BOREAS FOLLOW-ON HMET-04 1996-1998 NSA METEOROLOGICAL DATA
Get Data

Summary

As part of the BOREAS Follow-On, an extended period of data collection was supported in the NSA because of the continued efforts at the NSA-OBS site. This data set contains near-surface meteorological data collected and averaged over 15 minute intervals from two sites in the NSA, the SRC tower at the Thompson airport (YTH) and a temporary walkup wooden tower at the Old Black Spruce (OBS) tower site.

Data Citation

Cite this data set as follows (citation revised on October 30, 2002):

Betts, A. K., S. R. Shewchuk, H. Osborne, K. Young, and V. Wittrock. 2001. BOREAS Follow-On HMet-04 1996-1998 NSA Meteorological Data. Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS Follow-On HMet-04 1996-1998 NSA Meteorological Data

1.2 Data Set Introduction

This data set contains near-surface data collected and averaged over 15 minutes from two sites at and near the Thompson, Manitoba airport (SRC-Airport) and at the BOREAS NSA-OBS flux tower site (SRC-Old Black Spruce).

One data set is a continuation of the Thompson Airport site, which collected "Suite A" (meteorological) data throughout BOREAS (1994-1996). Data processing and quality checks continued though July 4, 1997, using the procedures in place for BOREAS. After this date, the work was subcontracted by SRC, the sites were visited only to change the data loggers, and data quality was significantly reduced. A separate data logger, and instruments to measure diffuse radiation and incoming long-wave (Suite B), were added to this site in the Fall 1997.

A second site was established at the northern Old Black Spruce location (BOREAS TF03 team) in summer of 1997, which ran for about one year, when measurements terminated at both sites. This site too was visited only to change the data loggers. The flux and separate meteorological measurements associated with TF-03/FLX-01 continue at this site.

Because of missing data (primarily when data loggers failed), researchers may have to merge the 2 data sets to get a single atmospheric driver set for Thompson for 1997 and the first half of 1998.

1.4 Summary of Parameters

Note that the file structure is identical for both sites:

Parameter	Units
SITE_NAME	NA
LOCATION	NA
DATE_OBS	DD-MON-YY
TIME_OBS	HHMM (start-time)
PAR_RAD	Wm^-2
S_PAR_RAD	Wm^-2
NET_RAD	Wm^-2
S_NET_RAD	Wm^-2
SOL_DOWN	Wm^-2
S_SOL_DOWN	Wm^-2
SOL_REFL	Wm^-2
S_SOL_REFL	Wm^-2
TEMP_UPPER	Deg_C
S_TEMP_UPPER	Deg_C
TEMP_LOWER	Deg_C
S_TEMP_LOWER	Deg_C
SOIL_10CM	Deg_C
S_SOIL_10CM	Deg_C
SOIL_20CM	Deg_C
S_SOIL_20CM	Deg_C
SOIL_50CM	Deg_C
S_SOIL_50CM	Deg_C
HUMIDITY	%_RH
S_HUMIDITY	%_RH
PRESSURE	mb
S_PRESSURE	mb
IR_TEMP	Deg_C
S_IR_TEMP	Deg_C
WIND_SPEED	ms^-1

S_WIND_SPEED	ms^-1
WIND_DIR	Deg_True
S_WIND_DIR	Deg_True
PRECIP_BELFORT	mm
SNOW_DEPTH	mm
TIP_B_15MIN	mm
TIP_BUCKET	mm
DIFFUSE	Wm^-2
LW_DOWN	Wm^-2
CRTFCN_CODE	NA
REVISION_DATE	DD-MON-YY

The data values are forward looking, that is, the data value at TIME_OBS=0 represents an average of the data stream from Time>=0 through Time<15 min. TIME_OBS is in GMT. Local time is GMT - 6 hours.

1.5 Discussion

Missing data. There are major blocks of time when the data are missing, primarily because of data logger failure. See section 6.1.

1.6 Related Data Sets

BOREAS AFM-07 SRC Surface Meteorological Data
BOREAS AES Campbell Scientific Surface Meteorological Data
BOREAS AES MARSII Surface Meteorological Data
BOREAS AES READAC Surface Meteorological Data
BOREAS TF-03 NSA-OBS Tower Flux, Meteorological, and Soil Temperature Data.

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2. Investigator(s)

2.1 Investigator(s) Name and Title

BOREAS Staff Science

2.2 Title of Investigation

BOREAS Follow-on HMet-4 1996-1998 NSA Meteorological Data

2.3 Contact Information

Although these data were collected by a sub-contractor to SRC, the data set was assembled by Alan Betts and John Ball, as the data files sent to the archive were not usable, nor were they documented.

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3. Theory of Measurements

The theory behind the meteorological measurements made for BOREAS were to enhance the understanding of the general climate of the Canadian boreal region. The main purpose of each AMS station was to gather enough precipitation, temperature and other meteorological information to fully understand the climate for that portion of the boreal forest. Data from all of the instruments were stored on a data logger which performed some of the initial data processing.

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4. Equipment

4.1 Sensor/Instrument Description

This section is a comprehensive description of the AMS sites. The parameters included are: site name, location and elevation and a list of each instrument at the site. Within are detailed descriptions of the instruments used, an explanation of what the instrument is used for, heights of the sensors, the supplier and/or manufacturers, and serial number when possible. Additionally, the description of radiation sensors will contain the wavelengths they are able to measure.

4.1.1 Collection Environment

The collection environment for the SRC AMS stations varied greatly from season to season and site to site. All instruments, except where otherwise noted, were exposed to the elements at all times. The sites were located in relatively undisturbed locations.

During winter, the instruments were exposed to frequent snow storms and temperatures

that reached -40° C. During the summer months, temperatures at the sites reached 30° C. No covers were built to protect the instrumentation from precipitation, wind, animal damage, or vandalism.

4.1.2 Source/Platform

Suite A sites use a triangular cross-section Rohn tower as a platform for mounting the majority of the suite A instruments. Each side of the tower is roughly 0.5 meters across and is internally supported by solid steel "zigzag" cross braces. The tower is designed with a hinge roughly halfway along its length that allows the tower to be folded down so that instruments may be attached and serviced without climbing gear. When the installation is complete the tower can be extended to its full height. Components mounted on the tower include the data logger, pressure sensor, solar panel, albedometer, net radiometer, air temperature and relative humidity sensors, PAR sensor and wind speed and direction sensor. A lightning rod is also attached to the top of each tower.

The precipitation gauges at each site are mounted on a separate wooden platform located a short distance from the Rohn tower. The distance varies by site. The platform is three meters high and 0.9 meters wide, and 2.4 meters long.

The Suite B sites are usually located a fair distance away from the Rohn tower that holds the suite A instrumentation. The suite B sites recorded information on a separate data logger (usually a CR10).

4.1.3 Source/Platform Mission Objectives

The objective of the Rohn tower is to provide a stable place to hang instrumentation for the duration of the experiment. Additionally, the tower provides a method of placing instruments at various levels within the canopy.

4.1.4 Key Variables

Instrument Type	Measured Parameters
PAR radiometer	PAR radiation
Net radiometer	Net radiation
Albedometer	Incoming solar radiation Reflected solar radiation
Temperature and relative humidity probe	Upper canopy air temperature Relative humidity
Temperature probe	Lower canopy air temperature
Soil temperature probe	Soil temperature
Barometric pressure	Air pressure
IR temperature	Surface IR temperature
Wind monitor	Wind direction Wind speed
Belfort rainfall transmitter	Precipitation
Ultrasonic depth gauge	Snow depth
Soil moisture sensor	Soil moisture
Tipping bucket rain gauge	Precipitation
Pyrgeometer	Incoming longwave radiation Outgoing longwave radiation
Pyranometer with shadow band	Diffuse solar radiation

4.1.5 Principles of Operation

Instrument	Principle of Operation
Data Logger	This instrument is used to store and partially manipulate the data.
Multiplexer	The Multiplexer is used to increase the number of sensors that may be scanned by Campbell Scientific (CS) data loggers.
Spark Gapped Junction Box	The Junction Box is designed to minimize damage to instruments connected to wires on which a high voltage could be induced through electrostatic discharge due to lightening. There are two per tower.
Modem	The DC112 Modem is a 300/1200 baud modem employing the "AT" command set. It is used as a remote site modem connected to a CS data logger.
Solar Panels	The Model MSX-30 Solarex Solar Panel photovoltaic module is designed to operate DC loads with small to moderate energy requirements.
PAR Radiometer	The Skye Single Channel PAR Sensor is used to measure PAR Radiation. These sensors have cosine-corrected heads, each containing a semiconductor diode and filter system responding to light.
Net Radiometer	The Fritschen Q-6 Net Radiometer is a high output instrument that is designed to measure net radiation. Net radiation is defined as the sum of all incoming radiation minus the outgoing radiation. Incoming radiation consists of direct and diffuse shortwave radiation and longwave sky radiation. Outgoing radiation consists of reflected and terrestrial longwave radiation.
Albedometer (Solar & Reflected)	None given
Temperature and Relative Humidity Probe (Above Canopy)	None given
Temperature Probe (Lower Canopy)	None given
Soil Temperature Probe	None given
Barometric Pressure sensor	None give
IR Thermometer	The Everest Interscience Model 4000AL Infrared Thermometer measures the IR radiation emitted by objects and outputs the temperature, or a signal that is related to the temperature, of the object. The major advantage of this IR sensor is that no physical contact is made with the object being measured.
Wind Direction/Wind Speed sensor: None given	
Belfort Precipitation Gauge	None given
Snow Depth Sensor	None given

Soil Moisture Sensor	The Matrix Water Potential Soil Moisture Sensor measures soil moisture by measuring the heat differential between a warmed temperature probe and an unwarmed probe. The theory is that when a probe is heated the temperature rise will be a function of the water content of the medium (the soil). By inserting a heater and a temperature sensor in a fixed porous block in contact with soil, the temperature rise of the heater can be correlated to the water potential of the soil.
Tipping Bucket Precipitation Gauge	None given
Pyrgeometer	This instrument measures the exchange of radiation between a horizontal blackened surface and the target viewed. For the measurement of longwave radiation in general, and for the isolation of this from the solar shortwave radiation in daytime, a 30 mm diameter hemisphere of silicon is used. This instrument is measuring downward longwave radiation from the atmosphere only.
Pyranometer	None given
Shadow Band Stand	The shadow band attaches to the suite B pyranometer that measures incoming solar radiation. The shadow band is intended to block out the direct rays of the sun, forcing the pyranometer to measure only the diffuse component of solar radiation. The band is wide enough to block the sun's direct rays for a few weeks at a time and requires regular manual adjustment. This was not performed for this post-BOREAS data.

4.1.6 Sensor/Instrument Measurement Geometry

Unless otherwise noted, all instruments are on the suite A tower present at each site. A negative height indicates that the instrument is located below ground surface.

Thompson Airport

Instrument	Height on tower/Location
PAR radiometer	18.9 m
Net radiometer	18.9 m
Albedometer	18.9 m
Temperature/relative humidity probe	18.9 m
Lower canopy temperature probe	1.8 m
Soil temperature probe	-10 cm, 2 m northwest of the tower
Soil temperature probe	-20 cm, 2 m northwest of the tower
Soil temperature probe	-50 cm, 2 m northwest of the tower
Barometric pressure	5.5 m
IR temperature	18.9 m
Wind monitor	18.9 m
Belfort precipitation gauge	7.3 m, 10 m northeast of tower
Snow depth gauge	2100 cm, 50 m east-northeast of tower
Soil moisture sensor	-10 cm, Not available
Tipping bucket precipitation	50 m east-northeast of tower

NSA-OBS

The NSA-OBS instruments were installed on a temporary walkup wooden tower,

nominally above the canopy at 15m, but exact heights and locations are unknown.

Instrument	Height on tower/Location
PAR radiometer	15.8 m
Net radiometer	15.8 m
Albedometer	15.8 m
Temperature/relative humidity probe	15.8 m
Lower canopy temperature probe	4.6 m
Soil temperature probe	-10 cm, Not available
Soil temperature probe	-20 cm, Not available
Soil temperature probe	-50 cm, Not available
Barometric pressure	16.2 m, north of the tower
IR temperature	15.8 m
Wind monitor	15.8 m
Belfort precipitation gauge	northwest of tower
Snow depth gauge	2200 cm, northwest of tower
Soil moisture sensor	-10 cm, Not available
Tipping bucket precipitation	northwest of tower
Pyrgeometer	3.7 m
Pyranometer	3.7 m
Shadow Band Stand	3.7 m

4.1.7 Manufacturer of Sensor/Instrument

Instrument	Description	Manufacturer
PAR radiometer	Skye Single Channel PAR Sensor	Skye Instruments Ltd.
Net radiometer	Fritschen Q-6 Net Radiometer	Radiation and Energy Balance Systems, Inc.
Albedometer (Solar and reflected)	Eppley Model PSP Precision Spectral Pyranometers	The Eppley Laboratory, Inc.
Temperature and relative humidity probe	Model HMP35CF Temperature and Relative Humidity Probe	Campbell Scientific
Lower canopy temperature probe	Model 107F Temperature Probe	Campbell Scientific
Soil temperature probe	Model 108BAM Temperature Probe	Campbell Scientific
Barometric pressure sensor	Model SBP270 Barometric Pressure Sensor	Setra
IR temperature sensor	Model 4000AL Infrared Thermometer	Everest Interscience
Wind monitor	Model 05103-10 Wind Monitor	R.M. Young
Belfort precipitation gauge	Belfort Rainfall Transmitter	Belfort Instrument Company
Snow depth gauge	UDG01 Ultrasonic Depth Gauge	Campbell Scientific.
Soil moisture sensor		Matrix

	Matrix Water Potential Soil Moisture Sensor	
Tipping bucket precipitation gauge	Model TE525 Tipping Bucket Rain Gauge	Texas Electronics
Pyrgeometer	Model PIR Precision Infrared Radiometer	The Eppley Laboratory, Inc.
Pyranometer	Model PSP Precision Pyranometer	The Eppley Laboratory, Inc.
Shadow band stand		The Eppley Laboratory, Inc.

The following tables list the instrument serial numbers by site.

Thompson Airport Suite A

Instrument	Serial Number
PAR radiometer	SKE51006937022
Net radiometer	93213
Albedometer - Solar	29876F3
Albedometer - Reflected	29877F3
Temperature and relative humidity probe	C1187
Lower canopy temperature probe	C1233
Soil temperature probe at -10 cm	C1807
Soil temperature probe at -20 cm	C1832
Soil temperature probe at -50 cm	C1805
Barometric Pressure	414247
IR Temperature	2608-1
Wind monitor	14288
Belfort precipitation gauge	5-4057
Snow depth gauge	C1341
Soil moisture sensor	1038
Tipping bucket precipitation gauge	Not available

NSA-OBS Suite A

Instrument	Serial Number
PAR radiometer	SKE51006937023
Net radiometer	93236
Albedometer - Solar	29806F3
Albedometer - Reflected	29807F3
Temperature and relative humidity probe	C1053
Lower canopy temperature probe	C1234
Soil temperature probe at -10 cm	C1823
Soil temperature probe at -20 cm	C1806
Soil temperature probe at -50 cm	C1808
Barometric Pressure	395168
IR Temperature	2608-9
Wind monitor	14681

Belfort precipitation gauge	Not available
Snow depth gauge	C1505
Soil moisture sensor	1039
Tipping bucket precipitation gauge	Not available

NSA-OBS Suite B

Instrument	Serial Number
Pyrgeometer	29754F3
Pyranometer	29721F3
Shadow band stand	Not available

4.2 Calibration

4.2.1 Specifications

The following tables give the calibration multiplier and constant (if applicable) for each instrument at each site.

Thompson Airport Suite A

Instrument Type	Multiplier	Calibration Constant
PAR radiometer	0.5	Not available
Net radiometer	0.0645	12.9 w^2/(mVm^2)
Albedometer - Solar	0.58343	8.57 microV/wm^2
Albedometer - Reflected	0.57274	8.73 microV/wm^2
Temperature and relative humidity probe	0.001 (temp) 0.1 (humidity)	10 feet
Lower canopy temperature probe	0.001	None given
Soil temperature probe at -10 cm	None given	None given
Soil temperature probe at -20 cm	None given	None given
Soil temperature probe at -50 cm	None given	None given
Barometric Pressure	0.12	80
IR Temperature	None given	None given
Wind monitor	0.098 (speed) 0.071 (direction)	None given
Belfort precipitation gauge	0.11518	None given
Snow depth gauge	1	None given
Soil moisture	None given	None given
Tipping bucket precipitation gauge	None given	None given

NSA-OBS Suite A

Instrument Type	Multiplier	Calibration Constant
PAR radiometer	None given	None given
Net radiometer	0.0645	12.9 w^2/(mVm^2)
Albedometer - Solar	0.59595	8.39 microV/wm^2
Albedometer - Reflected	0.61652	8.11 microV/wm^2

Temperature and relative humidity probe	0.001 (temp) 0.1 (humidity)	None given
Lower canopy temperature probe	0.001	None given
Soil temperature probe at -10 cm	None given	None given
Soil temperature probe at -20 cm	None given	None given
Soil temperature probe at -50 cm	None given	None given
Barometric Pressure	0.12	80
IR Temperature	None given	None given
Wind monitor	0.098 (speed) 0.071 (direction)	None given
Belfort precipitation gauge	0.07824	None given
Snow depth gauge	None given	None given
Soil moisture sensor	None given	None given
Tipping bucket precipitation gauge	0.025	None given

NSA-OBS Suite B

Instrument Type	Multiplier	Calibration Constant
Pyrgeometer	None given	3.42 W/m^2
Pyranometer	None given	8.55 W/m^2

4.2.1.1 Tolerance

The following list gives information relating to the tolerances of the instruments used:

Instrument	Tolerance
PAR radiation	Without filters, this instrument is sensitive to electromagnetic energy with wavelengths between 300 and 1000 nanometers. The instrument contains glass and metal interference filters that cut the response to between 400 and 700 nanometers.
Net radiation	A 5 degree error in leveling the net radiometer may result in an error of up to 6 percent under normal conditions (e.g. the sun is relatively high in the sky). Errors greater than 6 percent may occur when the sun is near the horizon.
Albedometer	The albedometers used in the BOREAS study are sensitive to electromagnetic energy with wavelengths between 285 and 2800 nanometers.
Temperature and relative humidity probe	The temperature piece of this ensemble has an accuracy rating of +/- 0.4° C over a temperature range from -53 to +48° C. The humidity probe has an accuracy of +/- 2 percent relative humidity from 0 to 90 percent and a rating of +/- 3 percent over a relative humidity of 90 percent.
Lower canopy temperature probe	This probe has an accuracy rating of +/- 0.4° C over a temperature range from -53 to +48° C.
Soil temperature probes	The soil temperature probes located at the BOREAS sites have an accuracy of +/- 0.4° C over a from of temperature

	from -33 to +48° C.
Barometric pressure sensor	The accuracy of the Setra SBP270 is +/- 0.2 millibars.
IR Thermometer	None given.
Wind sensor	The range in wind speeds measured by the R.M. Young Wind Monitor is - to 60 meters/second with a maximum gust survival of 100 meters/second.
Belfort precipitation gauge	None given.
Snow depth sensor	The snow depth sensor can measure depths between 0.6 meters and 10 meters with an accuracy of +/- 1 centimeter or 0.4 percent of the distance from the sensor to the target. The vertical resolution of the sensor is 0.5 millimeters.
Soil moisture	None given.
Tipping bucket precipitation gauge	None given.
Pyrgeometer	The Eppley pyrgeometer has a temperature dependence of +/- 2 percent when the temperature is between -20 and +40° C.
Pyranometer	The pyranometers used for Suite B sites have a temperature dependence of +/- 1 percent over a range in ambient temperatures from -20 to +40° C.

4.2.2 Frequency of Calibration

All instruments were calibrated by the manufacturer or by SRC before being installed in the sites before the first BOREAS field campaigns. Most of the instruments were again calibrated at the end of March, 1994 during the spring inspection tour. Due to the relative brevity of the experiments the instruments were not required to have full laboratory calibrations. Not calibration was performed after 1994.

4.2.3 Other Calibration Information

None given.

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5. Data Acquisition Methods

The AMS system installed for BOREAS consists of transportable computerized weather observing stations that routinely measure wind, temperature, humidity, pressure, and precipitation at all stations. The stations are equipped to measure soil temperature, surface radiative temperature, shortwave, net, and infrared radiation, and soil moisture. Most of the instruments are scanned every five seconds and averaged every 15 minutes. Many of the stations are powered by solar panels, thereby enabling them to be located remotely without the need for commercial power. Data are collected via a modem and commercial phone lines. The data is downloaded every six hours to the base station at SRC. A computerized limit checker examines the data to be sure it is within specified limits.

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6. Observations

6.1 Data Notes

Detailed notes on site maintenance and problems are given in Section 11.

- Suite A Data: Thompson Airport, Missing from 12/2/97 through 2/6/98
- Suite B Data: Thompson Airport, Missing from 12/1/96 through 10/16/97 and from 2/7/98 through end of data set.
- Suite B Data: Old Black Spruce site, Missing from beginning of data set until 2/12/98

6.2 Field Notes

Detailed notes on site maintenance and problems are given in Section 11.

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7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage:

Site	Latitude	Longitude	Elevation
NSA-9BS-YTHSA (Airport)	55.8° N	-97.87° W	221m
NSA-OBS-FLXTR	55.879° N	-98.48° W	250m

NSA-9BS-YTHSA (Airport)

The Thompson Airport is a fully-instrumented Suite A AMS site. The instruments are located in an area that is dominated by spruce and poplar. The tops of the trees nearest the tower are approximately 13 meters while the top of the tower extends to 19 meters. This site is about 1 kilometer away from the town of Thompson.

NSA-OBS-FLXTR

The NSA-OBS site was installed new in summer 1997 on a new makeshift tower, near the NSA-OBS TF03 site. The suite A and B instruments were moved from the NSA-OJP and NSA-FEN sites, and reinstalled here. The site is a 70-100 year old Black Spruce site of medium to high density, with an average height of approximately 10 m.

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

The data represent point source measurements taken at the sites indicated.

7.1.4 Projection

Not applicable

7.1.5 Grid Description

Not applicable

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

See section 7.2.2.

7.2.2 Temporal Coverage Map

The table below gives detailed date ranges for individual sites:

Site	Dates of Data Set	Type of Data
NSA-9BS-YTHSA (Airport)	Dec 1, 1996 - June 30, 1998	Suite A&B*
NSA-OBS-FLXTR	July 24, 1997 - June 26, 1998	Suite A&B

Note: This table gives nominal start and end dates for data collection at site. Specific instruments did not necessarily begin or end data collection at the above times. *See section 6.1 Data Notes.

7.2.3 Temporal Resolution

To fully understand the microclimate of the boreal forest, it was necessary to make consistent measurements over a long time period. Consequently, the nominal sampling period did not change for the duration of the experiment. Individual cases of instrument error or data logger failure occasionally caused the period between recorded data to change. A list of known errors of this type are given in Section 11.

For the most part, the BOREAS SRC AMS sites collected data with the same sampling strategy. Samples of each variable were acquired every five seconds. These samples were then averaged over fifteen minute periods to get the actual data values. The standard deviations given are for the five-second samples that make up the fifteen minute averages.

The exceptions to this strategy were the Belfort precipitation, Snow depth, Tipping bucket precipitation, and Soil moisture data. The Belfort precipitation and Snow depth data were sampled every minute, the reported data for each hour were the average from minute 55 to minute 59, and the standard deviations were recorded from those five minute periods. The Tipping bucket precipitation was sampled every five seconds, the data values are the running total, and the standard deviations of the samples are given every fifteen minutes. The Soil Moisture data were sampled every 30 seconds, the data value is given at minute 50, and the standard deviation of the samples are taken every minute.

7.3 Data Characteristics

"Suite A" Data are a set of 14 meteorological variables and their standard deviations plus precipitation measurements (see section 1.4). "Suite B" Data measures the two additional fluxes of DIFFUSE and LW-DOWN radiation. There are major blocks of time when the data is missing, primarily because of data logger failure: see section 1.5.

7.3.1 Parameter/Variable

The parameters contained in the data files are:

Column Name
SITE_NAME
LOCATION
DATE_OBS
TIME_OBS

```
PAR_RAD
S_PAR_RAD
NET_RAD
S_NET_RAD
SOL_DOWN
S_SOL_DOWN
SOL_REFL
S_SOL_REFL
TEMP_UPPER
S_TEMP_UPPER
TEMP_LOWER
S_TEMP_LOWER
SOIL_10CM
S_SOIL_10CM
SOIL_20CM
S_SOIL_20CM
SOIL_50CM
S_SOIL_50CM
HUMIDITY
S_HUMIDITY
PRESSURE
S_PRESSURE
IR_TEMP
S_IR_TEMP
WIND_SPEED
S_WIND_SPEED
WIND_DIR
S_WIND_DIR
PRECIP_BELFORT
SNOW_DEPTH
TIP_B_15MIN
TIP_B_TOTAL
DIFFUSE
LW_DOWN
CRTFCN_CODE
REVISION_DATE
```

7.3.2 Description/Definition

The descriptions of the parameters contained in the data files 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.
LOCATION	A more detailed description of the location.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) of the start of the 15 minute observation period.
PAR_RAD	Photosynthetically active radiation.
S_PAR_RAD	Standard deviation of the photosynthetically active radiation.
NET_RAD	Net radiation.
S_NET_RAD	Standard deviation of the net radiation.
SOL_DOWN	Incoming solar radiation.
S_SOL_DOWN	Standard deviation of the incoming solar

	radiation.
SOL_REFL	Reflected solar radiation.
S_SOL_REFL	Standard deviation of the reflected solar radiation.
TEMP_UPPER	Upper canopy air temperature.
S_TEMP_UPPER	Standard deviation of the upper canopy air temperature.
TEMP_LOWER	Lower canopy air temperature.
S_TEMP_LOWER	Standard deviation of the lower canopy air temperature.
SOIL_10CM	Soil temperature at 10 cm.
S_SOIL_10CM	Standard deviation of the soil temperature at 10 cm.
SOIL_20CM	Soil temperature at 20 cm.
S_SOIL_20CM	Standard deviation of the soil temperature at 20 cm.
SOIL_50CM	Soil temperature at 50 cm.
S_SOIL_50CM	Standard deviation of the soil temperature at 50 cm.
HUMIDITY	Relative humidity.
S_HUMIDITY	Standard deviation of the relative humidity.
PRESSURE	Air pressure.
S_PRESSURE	Standard deviation of the air pressure.
IR_TEMP	Surface IR temperature.
S_IR_TEMP	Standard deviation of the surface IR temperature.
WIND_SPEED	Wind speed.
S_WIND_SPEED	Standard deviation of the wind speed.
WIND_DIR	Wind direction.
S_WIND_DIR	Standard deviation of the wind direction.
PRECIP_BELFORT	Precipitation from a Belfort rainfall transmitter.
SNOW_DEPTH	Snow depth.
TIP_B_15MIN	Precipitation from a tipping bucket, amount within the 15 minute period.
TIP_B_TOTAL	Precipitation from a tipping bucket (running total since the instrument was reset).
DIFFUSE	Diffuse solar radiation.
LW_DOWN	Incoming longwave radiation.
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 are:

Column Name	Units
SITE_NAME	[none]
LOCATION	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
PAR_RAD	[Watts][meter^-2]
S_PAR_RAD	[Watts][meter^-2]
NET_RAD	[Watts][meter^-2]
S_NET_RAD	[Watts][meter^-2]
SOL_DOWN	[Watts][meter^-2]
S_SOL_DOWN	[Watts][meter^-2]
SOL_REFL	[Watts][meter^-2]

S_SOL_REFL	[Watts][meter^-2]
TEMP_UPPER	[Degrees C]
S_TEMP_UPPER	[Degrees C]
TEMP_LOWER	[Decrees C]
S_TEMP_LOWER	[Degrees C]
SOIL_10CM	[Degrees C]
S_SOIL_10CM	[Degrees C]
SOIL_20CM	[Degrees C]
S_SOIL_20CM	[Degrees C]
SOIL_50CM	[Degrees C]
S_SOIL_50CM	[Degrees C]
HUMIDITY	[percent]
S_HUMIDITY	[percent]
PRESSURE	[millibars]
S_PRESSURE	[millibars]
IR_TEMP	[Degrees C]
S_IR_TEMP	[Degrees C]
WIND_SPEED	[meters][second^-1]
S_WIND_SPEED	[meters][second^-1]
WIND_DIR	[Degrees true]
S_WIND_DIR	[Degrees true]
PRECIP_BELFORT	[millimeters]
SNOW_DEPTH	[millimeters]
TIP_B_15MIN	[millimeters]
TIP_B_TOTAL	[millimeters]
DIFFUSE	[Watts][meter^-2]
LW_DOWN	[Watts][meter^-2]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The source of the parameter values contained in the data are (see Table 9.2 for detailed information):

Column Name	Data Source
SITE_NAME	[BORIS Designation]
LOCATION	[BORIS Designation]
DATE_OBS	[Human Observer]
TIME_OBS	[Human Observer]
PAR_RAD	[Instrument]
S_PAR_RAD	[Calculated]
NET_RAD	[Instrument]
S_NET_RAD	[Calculated]
SOL_DOWN	[Instrument]
S_SOL_DOWN	[Calculated]
SOL_REFL	[Instrument]
S_SOL_REFL	[Calculated]
TEMP_UPPER	[Instrument]
S_TEMP_UPPER	[Calculated]
TEMP_LOWER	[Instrument]
S_TEMP_LOWER	[Calculated]
SOIL_10CM	[Instrument]
S_SOIL_10CM	[Calculated]
SOIL_20CM	[Instrument]
S_SOIL_20CM	[Calculated]
SOIL_50CM	[Instrument]
S_SOIL_50CM	[Calculated]
HUMIDITY	[Instrument]
S_HUMIDITY	[Calculated]

```
PRESSURE                        [Instrument]
S_PRESSURE                      [Calculated]
IR_TEMP                         [Instrument]
S_IR_TEMP                       [Calculated]
WIND_SPEED                      [Instrument]
S_WIND_SPEED                    [Calculated]
WIND_DIR                        [Instrument]
S_WIND_DIR                      [Calculated]
PRECIP_BELFORT                  [Instrument]
SNOW_DEPTH                      [Instrument]
TIP_B_15MIN                     [Instrument]
TIP_B_TOTAL                     [Instrument]
DIFFUSE                         [Instrument]
LW_DOWN                         [Instrument]
CRTFCN_CODE                     [BORIS Designation]
REVISION_DATE                   [BORIS Designation]
```

7.3.5 Data Range

The actual ranges for the various parameters were not determined.

7.4 Sample Data Record

The following are samples of the first few data records contained the data files (records will wrap if longer that 80 characters):

```
SITE_NAME,LOCATION,DATE_OBS,TIME_OBS,PAR_RAD,S_PAR_RAD,NET_RAD,S_NET_RAD,
SOL_DOWN,S_SOL_DOWN,SOL_REFL,S_SOL_REFL,TEMP_UPPER,S_TEMP_UPPER,TEMP_LOWER,
S_TEMP_LOWER,SOIL_10CM,S_SOIL_10CM,SOIL_20CM,S_SOIL_20CM,SOIL_50CM,S_SOIL_50CM,
HUMIDITY,S_HUMIDITY,PRESSURE,S_PRESSURE,IR_TEMP,S_IR_TEMP,WIND_SPEED,
S_WIND_SPEED,WIND_DIR,S_WIND_DIR,PRECIP_BELFORT,SNOW_DEPTH,TIP_B_15MIN,
TIP_B_TOTAL,DIFFUSE,LW_DOWN,CRTFCN_CODE,REVISION_DATE
NSA-9BS-YTHSA,SRC-Airport,1-Dec-96,15,0.03074,0,-0.19228,0.2,0.00216,0,0.14832,
0,-21.53,0.152,-21.19,0.025,-2.203,0.006,-0.707,0.005,0.161,0.005,83.9,0.433,
989.56,0.06,-21.23,0.104,1.022,0.61,79.5,27.98,497.57,260,-999,-999,-999,-999,
CPI,28-Dec-00
NSA-9BS-YTHSA,SRC-Airport,1-Dec-96,30,0.0985,0,-0.03698,0,0.0043,0,0.01696,0,
-21.42,0.027,-21.12,0.025,-2.208,0.005,-0.708,0.005,0.161,0.005,84.5,0.384,
989.4,0.04,-21.13,0.1,1.09,0.669,71.3,28.46,497.57,260,-999,-999,-999,-999,
CPI,28-Dec-00
NSA-9BS-YTHSA,SRC-Airport,1-Dec-96,45,0.10249,0,0.03451,0,0.06673,0,0.00636,0,
-21.31,0.039,-21,0.03,-2.212,0.005,-0.71,0.005,0.161,0.005,84.9,0.268,989.29,
0.02,-21.01,0.097,1.087,0.615,79.8,30.69,497.57,260,-999,-999,-999,-999,CPI,
28-Dec-00
```

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8. Data Organization

8.1 Data Granularity

The data are organized by year, month, and station.

8.2 Data Format

The data files contain a series of numerical and character fields of varying length separated by commas. There are no spaces between the fields.

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9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

The data loggers accumulated radiation in KJ m^-2. The radiation data (PAR_RAD, NET_RAD, SOL_DOWN, SOL_REFL, LW_DOWN, DIFFUSE) have been corrected by a factor of (1000/900) to convert from KJ m^-2 to W m^-2 (900 seconds averaging interval).

The standard deviations of these radiation flux data have been multiplied by a factor of (1000/5) to convert the data logger calculation (based on 180 5-sec accumulated values in units of KJ m^-2) to Wm^-2 . Please note that these values are true standard deviation in Wm^-2. Please note also that these values, while correct, are not consistent with the radiation flux standard deviations in the BOREAS archive of AFM07 data for the preceding time period, 1994-1996. As of this date (12/15/98) these earlier data were incorrectly converted, and need to be divided by a factor of 5 (the 5-sec sampling period) to give standard deviation in Wm^-2 .This error is so large as to be obvious on partly cloudy days.

Some individual data files contained time errors of +/-6hrs, when the sub-contractor confused local time (GMT - 6) and GMT, and/or erred in correcting local time. These have been fixed, based on sunrise and sunset.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given

9.2.2 Processing Changes

None given

9.3 Calculations

9.3.1 Special Corrections/Adjustments

See Section 14.

9.3.2 Calculated Variables

See Section 14.

9.4 Graphs and Plots

None.

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10. Errors

There has been little quality control of this data. Known errors are:

- Diffuse: Most of the Diffuse radiation data at Thompson is in error, because the shadow band was not adjusted. It has been left as an indicator, and because some small portions could be used to fill in missing SOL_DOWN. DIFFUSE is missing at the Old Black Spruce site.
- Precipitation: The NSA-OBS precipitation data has been deleted as erroneous. The precipitation data (PRECIP_BELFORT, TIP_B_15MIN, and TIP_BUCKET) at Thompson airport is very questionable. Compare with the data at the TF03 NSA-OBS site of Steve Wofsy.
- SNOW_DEPTH: Seems erroneous.
- NET_RAD: In error at Thompson (Feb 6, 1998 through June 30, 1998). It is scaled up by a factor of approximately 6.5. The cause of this scaling error is unknown.

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11. Notes

11.1 Limitations of the Data

None given.

11.2 Known Problems with the Data

See section 9 and 10.

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12. Application of the Data Set

Although this was not necessarily a great data collection exercise, it is still valuable since combined, these two data sets fill in the gaps from each other and give a useful climate driver data set.

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13. Future Modifications and Plans

None.

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14. Software

14.1 Software Description

None given.

14.2 Software Access

None given.

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15. Data Access

15.1 Contact for Data Center/Data Access Information

These BOREAS data are available from the Earth Observing System Data and Information System (EOS-DIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC). The BOREAS contact at ORNL is:

ORNL DAAC User Services
Oak Ridge National Laboratory
(865) 241-3952
ornldaac@ornl.gov
ornl@eos.nasa.gov

15.2 Procedures for Obtaining Data

BOREAS data may be obtained through the ORNL DAAC World Wide Web site at http://www.daac.ornl.gov/ [Internet Link] or users may place requests for data by telephone or by electronic mail.

15.3 Output Products and Availability

Requested data can be provided electronically on the ORNL DAAC's anonymous FTP site or on various media including, CD-ROMs, 8-mm tapes, or diskettes.

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16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

None.

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17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

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17.3 Archive/DBMS Usage Documentation

None.

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18. Glossary of Terms

None.

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19. List of Acronyms

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AES      - Atmospheric and Environmental Services
AFM      - Aircraft Flux and Meteorology
AMS      - Automatic Meteorological Station
BOREAS   - BOReal Ecosystem-Atmosphere Study
BORIS    - BOREAS Information System
CD-ROM   - Compact Disk-Read-Only Memory
DAAC     - Distributed Active Archive Center
EOS      - Earth Observing System
EOSDIS   - EOS Data and Information System
FAX      - Facsimile
GSFC     - Goddard Space Flight Center
IFC      - Intensive Field Campaign
IR       - Infrared
ISLSCP   - International Satellite Land Surface Climatology Project
MARSII   - Meteorological Automatic Reporting System II
MESONET  - Mesoscale Network
NASA     - National Aeronautics and Space Administration
NSA       - Northern Study Area
OBS      - Old Black Spruce
ORNL     - Oak Ridge National Laboratory
PAR      - Photosynthetically Active Radiation
READAC   - Remote Environmental Automated Data Acquisition Concept
SRC      - Saskatchewan Research Council
URL      - Uniform Resource Locator
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20. Document Information

20.1 Document Revision Date

Written: 15-Dec-1998
Last Updated: 05-Feb-2001 (citation revised on 30-Oct-2002)

20.2 Document Review Date(s)

BORIS Review: 15-Mar-2000
Science Review:

20.3 Document ID

hmet04_met

20.4 Citation

Cite this data set as follows (citation revised on October 30, 2002):

Betts, A. K., S. R. Shewchuk, H. Osborne, K. Young, and V. Wittrock. 2001. BOREAS Follow-On HMet-04 1996-1998 NSA Meteorological Data. Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

20.5 Document Curator:

webmaster@daac.ornl.gov

20.6 Document URL:

http://daac.ornl.gov/BOREAS/FollowOn/guides/hmet04_src_nsa_met_doc.html

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Keywords
SURFACE METEOROLOGY
TEMPERATURE
RELATIVE HUMIDITY
WIND SPEED
WIND DIRECTION

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