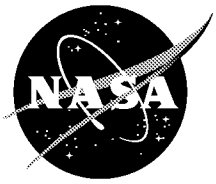
NASA/TM—2000–209891, Vol. 204



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

Forrest G. Hall and Karl Huemmrich, Editors

Volume 204

BOREAS TF-8 NSA-OJP and SSA-OBS Ceilometer Data

Kathleen E. Moore and David R. Fitzjarrald
State University of New York, Albany

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000

The NASA STI Program Office ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

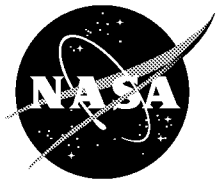
- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.
- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and mission, often concerned with subjects having substantial public interest.
- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at http://www.sti.nasa.gov/STI-homepage.html
- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA Access Help Desk at (301) 621-0134
- Telephone the NASA Access Help Desk at (301) 621-0390
- Write to:
  NASA Access Help Desk
  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076-1320

NASA/TM—2000–209891, Vol. 204



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

Forrest G. Hall and Karl Huemmrich, Editors

Volume 204

BOREAS TF-8 NSA-OJP and SSA-OBS Ceilometer Data

Kathleen E. Moore and David R. Fitzjarrald
State University of New York, Albany

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000

Available from:

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320
Price Code: A17

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Price Code: A10

BOREAS TF-8 NSA-OJP and SSA-OBS Ceilometer Data

Kathleen E. Moore, David R. Fitzjarrald

Summary

The BOREAS TF-8 team used ceilometers to collect data on the fraction of the sky covered with clouds and the cloud height. Included with these data is the surface-based lifting condensation level, derived from temperature and humidity values acquired at the flux tower at the NSA-OJP site. Ceilometer data were collected at the NSA-OJP site in 1994 and at the NSA-OJP and SSA-OBS sites in 1996. The data are available in tabular ASCII files.

Table of Contents

1) Data Set Overview
2) Investigator(s)
3) Theory of Measurements
4) Equipment
5) Data Acquisition Methods
6) Observations
7) Data Description
8) Data Organization
9) Data Manipulations
10) Errors
11) Notes
12) Application of the Data Set
13) Future Modifications and Plans
14) Software
15) Data Access
16) Output Products and Availability
17) References
18) Glossary of Terms
19) List of Acronyms
20) Document Information

1. Data Set Overview

1.1 Data Set Identification

BOREAS TF-08 NSA-OJP and SSA-OBS Ceilometer Data

1.2 Data Set Introduction

Ceilometers emit pulses of laser light and measure the time it takes for the photons to return after being scattered off of the cloud base. The ceilometer provides data on cloud base height and cloud cover. The cloud fraction is the time fraction of cloud cover based on ceilometer reports every minute (30 per half hour). The BOReal Ecosystem-Atmosphere Study (BOREAS) Tower Flux (TF)-08 team collected these data to obtain a seasonal record of cloud fraction and cloud type. Data were collected at the Northern Study Area (NSA)-Old Jack Pine (OJP) site in 1994 and at the NSA-OJP and Southern Study Area (SSA)-Old Black Spruce (OBS) sites in 1996.

1.3 Objective/Purpose

The objective was to collect information on cloud characteristics in conjunction with tower flux measurements.

1.4 Summary of Parameters

Measurements include fraction of cloud cover, the height of the cloud base, backscatter range, and the lifting condensation level. In 1996, cloud heights and backscatter ranges were reported for two cloud layers.

1.5 Discussion

Ceilometers were located near the flux towers to measure the fraction of cloud cover and the height of the cloud base. In 1994 a single Belfort ceilometer operated at the NSA-OJP site. That ceilometer collected data from 31-May-1994 to 20-Sep-1994. In 1996, two Vaisala ceilometers were used, one at the NSA-OJP, the other at the SSA-OBS site. The NSA-OJP ceilometer operated from 03-Jun-1996 to 10-Nov-1996. The SSA-OBS ceilometer operated from 14-Jul-1996 to 17-Oct-1996.

1.6 Related Data Sets

BOREAS AFM-05 Level-2 Upper-Air Network Standard Pressure Level Data
BOREAS AFM-06 NOAA/ETL 35-GHz Cloud/Turbulence Radar GIF Images
BOREAS TF-08 NSA-OJP Tower Flux, Meteorological, and Soil Temperature Data
BOREAS TF-03 NSA-OBS Tower Flux, Meteorological, and Soil Temperature Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

David R. Fitzjarrald
Research Associate
Atmospheric Sciences Research Center

Kathleen E. Moore
Research Scientist
Atmospheric Sciences Research Center

2.2 Title of Investigation

Surface Exchange Observations in the Canadian Boreal Forest Region

2.3 Contact Information

Contact 1:

Kathleen E. Moore
Research Scientist
Atmospheric Sciences Research Center
251 Fuller Rd.
Albany, NY 12203
(518) 437-8732
(518) 437-8758 (fax)
moore@asrc.cestm.albany.edu

Contact 2:

David R. Fitzjarrald
Research Associate
Atmospheric Sciences Research Center
251 Fuller Rd.
Albany, NY 12203
(518) 437-8735
(518) 437-8758 (fax)
fitz@asrc.cestm.albany.edu

Contact 3:
K. Fred Huemmrich
University of Maryland
Code 923
NASA GSFC
Greenbelt, MD 20771
(301) 286-4862
(301) 286-0239 (fax)
Karl.Huemmrich@gsfc.nasa.gov

3. Theory of Measurements

The operating principle of the laser ceilometer is based on measuring the time needed for a short pulse of light to traverse the distance through the atmosphere from the transmitter of the ceilometer to a backscattering cloud base and back to the ceilometer's receiver. From that time measurement, the height of the cloud base is calculated. The instantaneous magnitude of the return signal provides information on the backscatter properties of the atmosphere at a certain height. The cloud fraction is the time fraction of cloud cover based on ceilometer reports every minute (30 per half hour).

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

Measurements were collected at the NSA-OJP site from late May through mid-September 1994 and early June through mid-November of 1996. At the SSA-OBS site, data were collected from mid-June through mid-October of 1996. Over the entire time period of data collection, temperature conditions from less than -15 °C to over 30 °C were experienced, as well as both rain and snow.

4.1.2 Source/Platform

The ceilometers were placed on wooden platforms. The platforms were less than 0.5 m off the ground and within 25 m of the flux towers.

4.1.3 Source/Platform Mission Objectives

The objective was to provide stable and level support for the ceilometer.

4.1.4 Key Variables

The ceilometers measured fraction of cloud cover, the height of the cloud base, and backscatter range. In 1996, cloud heights and backscatter ranges were reported for two cloud layers. The cloud fraction was the time fraction of cloud cover based on ceilometer reports every minute (30 per half hour). The surface-based lifting condensation level was derived from temperature and humidity values acquired at 22.68 m above ground level on the NSA-OJP flux tower.

4.1.5 Principles of Operation

The Belfort ceilometer used a 20-watt near-infrared Gallium-Arsenide laser operating at a wavelength of 0.91 microns. It employed 1,024 range gates, which yielded a vertical resolution of 7.62 m (25 feet) up to a maximum altitude of 7,802 m (25,600 feet). The fields of view of the transmitter and receiver were approximately 1°. The time interval between consecutive observations was set at 1 minute.

The Vaisala CT12K ceilometer digitally sampled the return signal every 100 ns and had a vertical resolution of 15.24 m (50 feet) from ground level to an altitude of 3,901 m (12,500 feet).

4.1.6 Sensor/Instrument Measurement Geometry

The ceilometers sat on a wooden platform within openings in the forest canopy allowing an unobstructed view of the sky.

4.1.7 Manufacturer of Sensor/Instrument

Belfort Instrument Company
727 South Wolfe Street
Baltimore, MD 21231
USA
(410) 342-2626
(410) 342-7028 (fax)
http://www.belfort-inst.com/

Vaisala Inc.
U.S. Office
100 Commerce Way
Woburn, MA 01801-1068
USA
(781) 933-4500

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

The Belfort ceilometer had a vertical resolution of 7.62 m (25 feet), and the Vaisala CT12K ceilometer had a vertical resolution of 15.24 m (50 feet).

4.2.2 Frequency of Calibration

Unknown.

4.2.3 Other Calibration Information

None given

5. Data Acquisition Methods

For each ceiling observation, the Belfort ceilometer goes through a cycle of measurements. The laser is fired 5,120 times, and the reflected signal is sampled for each range gate. On each of the 5,120 scans, for each range gate, the signal is compared with the appropriate noise level for that gate. Depending on whether the received signal is above, below, or within the noise level band, an integer value of 1, -1, or zero is assigned to that gate. These assigned integers are then summed for each gate and thus represent a modified histogram of counts versus height. A peak-location algorithm is then applied to this product to produce a first-order estimate of the cloud ceiling.

For the Vaisala CT12K ceilometer, the return signal strength is derived from the Lidar Equation. A threshold for the backscatter coefficient (a measure of reflection) is based upon assumed visibilities in cloud being in the range of 15 to 150 m.

6. Observations

6.1 Data Notes

None.

6.2 Field Notes

None.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The ceilometers measured cloud conditions at a single point. In 1994, data were collected only at NSA-OJP; in 1996, data were collected at both NSA-OJP and SSA-OBS sites. The ceilometers were located within 25 m of the flux towers. The North American Datum of 1983 (NAD83) coordinates for the sites were:

	Latitude	Longitude	Elevation
NSA-OJP tower	55.92842° N	98.62396° W	255.1 m
SSA-OBS tower	53.98717° N	105.11779° W	628.9 m.

7.1.2 Spatial Coverage Map

Not applicable.

7.1.3 Spatial Resolution

The ceilometer laser was aimed vertically and the fields-of-view of the transmitter and receiver were approximately 1°.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

In 1994, a single Belfort ceilometer operated at the NSA-OJP. That ceilometer collected data from 31-May-1994 to 20-Sep-1994. In 1996, two Vaisala ceilometers were used, one at the NSA-OJP, the other at the SSA-OBS. The NSA-OJP ceilometer operated from 03-Jun-1996 to 10-Nov-1996. The SSA-OBS ceilometer operated from 14-Jul-1996 to 17-Oct-1996.

7.2.2 Temporal Coverage Map

Not applicable.

7.2.3 Temporal Resolution

The time interval between consecutive observations was set at 1 minute for the Belfort ceilometer. The Vaisala CT12K ceilometer digitally sampled the return signal every 100 ns. The cloud fraction was the time fraction of cloud cover based on ceilometer reports every minute (30 per half hour). One-minute ceilometer data and 20-minute lifting condensation level data were interpolated to the half-hour averages provided in the data set.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
MEAN_CLOUD_COVER
CLOUD_HEIGHT_LOWEST
CLOUD_HEIGHT_SECOND
BACKSCATTER_RANGE_FIRST_LAYER
BACKSCATTER_RANGE_SECOND_LAYER
LIFTING_CONDENSATION_LEVEL
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) of the start of the data collection.
MEAN_CLOUD_COVER	The fraction of sky covered by clouds, based on ceilometer reports every minute averaged to a half hourly value.
CLOUD_HEIGHT_LOWEST	The lowest observed cloud base height. If multiple layers of clouds are observed, this is the height of the cloud base of the lower clouds.
CLOUD_HEIGHT_SECOND	If multiple layers of clouds are observed, this is the height of the cloud base of the second lowest cloud layer.
BACKSCATTER_RANGE_FIRST_LAYER	The range of backscatter in the first cloud layer
BACKSCATTER_RANGE_SECOND_LAYER	The range of backscatter in the second cloud layer.

LIFTING_CONDENSATION_LEVEL	The surface-based lifting condensation level, derived from temperature and humidity values acquired at the 22.68 m level on the flux tower.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
MEAN_CLOUD_COVER	[fraction]
CLOUD_HEIGHT_LOWEST	[meters]
CLOUD_HEIGHT_SECOND	[meters]
BACKSCATTER_RANGE_FIRST_LAYER	[1000 kilometers^-1][steradians^-1]
BACKSCATTER_RANGE_SECOND_LAYER	[1000 kilometers^-1][steradians^-1]
LIFTING_CONDENSATION_LEVEL	[meters]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS.]
SUB_SITE	[Assigned by BORIS.]
DATE_OBS	[Supplied by Investigator.]
TIME_OBS	[Supplied by Investigator.]
MEAN_CLOUD_COVER	[Ceilometer]
CLOUD_HEIGHT_LOWEST	[Ceilometer]
CLOUD_HEIGHT_SECOND	[Ceilometer]
BACKSCATTER_RANGE_FIRST_LAYER	[Ceilometer]
BACKSCATTER_RANGE_SECOND_LAYER	[Ceilometer]
LIFTING_CONDENSATION_LEVEL	[psychrometer]
CRTFCN_CODE	[Assigned by BORIS.]
REVISION_DATE	[Assigned by BORIS.]

7.3.5 Data Range

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

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-OJP-FLXTR	SSA-OBS-FLXTR	None	None	None	None
SUB_SITE	9TF08-CEILO	9TF08-CEILO	None	None	None	None
DATE_OBS	31-MAY-94	10-NOV-96	None	None	None	None
TIME_OBS	0	2330	None	None	None	None
MEAN_CLOUD_COVER	0	1	-999	None	None	None
CLOUD_HEIGHT_LOWEST	0	7315.2	-999	None	None	None
CLOUD_HEIGHT_SECOND	0	3810	-999	None	None	Blank
BACKSCATTER_RANGE_FIRST_LAYER	0	12600	-999	None	None	Blank
BACKSCATTER_RANGE_SECOND_LAYER	0	500	-999	None	None	Blank
LIFTING_CONDENSATION_LEVEL	0	3971.77	-999	None	None	Blank
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	17-FEB-99	17-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 CD-ROM.

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,MEAN_CLOUD_COVER,CLOUD_HEIGHT_LOWEST,
CLOUD_HEIGHT_SECOND,BACKSCATTER_RANGE_FIRST_LAYER,
BACKSCATTER_RANGE_SECOND_LAYER,LIFTING_CONDENSATION_LEVEL,CRTFCN_CODE,
REVISION_DATE
'NSA-OJP-FLXTR','9TF08-CEILO',01-AUG-96,0,.1,2646.68,-999.0,50.0,-999.0,2450.76,
'CPI',17-FEB-99
'NSA-OJP-FLXTR','9TF08-CEILO',01-AUG-96,100,0.0,0.0,0.0,0.0,0.0,2491.06,'CPI',
17-FEB-99
```

8. Data Organization

8.1 Data Granularity

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

8.2 Data Format

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

None given.

9.2 Data Processing Sequence

9.2.1 Processing Steps

BORIS staff processed these data by:

- Reviewing the initial data files and loading them online for BOREAS team access.
- Designing relational data base tables to inventory and store the data.
- Loading the data into the relational data base tables.
- Working with the team to document the data set.
- Extracting the data into logical files.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

One-minute ceilometer data and 20-minute lifting condensation level data were interpolated to half-hour averages.

9.3.2 Calculated Variables

The surface-based lifting condensation level was derived from temperature and humidity values acquired at 22.68 m above ground level on the NSA-OJP flux tower. The cloud fraction was the time fraction of cloud cover based on ceilometer reports every minute (30 per half hour).

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

None given.

10.2 Quality Assessment

None given.

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

The Belfort ceilometer had a vertical resolution of 7.62 m (25 feet), and the Vaisala CT12K ceilometer had a vertical resolution of 15.24 m (50 feet).

10.2.4 Additional Quality Assessments

None given.

10.2.5 Data Verification by Data Center

Data were examined to check for spikes, values that were four standard deviations from the mean, long periods of constant values, and missing data.

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

None given.

12. Application of the Data Set

The ceilometer data provide a continuous record of cloud conditions that can be linked with surface observations of heat and moisture fluxes measured from the flux towers.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

None given.

14.2 Software Access

None.

15. Data Access

The NSA-OJP and SSA-OBS ceilometer data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

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

15.4 Data Center Status/Plans

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

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

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

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

None 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
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
NAD83   - North American Datum of 1983
NASA    - National Aeronautics and Space Administration
NOAA    - National Oceanic and Atmospheric Administration
NSA     - Northern Study Area
OBS     - Old Black Spruce
OJP     - Old Jack Pine
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
SSA     - Southern Study Area
TF      - Tower Flux
TGB     - Trace Gas Biogeochemistry
URL     - Uniform Resource Locator
```

20. Document Information

20.1 Document Revision Date

Written: 06-May-1999
Revised: 25-Oct-1999

20.2 Document Review Date(s)

BORIS Review: 07-May-1999
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:

These data were provided by Drs. David R. Fitzjarrald and Kathleen E. Moore.

If using data from the BOREAS CD-ROM series, also reference the data as:

Fitzjarrald, D.R. and K.E. Moore, "Surface Exchange Observations in the Canadian Boreal Forest Region." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, 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. CD-ROM. NASA, 2000.

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
	November 2000	Technical Memorandum

4. TITLE AND SUBTITLE
Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)
BOREAS TF-8 NSA-OJP and SSA-OBS Ceilometer Data

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

6. AUTHOR(S)
Kathleen E. Moore and David R. Fitzjarrald
Forrest G. Hall and Karl Huemmrich, 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. 204

11. SUPPLEMENTARY NOTES
K.E. Moore and D.R. Fitzjarrald: State University of New York, Albany;
K. Huemmrich: University of Maryland, 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 TF-8 team used ceilometers to collect data on the fraction of the sky covered with clouds and the cloud height. Included with these data is the surface-based lifting condensation level, derived from temperature and humidity values acquired at the flux tower at the NSA-OJP site. Ceilometer data were collected at the NSA-OJP site in 1994 and at the NSA-OJP and SSA-OBS sites in 1996. The data are available in tabular ASCII files.

14. SUBJECT TERMS
BOREAS, tower flux, ceilometer data.

15. NUMBER OF PAGES
14

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