17.17,15.91,28.97,29.38,
28.35,28.86,'CPI',20-AUG-97
'SSA-YJP-FLXTR','RSS17-SST01',01-AUG-94,100,20.77,17.63,17.25,15.95,28.82,29.19,
27.82,28.82,'CPI',20-AUG-97
```

8. Data Organization

8.1 Data Granularity

The unit of data tracked by BORIS is all the data collected at a site on a given day or for a given time period.

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
Thermistor resistance was measured in kOhms and converted to °C using the manufacturer's data conversion table.

9.2.2 Processing Changes
None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments
None given.

9.3.2 Calculated Variables
Thermistor resistance was measured in kOhms and converted to °C using the manufacturer's data conversion table.

9.4 Graphs and Plots
None.

10. Errors

10.1 Sources of Error
Thermistors may read higher temperatures than their environment when exposed to direct radiation or if output leads get shorted by moisture in cables with faulty insulation. The latter is a problem after rain if the shorting resistance is very high, and its effect is hard to separate/detect from true readings of sensor resistance.

10.2 Quality Assessment

10.2.1 Data Validation by Source
None given.

10.2.2 Confidence Level/Accuracy Judgment
Measurement accuracy of the thermistors was determined to be +/- 0.2 °C, as based on laboratory testing.

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

BOREAS staff performed initial quality checks while loading the data into BORIS. This was, by no means, an exhaustive effort. Individual users are cautioned that unreliable data may still be present.

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

- NSA-OBS: One soil temperature sensor was also inserted to a depth of 700 mm below the surface but it was shorted during the season in 1994 by cable damage and thus not used in this data file.
- SSA-OA: One stem temperature probe was also inserted at 10 mm into JP1, but the sensor readings were found to be erratic beginning in September 1994. Data collected after this date were removed.
- SSA-OBS: Four soil temperature sensors were also inserted to a depth of 50, 250, 450, and 700 mm below the surface, but they were shorted by sensor and cable damage during 1994 and thus the data were not included in this file.

12. Application of the Data Set

Radar may be applied to assess growing season length in boreal landscapes.

13. Future Modifications and Plans

No future modifications are planned.

14. Software

14.1 Software Description

Data conversion was performed in Sigmaplot 4.0 for DOS (Jandel Scientific, acquired by SPSS, Inc., http://www.spss.com/ [Internet Link]).

14.2 Software Access

The software mentioned above may be acquired from SPSS, Inc., or a software reseller.

15. Data Access

The RSS-17 stem, soil, and air temperature 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/ [Internet Link].

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

None given.

17.2 Journal Articles and Study Reports

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).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

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
DC	- Direct Current
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
ERS-1	- Earth Resources Satellite-1
GIS	- Geographic Information System

GSFC - Goddard Space Flight Center
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
RSS - Remote Sensing Science
SAR - Synthetic Aperture Radar
SSA - Southern Study Area
URL - Uniform Resource Locator
UTM - Universal Transverse Mercator
YJP - Young Jack Pine

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

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13. ABSTRACT *(Maximum 200 words)*

The BOREAS RSS-17 team collected several data sets in support of its research in monitoring and analyzing environmental and phenological states using radar data. This data set consists of tree bole and soil temperature measurements from various BOREAS flux tower sites. Temperatures were measured with thermistors implanted in the hydroconductive tissue of the trunks of several trees at each site and at various depths in the soil. Data were stored on a data logger at intervals of either 1 or 2 hours. The majority of the data were acquired between early 1994 and early 1995. The primary product of this data set is the diurnal stem temperature measurements acquired for selected trees at five BOREAS tower sites. The data are provided in tabular ASCII format.

14. SUBJECT TERMS
BOREAS, remote sensing science, tree bole measurements, soil temperature measurements.

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