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

Forrest G. Hall and David E. Knapp, Editors

Volume 3
BOREAS AFM-2 Wyoming King Air 1994 Aircraft
Sounding Data

R. D. Kelly

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

June 2000
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Robert D. Kelly, University of Wyoming

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Summary

The BOREAS AFM-2 team used the University of Wyoming King Air aircraft during IFCs 1, 2, and 3 in 1994 to collect pass-by-pass fluxes (and many other statistics) for the large number of level (constant altitude), straight-line passes used in a variety of flight patterns over the SSA and NSA and areas along the transect between these study areas. The data described here form a second set, namely soundings that were incorporated into nearly every research flight by the King Air in 1994. These soundings generally went from near the surface to above the inversion layer. Most were flown immediately after takeoff or immediately after finishing the last flux pattern of that particular day's flights. The parameters that were measured include wind direction, wind speed, west wind component (u), south wind component (v), static pressure, air dry bulb temperature, potential temperature, dewpoint temperature, water vapor mixing ratio, and CO₂ concentration. Data on the aircraft's location, attitude, and altitude during data collection are also provided. These data are stored in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification
BOREAS AFM-02 Wyoming King Air 1994 Aircraft Sounding Data

1.2 Data Set Introduction
The BOREal Ecosystem-Atmosphere Study (BOREAS) Airborne Fluxes and Meteorology (AFM)-02 team used the University of Wyoming King Air aircraft during Intensive Field Campaigns (IFCs) 1, 2, and 3 in 1994 to collect pass-by-pass fluxes (and many other statistics) for the large number of level (constant altitude), straight-line passes used in a variety of flight patterns. The data...
described here form a second set, namely soundings that were incorporated into nearly every research flight by the King Air in 1994. These soundings generally went from near the surface to above the inversion layer. Most were flown immediately after takeoff or immediately after finishing the last flux pattern of that particular day's flights. The parameters that were measured include wind direction, wind speed, west wind component (u), south wind component (v), static pressure, air dry bulb temperature, potential temperature, dewpoint, temperature, water vapor mixing ratio, and CO2 concentration. Data on the aircraft's location, attitude, and altitude during data collection are also provided. These data are stored in tabular American Standard Code for Information Interchange (ASCII) files.

1.3 Objective/Purpose

The objective of this data set is to add to the set of soundings represented by the network of rawinsondes launched during the project.

1.4 Summary of Parameters

The following is a simple list of the variables archived for each sounding by the King Air. Section 7 defines the variables and their origins in detail. Those variables flagged (**) were not measured by the King Air.

VARIABLES:
- BOREAS aircraft i.d.
- 20-character aircraft descriptor
- Date
- BOREAS mission designator
- Start time, Greenwich Mean Time (GMT)
- End time
- Starting latitude
- End latitude
- Starting longitude
- End longitude
- Starting BOREAS Information System (BORIS) grid E
- End BORIS grid E
- Starting BORIS grid N
- End BORIS grid N

There is one line of data for each second of sounding data. For data collected at rates greater than 1 Hz, the entry is a 1-second average:
- Time, GMT
- Latitude
- Longitude
- Pressure altitude
- Radar altitude
- Aircraft heading
- Wind direction
- Wind speed
- West wind component, u
- South wind component, v
- Static pressure
- Air dry bulb temperature
- Potential temperature
- Dewpoint temperature
- Water vapor mixing ratio
- CO2 concentration
- Ozone concentration **
1.5 Discussion
The King Air was flown in all three IFCs in 1994. These archived sounding data were collected primarily over the two BOREAS study areas and occasionally on regional runs between the Southern Study Area (SSA) and the Northern Study Area (NSA). The high-rate data from which all these variables were computed were not submitted to BORIS. If required, they may be acquired from the University of Wyoming directly.

1.6 Related Data Sets
Related data sets include the King Air flux data for BOREAS-94 and the flux and/or sounding archives from the other three flux aircraft (AFM-01, AFM-03, AFM-04). Other related data sets include soundings from rawinsondes (AFM-05) launched during corresponding dates.

- BOREAS AFM-01 NOAA/ATDD Long-EZ 1994 Aircraft Flux Data over the SSA
- BOREAS AFM-02 Wyoming King Air 1994 Aircraft Flux and Moving Window Data
- BOREAS AFM-03 NCAR Electra 1994 Aircraft Flux and Moving Window Data
- BOREAS AFM-03 NCAR Electra 1994 Aircraft Sounding Data
- BOREAS AFM-04 NRC Twin Otter Aircraft Flux Data
- BOREAS AFM-04 NRC Twin Otter Aircraft Sounding Data
- BOREAS AFM-05 Level-1 Upper Air Network Data
- BOREAS AFM-05 Level-2 Upper Air Network Standard Pressure Level Data

2. Investigator(s)

2.1 Investigator(s) Name and Title
Dr. Robert D. Kelly, Associate Professor
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2.2 Title of Investigation
Airborne Investigation of Biosphere-Atmosphere Interactions over the Boreal Forest

2.3 Contact Information

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3. Theory of Measurements

The theory and practice of measuring atmospheric variables from a moving, aircraft platform have been discussed by many researchers. A series of introductory monographs addressing those topics may be found in Lenschow (1986).

Briefly, the aircraft uses gust sensors to measure the 3-D air motion relative to the aircraft and a combination of an inertial platform, accelerometers, and (more recently) a satellite-based global positioning system (GPS) to measure the motion of the aircraft relative to Earth. These data are combined to determine aircraft position and the Earth-relative 3-D winds. Scalar quantities, including static pressure, temperature, water vapor mixing ratio, and CO₂ mixing ratio are also measured with fast-response, aircraft-mounted sensors.

4. Equipment

4.1 Sensor/Instrument Description

<table>
<thead>
<tr>
<th>Variable</th>
<th>Instrument</th>
<th>Accuracy</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi-rate temperature</td>
<td>Rosemount housing, fast-response</td>
<td>0.50 C</td>
<td>0.01 C</td>
</tr>
<tr>
<td></td>
<td>thermistor (design by Friehe, UCI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dewpoint temperature</td>
<td>Cambridge Model 1373C</td>
<td>1.0 C, &gt;0 C</td>
<td>0.006 C</td>
</tr>
<tr>
<td>Water vapor mix ratio</td>
<td>LICOR 6262 IR spectrometer</td>
<td>1% of reading</td>
<td>0.001 g/kg</td>
</tr>
<tr>
<td>CO₂ mix ratio</td>
<td>LICOR 6262 IR spectrometer</td>
<td>+/-1 ppm at .01 ppm</td>
<td>350 ppm</td>
</tr>
<tr>
<td>Magnetic heading</td>
<td>King KPI553/Sperry C14-43</td>
<td>1 degree</td>
<td>0.02 degree</td>
</tr>
<tr>
<td>Static pressure</td>
<td>Rosemount 1201FA1B1A</td>
<td>0.5 mb</td>
<td>0.06 mb</td>
</tr>
<tr>
<td>Static pressure</td>
<td>Rosemount 1501</td>
<td>0.5 mb</td>
<td>0.003 mb</td>
</tr>
<tr>
<td>Geometric Altitude</td>
<td>Stewart Warner APN159</td>
<td>1% reading</td>
<td>0.24 ft</td>
</tr>
<tr>
<td>Geometric Altitude</td>
<td>King KPA 405</td>
<td>3% &lt;500 ft</td>
<td>0.48 ft</td>
</tr>
<tr>
<td>Total pressure</td>
<td>Rosemount 831CPX</td>
<td>6% &gt; 500 ft</td>
<td></td>
</tr>
<tr>
<td>Azimuth VOR</td>
<td>King AIR615 VOR</td>
<td>2 mb</td>
<td>0.005 mb</td>
</tr>
<tr>
<td>Distance DME</td>
<td>King KNR705A DME</td>
<td>1 degree</td>
<td>0.02 degree</td>
</tr>
<tr>
<td>Latitude/longitude</td>
<td>Tremble 2000 GPS</td>
<td>0.2 nautical miles</td>
<td>0.1 nautical mile</td>
</tr>
<tr>
<td>Ground velocity</td>
<td>Honeywell Laseref SM</td>
<td>100 m</td>
<td>0.000172 degree</td>
</tr>
<tr>
<td>Vertical velocity</td>
<td>Honeywell Laseref SM</td>
<td>0.8 mm/hr drift</td>
<td>0.000172 degree</td>
</tr>
<tr>
<td>Pitch/roll</td>
<td>Honeywell Laseref SM</td>
<td>13.5 ft/s</td>
<td>0.0325 kts</td>
</tr>
<tr>
<td>Platform heading</td>
<td>Honeywell Laseref SM</td>
<td>0.5 ft/s</td>
<td>0.03215 ft/min</td>
</tr>
<tr>
<td>Flow angle</td>
<td>Rosemount 858AJ/831CPX</td>
<td>0.2 degree</td>
<td>0.000172 degree</td>
</tr>
<tr>
<td>Vertical acceleration</td>
<td>Humphrey SA905021</td>
<td>0.002 g</td>
<td>0.0001 g</td>
</tr>
<tr>
<td>Rate of climb</td>
<td>Rosemount 1241A4BCDE</td>
<td>1%, &lt;15000 ft</td>
<td>0.004 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2%, &gt;25000 ft</td>
<td></td>
</tr>
<tr>
<td>Engine torque</td>
<td>--</td>
<td>--</td>
<td>0.2 ft-lbf</td>
</tr>
<tr>
<td>Liquid Water Content</td>
<td>In-house CSIRO hot wire</td>
<td>0.2 g/m³</td>
<td>0.0003 g/m³</td>
</tr>
<tr>
<td>Liquid Water Content</td>
<td>Bacharach LWH</td>
<td>0.2 g/m³</td>
<td>0.0002 g/m³</td>
</tr>
<tr>
<td>Cloud drops</td>
<td>PMS FSSP</td>
<td>3 micron</td>
<td>3 micron</td>
</tr>
<tr>
<td>Radiation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upwelling Shortwave</td>
<td>Eppley Pyranometer</td>
<td>5 W/m²</td>
<td>1 W/m²</td>
</tr>
<tr>
<td>(0.3-3 microns)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downwelling Shortwave</td>
<td>Eppley Pyranometer</td>
<td>5 W/m²</td>
<td>1 W/m²</td>
</tr>
</tbody>
</table>
4.1.1 Collection Environment
The data were collected at the beginning and end of each day's flights over a vertical range with varying atmospheric conditions.

4.1.2 Source/Platform
Platform: Beechcraft Super King Air model 200T, twin-turboprop aircraft.

4.1.3 Source/Platform Mission Objectives
See Section 1.4.

4.1.4 Key Variables
See Sections 1.4, 1.5, and 7.3.

4.1.5 Principles of Operation
See Section 3.

4.1.6 Sensor/Instrument Measurement Geometry
The gust probe was mounted at the end of the aircraft nose boom, so that the gust probe tip was about 2 m ahead of the nose of the aircraft. The inertial reference system (IRS) and accelerometers were mounted close to the main wing spar (close to aircraft’s center of gravity). The fast-response (Friehe-type) temperature probe was mounted below the nose of the aircraft, 1.29 m aft from the gust probe tip. Water vapor and CO2 measurements were obtained with the LI-COR 6262 infrared absorption spectrometer. Air was drawn from the airstream above the aircraft cabin into a 12.7-mm i.d. "snorkel" tube that faced forward, about 0.3 m above the fuselage skin and 4.06 m aft of the gust probe tip. Airflow in the snorkel tube was maintained with a high-capacity vacuum pump at 60-70 SLPM (about 9 m/s), for Reynolds number about 50,000 (fully developed turbulent flow). At 1.52 m from the inlet, air was drawn from the center of the snorkel tube into the LI-COR through a short 6.4-mm i.d. tube, again by vacuum pump, at an average flow rate of 6-8 SLPM (also fully turbulent). As verified by flying the aircraft through a power-plant plume, there was a time delay of 0.3 s between the gust probe data and the LI-COR data. This delay is removed in the software at the time of data processing.

Further notes on LI-COR operation: The LI-COR 6262 was operated in "absolute" mode, in which the closed-path absorption in the sample chamber was simultaneously compared to the closed-path absorption in the reference chamber. Air in the reference chamber was circulated continuously through scrubbers that removed both water and CO2, and was circulated at a flow rate of 2 SLPM. A Cambridge chilled-mirror dewpoint hygrometer was mounted inside the cabin, drawing air from the vacuum-pump driven sample tube. All cloud and precipitation probes (PMS and liquid water content) were mounted near the wing tips of both wings.

4.1.7 Manufacturer of Sensor/Instrument
See table in Section 4.1

4.2 Calibration
The instruments were subject to calibration as follows:
- **Air temperature:** The manufacturer's one-time calibration was used for the Rosemount model 102, and the Friehe-type probe was then compared against the Rosemount.
- **Water vapor concentration:** Before each flight, the LI-COR H2O channel was calibrated by flushing the chamber with a beam-filling gas of known H2O concentration, generated with a LI-COR Model 610 dewpoint generator, with accuracy +/-0.03 °C.
- **CO₂ concentration**: Before each flight, the LI-COR CO₂ channel was calibrated by flushing the chamber with a gas of known CO₂ concentration (Source: Scott Specialty, Longmont, CO, concentration 403.5 ppm, accurate to 4%).

- **Static pressure and gust differential pressures**: The gust probe differential pressure sensors (for up-down and left-right angle of flow measurements) and absolute pressure sensor (gust probe total pressure) were calibrated at the beginning of each IFC, using the Rosemount 1501 (accurate to 0.5 mb).

4.2.1 Specifications

See table in Section 4.1.

4.2.1.1 Tolerance

See table in Section 4.1.

4.2.2 Frequency of Calibration

See Section 4.2.

4.2.3 Other Calibration Information

None given.

5. Data Acquisition Methods

Whenever possible, the soundings were executed at a relatively slow rate of ascent or descent (about 500 feet per minute). Some, however, were flown at faster rates (see data for each sounding to ascertain rate).

6. Observations

6.1 Data Notes

None.

6.2 Field Notes

None.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

These data cover various point locations within the SSA and NSA and areas along the transect between these study areas. The majority of the data were collected over the BOREAS SSA and NSA.

The North American Datum of 1983 (NAD83) corner coordinates of the SSA are:

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>54.321° N</td>
<td>106.228° W</td>
</tr>
<tr>
<td>Northeast</td>
<td>54.225° N</td>
<td>104.237° W</td>
</tr>
<tr>
<td>Southwest</td>
<td>53.515° N</td>
<td>106.321° W</td>
</tr>
<tr>
<td>Southeast</td>
<td>53.420° N</td>
<td>104.368° W</td>
</tr>
</tbody>
</table>
The NAD83 corner coordinates of the NSA are:

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>56.249° N</td>
<td>98.825° W</td>
</tr>
<tr>
<td>Northeast</td>
<td>56.083° N</td>
<td>97.234° W</td>
</tr>
<tr>
<td>Southwest</td>
<td>55.542° N</td>
<td>99.045° W</td>
</tr>
<tr>
<td>Southeast</td>
<td>55.379° N</td>
<td>97.489° W</td>
</tr>
</tbody>
</table>

7.1.2 Spatial Coverage Map
Data were collected over the NSA and SSA of BOREAS, and along a transect between them.
7.1.3 Spatial Resolution
Each sounding occupied a finite horizontal distance, which can be ascertained from the location information included in the data.

7.1.4 Projection
These data represent point measurements.

7.1.5 Grid Description
None.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
Times of data collection are contained in the table below. See Section 5 for flight pattern descriptions.

Table of UW King Air Research Flights for BOREAS 1994

<table>
<thead>
<tr>
<th>Date</th>
<th>Start</th>
<th>End</th>
<th>Hrs</th>
<th>Weather</th>
<th>Description and comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940525</td>
<td>1745</td>
<td>2000</td>
<td>2.9</td>
<td>5-10% set cu</td>
<td>CS, 2 rts a-h, 300 agl FS, first a-h with FE</td>
</tr>
<tr>
<td>1940526</td>
<td>1646</td>
<td>1905</td>
<td>3.0</td>
<td>ci, small % cu</td>
<td>GS, full rt, 300 agl</td>
</tr>
<tr>
<td>1940531</td>
<td>1645</td>
<td>1929</td>
<td>3.6</td>
<td>cu incr 10-40% sharp jump Z</td>
<td>FS, 300 agl with FT PS, using W,E ends FK grid at 200 agl, 2500 and 3400 msl FS, a-d, 300 agl, with FE</td>
</tr>
<tr>
<td>1940601</td>
<td>630</td>
<td>1802</td>
<td>2.4</td>
<td>H, ci, cist set cu &lt; 1%</td>
<td>LS, j-i-h-i-j, 200 agl CS, one rt d-a-d, 200 agl</td>
</tr>
<tr>
<td>1940604</td>
<td>1616</td>
<td>1919</td>
<td>3.8</td>
<td>clr then cu incr rapidly, end ovc</td>
<td>CS, mult passes 200 agl, 3000 msl FS, d-a, 200 agl, with FL</td>
</tr>
<tr>
<td>1940606</td>
<td>1546</td>
<td>1809</td>
<td>3.1</td>
<td>cu &lt; 5%</td>
<td>LS, mult h-i-j, 200 agl-2900 msl</td>
</tr>
<tr>
<td>1940607</td>
<td>1447</td>
<td>1649</td>
<td>4.8</td>
<td>clr entire pattern</td>
<td>RT, a-h-k-l-m, 200 agl</td>
</tr>
<tr>
<td></td>
<td>1649</td>
<td>1904</td>
<td></td>
<td>clr entire pattern</td>
<td>GN, full rt, all 300 agl, EW lines</td>
</tr>
<tr>
<td>1940608</td>
<td>1520</td>
<td>1742</td>
<td>2.9</td>
<td>clr</td>
<td>LN, mult t-o at 200 agl, 2100 msl FN, m-o, 300 agl with FT</td>
</tr>
<tr>
<td>1940610</td>
<td>1642</td>
<td>1901</td>
<td>3.0</td>
<td>set ci, K all sky</td>
<td>GN, full rt, 200 agl, NS lines</td>
</tr>
<tr>
<td>1940611</td>
<td>1646</td>
<td>1844</td>
<td>2.6</td>
<td>K, cu to 80%, RW-</td>
<td>RT, o-m-l-k-h-a, 200 agl</td>
</tr>
<tr>
<td>1940720</td>
<td>1656</td>
<td>2044</td>
<td>4.4</td>
<td>H, K, cu 10-50%</td>
<td>CS, a-d, 300 agl to 4800 msl (co-ord with FE) FS, two a-d, 300 agl with FE</td>
</tr>
<tr>
<td>1940721</td>
<td>1652</td>
<td>1905</td>
<td>3.0</td>
<td>clr?</td>
<td>GS, full rt, 200 agl, NS lines FS, one run SW of grid with FT</td>
</tr>
<tr>
<td>1940723</td>
<td>1528</td>
<td>1800</td>
<td>3.2</td>
<td>clr, incr to 20% cu</td>
<td>CS, mult a-d at 200 agl, 3500 msl</td>
</tr>
<tr>
<td>1940724</td>
<td>1655</td>
<td>1943</td>
<td>3.4</td>
<td>clr over site</td>
<td>GS, full rt, 200 agl, EW lines</td>
</tr>
<tr>
<td>Date</td>
<td>Start</td>
<td>End</td>
<td>Hrs</td>
<td>Weather</td>
<td>Description and comments</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-----</td>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>940725</td>
<td>1519</td>
<td>1753</td>
<td>3.2</td>
<td>clr</td>
<td>CS, mult a-d at 200 agl, 3000 msl</td>
</tr>
<tr>
<td>940726</td>
<td>1628</td>
<td>1832</td>
<td>2.7</td>
<td>K, ci</td>
<td>RT, a-h-k-l-m-o, 200 agl</td>
</tr>
<tr>
<td>940727</td>
<td>1609</td>
<td>1909</td>
<td>4.3</td>
<td>K, altocu, cu</td>
<td>GN, full rt 200 agl, NS lines TN (mult) at radar, 500-1000 agl</td>
</tr>
<tr>
<td>940728</td>
<td>1620</td>
<td>1810</td>
<td>2.6</td>
<td>K, ci</td>
<td>HN(GN) time-centered m-o, 200 agl, 1800 and 2700 msl</td>
</tr>
<tr>
<td>940731</td>
<td>1550</td>
<td>1859</td>
<td>3.7</td>
<td>K, clr above</td>
<td>GN</td>
</tr>
<tr>
<td>940831</td>
<td>1720</td>
<td>1938</td>
<td>2.9</td>
<td>K, cu &lt;1 to 40%</td>
<td>GN, full rt, 200 agl, EW lines</td>
</tr>
<tr>
<td>940901</td>
<td>1550</td>
<td>1717</td>
<td>1.9</td>
<td>clr above K</td>
<td>FN, rt 200 agl, with FT FN, rt 200 agl, diff TAS than FT LN, o-m-o-m-o, 200 agl</td>
</tr>
<tr>
<td>940903</td>
<td>1548</td>
<td>1811</td>
<td>3.0</td>
<td>ci, K, cu 0-10%</td>
<td>GN, full rt, 200 agl, EW lines</td>
</tr>
<tr>
<td>940906</td>
<td>1605</td>
<td>1833</td>
<td>2.9</td>
<td>cu 20-80%</td>
<td>GN, full rt, 200 agl, NS lines</td>
</tr>
<tr>
<td>940908</td>
<td>1606</td>
<td>1823</td>
<td>2.8</td>
<td>acu, ci, cist, ci ovc</td>
<td>RT, o-m-l-k-h-a, 200 agl</td>
</tr>
<tr>
<td>940909</td>
<td>1940</td>
<td>2131</td>
<td>2.7</td>
<td>ci, cist thinning</td>
<td>CS, mult 200 agl-2600 msl, with FE FS, 300 agl, with FE</td>
</tr>
<tr>
<td>940912</td>
<td>1735</td>
<td>2004</td>
<td>3.6</td>
<td>cu incr 0-30%</td>
<td>CS, 3 rts, all 200 agl Test = 3 rt over OA area of CS</td>
</tr>
<tr>
<td>940913</td>
<td>1645</td>
<td>1905</td>
<td>3.4</td>
<td>clr, then cist and ci</td>
<td>GS, full rt, 200 agl, EW lines Test = wind &quot;L&quot; at 8500 msl</td>
</tr>
<tr>
<td>940916</td>
<td>1653</td>
<td>1914</td>
<td>4.8</td>
<td>clr</td>
<td>GS, full rt, NS lines, 200 agl</td>
</tr>
<tr>
<td>1925</td>
<td>2053</td>
<td></td>
<td></td>
<td>clr then &lt;5% cu</td>
<td>CS, d-a mult lvs, with FE FS, second a-d with FE, 600 agl</td>
</tr>
<tr>
<td>940917</td>
<td>1712</td>
<td>1902</td>
<td>2.4</td>
<td>clr, thin ci to W</td>
<td>FS, one end=a, 200 agl, with FT CS, a-d, two rts, 200 agl</td>
</tr>
</tbody>
</table>

**Abbreviations used for flight patterns:**

- **ID** Description (second letter denotes NSA or SSA).
- **CS** Candle Lake runs, SSA only, usually along path a-d.
- **FS, FN** Flights of two (intercomparison runs), various locns.
- **GS, GN** Grid patterns. Sequence of 9 evenly spaced, parallel flight lines, covering a 32-x 32-km square area (King Air), with lines oriented either east-west or north-south.
- **HS, HN** Stack patterns.
- **LS, LN** Transects of intermediate length (e.g., 100 km).
- **PS, PN** Budget box pattern (see Betts et al., 1990b).
- **RT** Regional transect. For King Air, route used in transit between NSA and SSA. Coincides with Electra RTs.
- **TS, TN** Site-specific run at a TF (tower flux) site.
Abbreviations used in weather notes in table:
cu  cumulus
st  status
cl  cirrus
sct  scattered
Zi  inversion height above ground
H  haze
K  smoke
cist  cirrostratus
clr  clear
ovc  overcast
RW- light rain showers
acu  altocumulus

Abbreviations in flight descriptions:
rt  round trip
agl  above ground level (in feet)
msl  above mean sea level (in feet)
mult  multiple
TAS  true airspeed
lvl  level
wind "L" "L" with one leg parallel to wind
direction, flown as at least one round trip

7.2.2 Temporal Coverage Map
None.

7.2.3 Temporal Resolution
See Section 7.2.1. Also, each archived data entry contains the time for the sounding being summarized.

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>SPATIAL_COVERAGE</td>
</tr>
<tr>
<td>DATE_OBS</td>
</tr>
<tr>
<td>TIME</td>
</tr>
<tr>
<td>FLUX_MISSION_DESIGNATOR</td>
</tr>
<tr>
<td>LATITUDE</td>
</tr>
<tr>
<td>LONGITUDE</td>
</tr>
<tr>
<td>BOREAS_X</td>
</tr>
<tr>
<td>BOREAS_Y</td>
</tr>
<tr>
<td>PRESS_ALT</td>
</tr>
<tr>
<td>RADAR_ALT</td>
</tr>
<tr>
<td>HEADING</td>
</tr>
<tr>
<td>WIND_DIR</td>
</tr>
<tr>
<td>WIND_SPEED</td>
</tr>
<tr>
<td>U_COMPNT_WIND_VELOC</td>
</tr>
<tr>
<td>V_COMPNT_WIND_VELOC</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>SPATIAL_COVERAGE</td>
<td>The general term used to denote the spatial area over which the data were collected.</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>The date on which the data were collected.</td>
</tr>
<tr>
<td>TIME</td>
<td>The Greenwich Mean Time (GMT) when the data were collected.</td>
</tr>
<tr>
<td>FLUX_MISSION_DESIGNATOR</td>
<td>The two-letter mission identifier used to identify the type of mission being flown, where GS or GN=grids and stacks, CS=Candle Lake runs, TS or TN=site-specific runs, RT=transects, LS or LN=mini- or meso-transects, FS or FN=flights of two for intercomparison, ZS=low-level routes, and XX=not standard.</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>The NAD83-based latitude coordinate at the site.</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>The NAD83-based longitude coordinate at the site.</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>The x component of the BOREAS grid coordinate at the site.</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>The y component of the BOREAS grid coordinate at the site.</td>
</tr>
<tr>
<td>PRESS_ALT</td>
<td>The measured pressure altitude.</td>
</tr>
<tr>
<td>RADAR_ALT</td>
<td>The measured radar altitude.</td>
</tr>
<tr>
<td>HEADING</td>
<td>The aircraft heading.</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>WIND_SPEED</td>
<td>The wind speed.</td>
</tr>
<tr>
<td>U_COMPRT_WIND_VELOC</td>
<td>The westerly (from the west) vector component of the wind speed and wind direction.</td>
</tr>
<tr>
<td>V_COMPRT_WIND_VELOC</td>
<td>The southerly (from the south) vector component of the wind speed and wind direction.</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>The atmospheric pressure.</td>
</tr>
<tr>
<td>DRY_BULB_TEMP</td>
<td>The temperature measured from the dry-bulb thermometer.</td>
</tr>
<tr>
<td>POTENT_TEMP</td>
<td>The computed potential temperature.</td>
</tr>
<tr>
<td>DEWPOINT_TEMP</td>
<td>The measured dewpoint temperature.</td>
</tr>
<tr>
<td>MIXING_RATIO_AFM</td>
<td>The calculated mixing ratio.</td>
</tr>
<tr>
<td>CO2_CONC</td>
<td>CO2 concentration.</td>
</tr>
<tr>
<td>O3_CONC</td>
<td>The measured ozone concentration.</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>The BOREAS certification level of the data.</td>
</tr>
</tbody>
</table>
Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-?? (CPI but questionable).

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:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPATIAL COVERAGE</td>
<td>[none]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>TIME</td>
<td>[HHMMSS GMT]</td>
</tr>
<tr>
<td>FLUX_MISSION_DESIGNATOR</td>
<td>[none]</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>[degrees]</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>[degrees]</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>[kilometers]</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>[kilometers]</td>
</tr>
<tr>
<td>PRESS_ALT</td>
<td>[meters]</td>
</tr>
<tr>
<td>RADAR_ALT</td>
<td>[meters]</td>
</tr>
<tr>
<td>HEADING</td>
<td>[degrees]</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>[degrees]</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>[meters][second^-1]</td>
</tr>
<tr>
<td>U_COMPNT_WIND_VELOC</td>
<td>[meters][second^-1]</td>
</tr>
<tr>
<td>V_COMPNT_WIND_VELOC</td>
<td>[meters][second^-1]</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>[kiloPascals]</td>
</tr>
<tr>
<td>DRY_BULB_TEMP</td>
<td>[degrees Celsius]</td>
</tr>
<tr>
<td>POTENT_TEMP</td>
<td>[degrees Kelvin]</td>
</tr>
<tr>
<td>DEWPOINT_TEMP</td>
<td>[degrees Celsius]</td>
</tr>
<tr>
<td>MIXING_RATIO_AFM</td>
<td>[grams of water vapor][kilogram dry air^-1]</td>
</tr>
<tr>
<td>CO2_CONC</td>
<td>[parts per million]</td>
</tr>
<tr>
<td>O3_CONC</td>
<td>[parts per billion]</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>[none]</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>[DD-MON-YY]</td>
</tr>
</tbody>
</table>

### 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>SPATIAL COVERAGE</td>
<td>[Assigned by BORIS.]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>TIME</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>FLUX_MISSION_DESIGNATOR</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>PRESS_ALT</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>RADAR_ALT</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>HEADING</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>[Supplied by Investigator.]</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>[Supplied by Investigator.]</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>Missing Data Value</th>
<th>Unrel Data Value</th>
<th>Below Data Value</th>
<th>Detect Limit</th>
<th>Not Collectd</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPATIAL_COVERAGE</td>
<td>N/A</td>
<td>N/A</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>25-MAY-94</td>
<td>17-SEP-94</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>TIME</td>
<td>143600</td>
<td>213630</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>FLUX_MISSION_DESIGNATOR</td>
<td>SN</td>
<td>SN</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>53.2171</td>
<td>56.1223</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>-106.551</td>
<td>-97.7009</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>294.792</td>
<td>821.222</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>260.055</td>
<td>649.007</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PRESS_ALT</td>
<td>205</td>
<td>3472</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>RADAR_ALT</td>
<td>42.2</td>
<td>762.7</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>HEADING</td>
<td>.2</td>
<td>359.9</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>WIND_DIR</td>
<td>0</td>
<td>360</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>WIND_SPEED</td>
<td>.1</td>
<td>23.7</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>U_COMPNT_WIND_VELOC</td>
<td>-17.45</td>
<td>20.43</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>V_COMPNT_WIND_VELOC</td>
<td>-20.85</td>
<td>16.56</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>ATMOSPHERIC_PRESS</td>
<td>66</td>
<td>98.88</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DRY_BULB_TEMP</td>
<td>-6.32</td>
<td>25.94</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>POTENT_TEMP</td>
<td>285.52</td>
<td>313.34</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DEWPOINT_TEMP</td>
<td>-26.4</td>
<td>15.4</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>MIXING_RATIO_AFM</td>
<td>.59</td>
<td>11.98</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>CO2_CONC</td>
<td>308.3</td>
<td>778.4</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>O3_CONC</td>
<td></td>
<td></td>
<td>-999</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>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>05-AUG-96</td>
<td>02-MAR-99</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.
Missing 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.
Unreliable 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.

SPATIAL_COVERAGE, DATE_OBS, TIME, FLUX_MISSION_DESIGNATOR, LATITUDE, LONGITUDE, BOREAS_X, BOREAS_Y, PRESS_ALT, RADAR_ALT, HEADING, WIND_DIR, WIND_SPEED, U_COMP_WIND_VELOC, V_COMP_WIND_VELOC, ATMOSPHERIC_PRESS, DRY_BULB_TEMP, POTENT_TEMP, DEWPOINT_TEMP, MIXING_RATIO_AFM, CO2_CONC, O3_CONC, CRTFCN_CODE, REVISION_DATE
'SSA', 04-JUN-94, 192036, 'SN', 53.93776, -104.764, 408.602, 345.178, 610.3, 76.3, 222.9, 156, 2.2, -.87, 1.97, 94.2, 21.1, 299.31, 6.1, 6.28, 348.9, -999.0, 'CPI', 05-AUG-96
'SSA', 04-JUN-94, 192037, 'SN', 53.93756, -104.764, 408.604, 345.156, 611.1, 74.2, 222.8, 147, 1.9, -1.06, 1.58, 94.2, 21.09, 299.31, 6.2, 6.35, 349.1, -999.0, 'CPI', 05-AUG-96

8. Data Organization

8.1 Data Granularity
The smallest orderable data set available is the one of two files of soundings for a day.

8.2 Data Format(s)
The Compact Disk-Read-Only Memory (CD-ROM) files contain 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
- AFM-02 processed the data and sent them to BORIS.
- BORIS staff received the data, made necessary conversions to standard units, and loaded the data into the data base.
- BORIS staff documented the data set and compiled basic statistics about the data.

9.2.2 Processing Changes
None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments
Time lag between CO$_2$/H$_2$O measurements and gust probe:

Due to the geometry of the instrument locations (see Section 4.1.6), there is a significant lag between measurements by the LI-COR device (water vapor and carbon dioxide) and the 3-D winds. Based on instrument placement, external airflow velocities, and internal (sampling tubes) flow velocities, the lag was predicted to be 0.3 sec. In contrast, the distance between the gust probe tip and the Friehe temperature probe caused negligible lag between the temperature and wind measurements. Thus, the lag between the temperature and LI-COR measurements should be equivalent to that between the wind and LI-COR measurements. The predicted temperature-LI-COR lag (0.3 sec) was verified by flying the plane several times through the plume from a local power plant, at distances close enough to the source that changes in temperature, water vapor, and CO$_2$ were very abrupt at the plume edges. Thus, prior to any other calculations, the LI-COR data are shifted 0.3 sec, to bring those data in sync with the remainder of the data.

9.3.2 Calculated Variables
None given.

9.4 Graphs and Plots
None.
10. Errors

10.1 Sources of Error
See Section 11.2 for a description of instrument limits.

10.2 Quality Assessment
An extensive intercomparison of the BOREAS flux aircraft has been written and published by Dobosy et al. (1997). In that text, King Air measurements, including means and variances of all the flux variables, as well as the fluxes themselves, are compared with corresponding values from the Canadian National Research Council (NRC) Twin Otter and the National Center for Atmospheric Research (NCAR) Electra, for multiple wing-to-wing passes at various times during the 1994 experiment. As of this writing, these comparisons are the best available assessments of the overall data quality for the King Air, at least in comparison with similarly instrumented platforms.

10.2.1 Data Validation by Source
None.

10.2.2 Confidence Level/Accuracy Judgment
The data are considered to be reasonably accurate. See Section 11.2 for description of possible problems.

10.2.3 Measurement Error for Parameters
See table in Section 4.1.

10.2.4 Additional Quality Assessments
None.

10.2.5 Data Verification by Data Center
Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data

Vertical velocity measurements:
Spectral density plots of vertical velocity (w) generally show a fairly well defined inertial subrange, with -5/3 slope out to about 9 Hz, at which point the effects of the anti-aliasing low-pass filter are evident. Many of the w spectral plots do, however, show a slight "bulge" above the -5/3 line in the range 0.1-1 Hz. As of this writing (09-Jul-1996), we believe this is an artifact of the postflight calculations. Examples of these spectra can be seen in Dobosy et al. (1997).

High-rate H2O measurements (LI-COR 6262):
The LI-COR 6262 response is described by the manufacturer as being a 90% response to step-function changes in concentration in 0.1 s. The combination of this characteristic, any along-flow mixing in the sample tubes, and the anti-aliasing filter is evident in the spectral density plots for H2O mixing ratio. These plots generally show an inertial subrange (slope -5/3) out to about 2 Hz, at which point the response drops sharply. At 2 Hz, the signal-to-noise ratio (SNR) is usually about 20 dB. Implications of this response for the flux calculations are that the H2O fluxes are being resolved only to about 2 Hz (about 40 m for typical research airspeeds).
CO₂ measurements (LI-COR 6262):
The response characteristics for CO₂ are generally the same as for H₂O, except that the SNR at 2 Hz is usually 10 dB or less. As with CO₂, these figures imply that the CO₂ fluxes are being resolved only to about 2 Hz (about 40 m for typical research airspeeds).

11.3 Usage Guidance
None given.

11.4 Other Relevant Information
None.

12. Application of the Data Set
This data set can be used to understand the change in CO₂ concentration with altitude, which can in turn be used to infer fluxes.

13. Future Modifications and Plans
None given.

14. Software

14.1 Software Description
None given.

14.2 Software Access
None given.

15. Data Access
The Wyoming King Air 1994 aircraft sounding 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: ormlaadac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification
Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/ [Internet Link].
15.3 Procedures for Obtaining Data
Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

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

16. Output Products and Availability

16.1 Tape Products
Not applicable.

16.2 Film Products
Not applicable.

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

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation
See references listed in Section 17.2.

17.2 Journal Articles and Study Reports


17.3 Archive/DBMS Usage Documentation
None.
18. Glossary of Terms

Abbreviations used in weather notes:
- cu - cumulus
- st - status
- ci - cirrus
- sct - scattered
- zi - inversion height above ground
- H - haze
- K - smoke
- cist - cirrostratus
- clr - clear
- ovc - overcast
- RW - light rain showers
- acu - altocumulus

Abbreviations in flight descriptions:
- rt - round trip
- agl - above ground level (in feet)
- msl - above mean sea level (in feet)
- mult - multiple
- TAS - true airspeed
- lvl - level
- wind "L" - "L" with one leg parallel to wind direction, flown as at least one round trip

19. List of Acronyms

AFM - Airborne Fluxes and Meteorology
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
GPS - Global Positioning System
GSFC - Goddard Space Flight Center
HTML - HyperText Markup Language
IFC - Intensive Field Campaign
IRS - Inertial Reference System
NASA - National Aeronautics and Space Administration
NCAR - National Center for Atmospheric Research
NRC - National Research Council, Canada
NSA - Northern Study Area
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
SA - Study Area
SNR - Signal to Noise Ratio
SSA - Southern Study Area
URL - Uniform Resource Locator
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When using these data, please contact the personnel listed in Section 2.3 as well as citing relevant papers in Section 17.2.

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 AFM-2 team used the University of Wyoming King Air aircraft during IFCs 1, 2, and 3 in 1994 to collected pass-by-pass fluxes (and many other statistics) for the large number of level (constant altitude), straight-line passes used in a variety of flight patterns over the SSA and NSA and areas along the transect between these study areas. The data described here form a second set, namely soundings that were incorporated into nearly every research flight by the King Air in 1994. These soundings generally went from near the surface to above the inversion layer. Most were flown immediately after takeoff or immediately after finishing the last flux pattern of that particular day’s flights. The parameters that were measured include wind direction, wind speed, west wind component (u), south wind component (v), static pressure, air dry bulb temperature, potential temperature, dewpoint, temperature, water vapor mixing ratio, and CO₂ concentration. Data on the aircraft’s location, attitude, and altitude during data collection are also provided. These data are stored in tabular ASCII files.