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

Forrest G. Hall and Karl Huemmrich, Editors

Volume 194
BOREAS TF-2 SSA-OA Tethersonde Meteorological and Ozone Data

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Atmospheric Environment Service, Downsview, Ontario

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

October 2000
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Summary

The BOREAS TF-2 team collected meteorological and ozone measurements from instruments mounted below a tethered balloon. These data were collected at the SSA-OA site to extend meteorological and ozone measurements made from the flux tower to heights of 300 m. The tethersonde operated during the fall of 1993 and the spring, summer, and fall of 1994. The data are available in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification
  BOREAS TF-02 SSA-OA Tethersonde Meteorological and Ozone Data

1.2 Data Set Introduction
  A tethersonde program was carried out at the BOREal Ecosystem-Atmosphere Study (BOREAL) Southern Study Area (SSA) Old Aspen (OA) site to extend meteorological and ozone measurements made from the flux tower to heights of 300 m. Launched from a clearing approximately 100 m from the main tower, an Atmospheric Instrumentation Research (AIR) tethersonde package was mounted below a 25-m³ tethered balloon and profiled during selected periods of the field experiment. For most of the profiles, a Mast-Brewer ozone sonde was coupled to the tethersonde. Data were collected in the fall of 1993 and during the Intensive Field Campaigns (IFCs) of 1994.

1.3 Objective/Purpose
  The purpose of this study was to characterize the atmosphere's vertical structure in terms of air pressure, temperature, humidity, winds, and ozone concentration to complement and extend the data being collected from the SSA-OA flux tower and flux aircraft.
1.4 Summary of Parameters and Variables

From the tethersonde, vertical profiles of air temperature, potential temperature, relative humidity, air pressure, wind speed and direction, and ozone concentration were collected. Measurements were located along the profiles by the height above ground level.

1.5 Discussion

This study measured high-resolution vertical profiles of temperature, humidity, pressure, wind speed and direction, and ozone concentration in the lower atmospheric boundary layer. An AIR tethersonde package (TS-3A-SP) was mounted below a 25 m³ tethered balloon and profiled during selected periods of the field experiment. For most of the profiles, a Mast-Brewer ozone sonde (AIR OZ-3A-T) was coupled to the tethersonde. The tethersonde was raised and lowered using a heavy-duty winch.

1.6 Related Data Sets
BOREAS TF-02 SSA-OA Tower Flux and Meteorological Data
BOREAS TF-01 SSA-OA Undercanopy Flux, Meteorological, and Snow/Soil Temp Data

2. Investigator(s)

2.1 Investigator(s) Name and Title
Robert E. Mickle
Atmospheric Environment Service
A. James Arnold
Atmospheric Environment Service

2.2 Title of Investigation
AES Flux Tower Measurements for BOREAS: Exchange of Energy, Water Vapor, and Trace Gases Project

2.3 Contact Information

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A. James Arnold
Atmospheric Environment Service
4905 Dufferin Street
Downsview, Ontario M3H 5T4
Canada
(416) 739-4855
(416) 739-4293 (fax)
jim.arnold@ec.gc.ca

Contact 2:
Robert E. Mickle
Atmospheric Environment Service
4905 Dufferin Street
Downsview, Ontario M3H 5T4
Canada
REMSpC@golden.net
3. Theory of Measurements

A helium-filled balloon can lift instruments off of the ground and provides a stable platform for measurements at altitudes higher than can be reached by towers. Tethering the balloon allows control of the balloon's altitude and ensures retrieval of the attached instruments. The tether also lets one control the rates of ascent and descent. Because of these features, the tethersonde is able to provide high-resolution vertical profiles of the characteristics of the lower atmospheric boundary layer.

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment
The tethersonde could not be launched under conditions of high wind speeds.

4.1.2 Source/Platform
Instruments were attached below a 25-m³ tethered balloon. The tethersonde was launched from a clearing approximately 100 m from the SSA-OA flux tower. The tethersonde reached heights of 300 m, and was raised and lowered using a heavy-duty winch.

4.1.3 Source/Platform Mission Objectives
The purpose of the tethersonde was to allow vertical profiles of atmospheric variables to be measured at heights greater than the flux tower.

4.1.4 Key Variables
Vertical profiles of air temperature, potential temperature, relative humidity, air pressure, wind speed and direction, and ozone concentration were collected. Measurements were located along the profiles by the height above ground level.

4.1.5 Principles of Operation
The tethersonde supported an AIR tethersonde package (TS-3A-SP). The sensors include dry and wet bulb thermistors, an aneroid capacitance barometer, a three-cup anemometer with tachometer, and a magnetic compass. Humidity was obtained using dry and wet bulb measurements and the psychometric equation. For most of the profiles a Mast-Brewer ozone sonde (AIR OZ-3A-T) was coupled to the tethersonde.

4.1.6 Sensor/Instrument Measurement Geometry
The instruments were suspended under a 25-m³ balloon. The height of the measurements and the rate of ascent or descent were controlled by the winch on the ground.
4.1.7 Manufacturer of Sensor/Instrument
Tethersonde package (TS-3A-SP) and ozone sonde (AIR OZ-3A-T):
AIR, Inc.
8401 Baseline Rd.
Boulder, CO 80303
(303) 499-1701
(303) 499-1767 (fax)
rons@airmfg.com

4.2 Calibration

4.2.1 Specifications
Factory calibrations for the meteorology package provided sensor precision of 0.5 °C for air temperature, 5 percent for relative humidity, 1 mb for the aneroid barometer, 0.25 m/s for wind speed, and 5° for wind direction. Prior to and after each profile, the ozone sonde was calibrated against a Dasibi (Model 1008-RS) calibrator/analyzer to minimize drift due to cell aging. Calibrations were repeatable to within 3 ppb.

4.2.1.1 Tolerance
The wet and dry bulb thermistors operated over a range of 50 to -70 °C with a precision of 0.5 °C and a resolution of 0.01 °C. The aneroid barometer operated over a range of 1050 to 600 mb with a precision of 1 mb and a resolution of 0.1 mb. The anemometer measured wind speed over the range 0 to 20 m/s with a precision of 0.25 m/s and a resolution of 0.01 m/s. The wind direction was measured over a range of 2 to 358° with a precision of 5° and a resolution of 1°.

4.2.2 Frequency of Calibration
Prior to and after each profile, the ozone sonde was calibrated against a Dasibi (Model 1008-RS) calibrator/analyzer to minimize drift due to cell aging.

4.2.3 Other Calibration Information
None.

5. Data Acquisition Methods
Launched from a clearing approximately 100 m from the main tower, an AIR tethersonde package was mounted below a 25 m³ tethered balloon and profiled during selected periods of the field experiment. The height of the measurements and the rate of ascent or descent were controlled by the winch on the ground. The tethersonde could not be launched under conditions of high wind speeds.

6. Observations

6.1 Data Notes
None.

6.2 Field Notes
None.
7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage
All data were collected at the BOREAS SSA-OA site. The tethersonde was launched from a clearing 100 m from the flux tower. The North American Datum of 1983 (NAD83) coordinates for the SSA-OA flux tower are latitude 53.62889° N, longitude 106.19779° W, and elevation of 600.63 m.

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
The spatial resolution of the measurements is dependent on sonde height and atmospheric conditions.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
Data were collected in 1993 from 17-Oct to 31-Oct. In 1994, data were collected during the periods of 26-May to 12-Jun, 21-Jul to 09-Aug, and 31-Aug to 19-Sep, corresponding to the IFCs.

7.2.2 Temporal Coverage Map
None.

7.2.3 Temporal Resolution
Samples were collected at a rate of one every 10 seconds.

7.3 Data Characteristics

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

<table>
<thead>
<tr>
<th>Column Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
</tr>
<tr>
<td>SUB_SITE</td>
</tr>
<tr>
<td>DATE_OBS</td>
</tr>
<tr>
<td>TIME_OBS</td>
</tr>
<tr>
<td>HT_AGL</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
</tr>
<tr>
<td>AIR_TEMP</td>
</tr>
<tr>
<td>REL_HUM</td>
</tr>
<tr>
<td>POTENTIAL_TEMP</td>
</tr>
<tr>
<td>WIND_SPEED</td>
</tr>
<tr>
<td>WIND_DIR</td>
</tr>
<tr>
<td>OZONE_CONC</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
</tr>
<tr>
<td>REVISION_DATE</td>
</tr>
</tbody>
</table>
7.3.2 Variable Description/Definition
The descriptions of the parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>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.</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>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.</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>The date on which the data were collected.</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>The Greenwich Mean Time (GMT) when the data were collected.</td>
</tr>
<tr>
<td>HT_AGL</td>
<td>The height above ground at which the measurements were taken.</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>The atmospheric pressure.</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>The air temperature.</td>
</tr>
<tr>
<td>REL_HUM</td>
<td>The calculated relative humidity.</td>
</tr>
<tr>
<td>POTENTIAL_TEMP</td>
<td>The measured potential temperature.</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>The wind speed.</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>The direction from which the wind was traveling, increasing in a clockwise direction from north.</td>
</tr>
<tr>
<td>OZONE_CONC</td>
<td>The ozone concentration.</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-?? (CPI but questionable).</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>The most recent date when the information in the referenced data base table record was revised.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>[none]</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>[none]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>[HHMM GMT]</td>
</tr>
<tr>
<td>HT_AGL</td>
<td>[meters]</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>[kiloPascals]</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>[degrees Celsius]</td>
</tr>
<tr>
<td>REL_HUM</td>
<td>[percent]</td>
</tr>
<tr>
<td>POTENTIAL_TEMP</td>
<td>[degrees Kelvin]</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>[meters][second^-1]</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>[degrees]</td>
</tr>
</tbody>
</table>

Page 6
7.3.4 Data Source

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>[Assigned by BORIS.]</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>[Assigned by BORIS.]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[Supplied by investigator.]</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>[Supplied by investigator.]</td>
</tr>
<tr>
<td>HT_AGL</td>
<td>[measurement of cable]</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>[aneroid capacitance barometer]</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>[dry bulb thermistor]</td>
</tr>
<tr>
<td>REL_HUM</td>
<td>[dry and wet bulb thermistors]</td>
</tr>
<tr>
<td>POTENTIAL_TEMP</td>
<td>[dry and wet bulb thermistors]</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>[cup anemometer]</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>[windvane]</td>
</tr>
<tr>
<td>OZONE_CONC</td>
<td>[Mast-Brewer ozone sonde]</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>[Assigned by BORIS.]</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>[Assigned by BORIS.]</td>
</tr>
</tbody>
</table>

7.3.5 Data Range

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Minimum Data Value</th>
<th>Maximum Data Value</th>
<th>Missng Data Value</th>
<th>Unrel Data Value</th>
<th>Below Data Detect</th>
<th>Not Detect Detect</th>
<th>Limit</th>
<th>Collect</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>SSA-9OA-FLXTR</td>
<td>SSA-9OA-FLXTR</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>9TF02-TET01</td>
<td>9TF02-TET01</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>17-OCT-93</td>
<td>09-AUG-94</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>0</td>
<td>2359</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>HT_AGL</td>
<td>-839.6</td>
<td>324.17</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>90.06</td>
<td>8888.888</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>AIR_TEMP</td>
<td>-13.01</td>
<td>29.58</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>REL_HUM</td>
<td>32.13</td>
<td>100</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>POTENTIAL_TEMP</td>
<td>266.33</td>
<td>307.73</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>0</td>
<td>35.5</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>.01</td>
<td>360</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>OZONE_CONC</td>
<td>6.29</td>
<td>86.02</td>
<td>-999</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>CPI</td>
<td>CPI</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>04-AUG-99</td>
<td>04-AUG-99</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

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
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 Collected -- 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 records from a sample data file on the CD-ROM.

SITE_NAME, SUB_SITE, DATE_OBS, TIME_OBS, HT_AGL, ATMOSPHERIC_PRESS, AIR_TEMP, REL_HUM, POTENTIAL_TEMP, WIND_SPEED, WIND_DIR, OZONE_CONC, CRTFCN_CODE, REVISION_DATE
'SSA-9OA-FLXTR', '9TF02-TET01', 01-JUN-94, 654, 0.0, 95.26, 9.13, -999.0, 286.23, .15, 177.0, 40.53, 'CPI', 04-AUG-99
'SSA-9OA-FLXTR', '9TF02-TET01', 01-JUN-94, 654, -.29, 95.26, 9.13, -999.0, 286.23, .1, 177.0, 40.5, 'CPI', 04-AUG-99
'SSA-9OA-FLXTR', '9TF02-TET01', 01-JUN-94, 655, -.58, 95.27, 9.16, -999.0, 286.25, .03, 183.0, 40.49, 'CPI', 04-AUG-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

9.1.1 Derivation Techniques and Algorithms
Humidity was obtained using dry and wet bulb measurements and the psychometric equation.

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
None given.

9.3.2 Calculated Variables
Humidity was obtained using dry and wet bulb measurements and the psychometric equation.

9.4 Graphs and Plots
None given.

10. Errors

10.1 Sources of Error
Prior to and after each profile, the ozone sonde was calibrated against a Dasibi (Model 1008-RS) calibrator/analyzer to minimize drift due to cell aging.

10.2 Quality Assessment

10.2.1 Data Validation by Source
Data were examined by investigators to check for unreasonable values.

10.2.2 Confidence Level/Accuracy Judgment
None given.

10.2.3 Measurement Error for Parameters
The wet and dry bulb thermistors operated over a range of 50 to -70 °C with a precision of 0.5 °C and a resolution of 0.01 °C. The aneroid barometer operated over a range of 1050 to 600 mb with a precision of 1 mb and a resolution of 0.1 mb. The anemometer measured wind speed over the range 0 to 20 m/s with a precision of 0.25 m/s and a resolution of 0.01 m/s. The wind direction was measured over a range of 2 to 358° with a precision of 5° and a resolution of 1°.
10.2.4 Additional Quality Assessments
None.

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

11. Notes

11.1 Limitations of the Data
The tethersonde could not be launched under conditions of high wind speeds.

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 data can be used for monitoring the development of the boundary layer and atmospheric movement and condition. In addition, the data can be used for comparisons with field studies occurring during respective IFCs.

13. Future Modifications and Plans
None.

14. Software

14.1 Software Description
None.

14.2 Software Access
None.

15. Data Access
The SSA-OA tethersonde meteorological and ozone 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

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.

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.


17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms
None.

19. List of Acronyms

AES - Atmospheric Environment Service
AFM - Aircraft Flux and Meteorology
AIR - Atmospheric Instrumentation Research
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
NSA - Northern Study Area
OA - Old Aspen
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
SSA - Southern Study Area
TF - Tower Flux
URL - Uniform Resource Locator
20. Document Information

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20.2 Document Review Date(s)
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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:

Data were collected and processed by Robert E. Mickle and A. James Arnold of the Atmospheric Environment Service.

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

Also, cite the BOREAS CD-ROM set as:

20.5 Document Curator

20.6 Document URL
The BOREAS TF-2 team collected meteorological and ozone measurements from instruments mounted below a tethered balloon. These data were collected at the SSA-OA site to extend meteorological and ozone measurements made from the flux tower to heights of 300 m. The tethersonde operated during the fall of 1993 and the spring, summer, and fall of 1994. The data are available in tabular ASCII files.