BOREAS FOLLOW-ON FLX-04 TOWER FLUX AND METEOROLOGICAL DATA FROM NSA BURN SITE

Get Data

Summary

Tower flux and meteorological data were collected above 4 black spruce forest sites in the NSA that experienced stand-replacing wildfires in 1989,1981,1964 and 1930. At each site, 4-6 weeks of data were collected during the peak growing season (June-September) in either 1999 or 2000. Fluxes were measured using paired portable solar powered eddy flux systems. The data are part of an ongoing age sequence study that will result in year round eddy flux and meteorological measurements in seven sites that burned between 2 and 150 years ago. The data are available in tabular ASCII files.

Data Citation

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

Litvak, M. E., M. L. Goulden, S. D. Miller, and S. Wofsy. 2001. BOREAS Follow-On FLX-04 Tower Flux and Meteorological Data from NSA Burn Site. Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS Follow-On FLX-04 Tower Flux and Meteorological Data from NSA Burn Site

1.2 Data Set Introduction

Eddy-correlation flux measurements of sensible heat, latent heat, CO_2, and momentum fluxes were made at 4 sites in the BOReal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA) for 4-6 weeks during either the 1999 or 2000 peak growing season (June-September). All sites experienced large-scale stand replacing wildfires of similar severity and were located in upland areas with well-drained soils and similar soil type. In all sites, the pre-burn dominant species was black spruce, and the regenerating forest will likely return to black spruce.

1.3 Objective/Purpose

The principal objective was to determine, directly, the net ecosystem exchange of CO_2 and the surface energy budget over these forests during the peak growing season. These observations were coupled with a comprehensive characterization of the physical environment (Photosynthetically Active Radiation (PAR), soil temperature, etc.).

These measurements are a preliminary part of an ongoing study to investigate how boreal forest CO_2, and energy exchange changes during secondary succession. Most investigations of forest CO_2 exchange in the boreal forest during the BOREAS campaign concentrated on mature forests only. One of the most striking aspects of the boreal forest landscape however is that it is a mosaic of large mixed-aged patches created by fires that burn in individual locations once every 100 years. The various stands in the mosaic likely differ markedly in carbon balance, with the recently disturbed sites probable sources of CO_2, the middle-aged stands likely sinks of CO_2, and the older stands most likely in near balance with the atmosphere. Observations from a single site therefore tells little about the current or future carbon balance of the region. The ultimate goal of this study is to provide a reliable determination of boreal forest carbon balance by considering the effect of stand age on CO_2 exchange. To do this we will make year round measurements of CO_2 and energy exchange in seven closely-matched stands (in terms of topography, soil type, and pre-burn forest characteristics), that range in age-since-last-disturbance from 2 to 150 years. The complete chronosequence includes burns from 1998, 1995, 1989, 1981, 1964, and 1850 (NSA-OBS).

1.4 Summary of Parameters

Latent heat flux, sensible heat flux, carbon dioxide flux, momentum flux, CO_2 concentration, air temperature, net radiation, incident Photosynthetic Photon Flux Density (PPFD), reflected PPFD, wind speed and direction.

1.5 Discussion

Eddy-correlation flux measurements for CO_2 and H_2O were made at 4 locations in the northern study area during the growing season of 1999 and 2000. The principal objective was to directly determine the net ecosystem exchange of CO_2, and the surface energy budget during the peak growing season at these sites and to couple these observations with a comprehensive characterization of the physical environment (PAR, air temperature, soil temperature etc.). Two roving lightweight portable eddy-correlation system powered by solar power were used to measure above canopy eddy fluxes of CO_2, sensible heat and water vapor, and incident and intercepted PAR. Soil temperature and moisture measurements at each site were recorded by a meteorological station located 100 m from the tower. Among other things, these measurements should allow assessment of the importance of secondary succession in determining CO_2 and energy exchange from boreal forests.

1.6 Related Data Sets

Tower flux measurements made at other sites:
BOREAS TF-09 NSA OJP Tower Flux, Meteorological, and Soil Temperature Data
BOREAS TF-09 SSA OBS Tower Flux, Meteorological, and Soil Temperature Data
BOREAS TF-10 NSA Fen and YJP Flux, Meteorological, and Soil Temperature Data

Other measurements made at the NSA-UBS site:
BOREAS TE-06 Forest Biophysical Measurements
BOREAS Follow-On Measurements of Above/Below ground NPP (Univ. of Wisconsin - Gower, P.I.)

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2. Investigator(s)

2.1 Investigator(s) Name and Title
Dr. Marcy E. Litvak
Dr. Michael L. Goulden
Dr. Scott D. Miller
Dr. Steven Wofsy

2.2 Title of Investigation
Peak growing season CO_2 and energy exchange along a boreal forest chronosequence

2.3 Contact Information

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3. Theory of Measurements

These data are from a pilot study in which our preliminary goal was to design and test a lightweight, fully autonomous, solar-powered eddy flux system that will allow relatively inexpensive measurements of CO_2 exchange during peak growing season in all seven identified sites in the chronosequence. We operated these portable systems in each site for 4-6 weeks to compare the rates of CO_2 and exchange with those measured simultaneously at NOBS. We also deployed this system on the OBS tower for two weeks in September 1999 and for 1 week in September 2000 to check for measurement biases relative to Harvard's system at NOBS. In 1999, the system used a closed path IRGA to measure CO_2 and H_2O. In 2000, the systems used an open path IRGA for determination of CO_2 and H_2O. In 1999, the agreement between the Harvard system and ours was good for CO_2, but not sensible heat flux (see section 10.1). In 2000, agreement between the Harvard system and ours was good for sensible heat flux and CO_2, but not for latent heat fluxes.

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4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

NSA-BRN-1989

The dominant tree species was aspen (1 m tall), with regenerating jack pine and black spruce. Numerous forb species were present as well. Measurements were made continuously from 23 July - 14 September, 2000.

NSA-BRN-1981

Dominant species were aspen (8m), jack pine(7 m), black spruce(4 m), and alder.

NSA-BRN-1964

Dominant species were black spruce, with jack pine and aspen. Ground cover was primarily feather moss.

NSA-BRN-1930

The 70 year old site was located 50 km from the nearest town and 200 m from the nearest road in the site designated as the Northern Study Area (NSA) Upland Black Spruce (UBS) site. The site is relatively homogeneous, and the trees were approximately 10-12 m tall. The ground cover was primarily feather moss mixed with some lower-level areas of sphagnum bog. Black spruce is the dominant species, with scattered jack pine, aspen, and alder present as well.

4.1.2 Source/Platform

The components of the eddy flux system used were different in 1999 and 2000. The differences are summarized below.

Summary of Eddy Correlation System used by UCI (1999):

Measurement	Sensor
Vertical and horizontal velocity	3-axis Solent HS sonic anemometer
Temperature sensor	Solent HS sonic anemometer
Moisture sensor (closed-path)	LiCor 6262 Infrared Gas Analyzer (IRGA)
CO2 sensor (closed-path)	LiCor 6262 IRGA
Inlet Filter	Gelman Zeflour 3 µm pores, 4 x 50 mm dia.
Tubing	0.156 ID PFA Teflon, 22 meters long
Pumps	KNF Neuberger KN828 DC brushless pump
Data logger	Campbell Scientific CR23X
Pressure and flow controllers	MKS Instruments

Summary of Eddy Correlation System used by UCI (2000):

Measurement	Sensor
Vertical and horizontal velocity	Campbell Scientific CSAT3 sonic anemometer
Temperature sensor	Campbell Scientific CSAT3,Vaisala HMP45C
Moisture sensor (open-path)	LiCor 7500 Open Path Infrared Gas Analyzer (IRGA)

CO2 sensor (open-path)	LiCor 7500 IRGA

4.1.3 Source/Platform Mission Objectives

The tower was erected to support instruments above the forest canopy to collect flux data from various burns in the NSA.

4.1.4 Key Variables

Eddy-correlation measurements of latent heat flux, sensible heat flux, CO_2 flux, and momentum flux. Above canopy CO_2 and water vapor concentration, and air temperature. Incident and reflected PPFD. Wind speed and direction.

4.1.5 Principles of Operation

Sonic Anemometer:

Three-dimensional orthogonal wind velocities (u, v, and w) and virtual temperature (Tv) were measured with a sonic anemometer (1999:Solent, Gill Instruments, Lymington, U.K.; 2000:Campbell Scientific Utah, USA). Virtual temperature heat flux was converted to sensible heat flux using algorithms described by Kaimal and Gaynor (1991) and Schotanus et al. (1983).

Infrared Absorption Spectrometer:

Water vapor and CO_2 concentrations were measured with a closed-path infrared absorption spectrometer in 1999, and with an open-path infrared absorption spectrometer in 2000.

For the closed path system in 1999: The LiCor sensor was placed in an insulated box at the base of the tower. The air was drawn down the tower at 7 standard liters per minute. Pressure was controlled in the cell of the LiCor at 48 kPa. The delay time between the wind speed and concentration measurement was calculated at 2.5 seconds. The time constant for response time of the instrument to a change in the mixing ratio of the air sample was determined to be 0.41 seconds for CO_2 and .44 seconds for H_2O. The difference in time was due to adsorption of H_2O to the tubing. The response-time corrections typically were 5% during the day and 15% at night. An averaging time of 30 minutes was used and a linear least-squares regression was used to detrend the flux data.

4.1.6 Sensor/Instrument Measurement Geometry

1999: The sonic anemometer was located at a height of 17-m on a 18-m triangular-cross-section telescoping tower (Aluma Tower). Air temperature and relative humidity, wind speed and direction, incident and reflected PPFD, incident and reflected solar radiation, and net radiation were measured at 17.0 m.

2000: At each burn, the sonic anemometer, open-path IRGA, air temperature and relative humidity sensor, incident and reflected PPFD, incident and reflected solar radiation and net radiation sensors were located at the same height on the triangular-cross section telescoping tower (Aluma Tower). The sensor heights for each burn site are as follows: 1989 burn(10 m), 1981 burn (12 m), 1964 burn (13 m).

4.1.8 Manufacturer of Sensor/Instrument

Sonic anemometer:
Solent HS
Gill Instruments
Lymington, U.K.

CSAT3
Campbell Scientific Instruments
P.O. Box 551
Logan, UT 84321

CO_2 and H_2O sensors:
LiCor
P.O. Box 4425
Lincoln, NE

Data logging systems:
Campbell Scientific Instruments
P.O. Box 551
Logan, UT 84321

Pressure and Flow Control:
MKS Instruments
Andover, MA

4.2 Calibration

4.2.1 Specifications

Sonic anemometer: Supplied by the manufacturer.

1999 CO_2 sensor: Calibrated every 6 hours by passing a span gas of 352±5% ppm through the LiCor IRGA at 1 standard liter per minute for 2 minutes followed by zero air (zero air passed through a column of soda lime) for 2 minutes.

1999 H_2O sensor: Calibrated at the beginning and end of the month using a LiCor dew point generator. Calibration was checked by comparison with a Vaisala probe on the tower. Zero information for the LiCor IRGA was recorded by passing zero air through the sample cell (zero air passed through a column of magnesium perchlorate) for 2 minutes, every 6 hours.

2000 CO_2 sensor: Calibrated once before IRGA was installed on tower at each site. Span gas was 349(5% ppm CO_2, and zero air contained less than 1% hydrocarbons. H_2O sensor: Calibrated once before IRGA was installed on tower at each site using a LiCor dew point generator.

4.2.1.1 Tolerance
Not known.

4.2.2 Frequency of Calibration
See 4.2.1

4.2.3 Other Calibration Information

Not known.

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5. Data Acquisition Methods

In both 1999 and 2000, data for flux measurements (output from sonic anemometer and IRGA) were continuously recorded at 4 Hz while output from air temperature, relative humidity, incident and reflected PPFD, incident and reflected solar radiation and net radiation sensors were recorded at 0.5 Hz. All data were stored on a laptop at the site and diagnostic variables were transmitted via GOES satellite every three hours.

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6. Observations

6.1 Data Notes

NSA-BRN-1989

The sonic was pointing due west, thus fluxes from wind directions 80-100 are questionable.

NSA-BRN-1981

The sonic was pointing north, and there was a patch of unburned older black spruce approximately 100 m to the north and 150 m to the south. We suggest disgarding fluxes from directions 345-30 degrees, and from 150-200 degrees.

NSA-BRN-1964

The sonic was pointing due north and tower was located 75 m north of a road cut. Because of this, fluxes from wind directions 150-250 are questionable.

NSA-BRN-1930

The sonic was pointing due west, thus fluxes from wind directions 80-100 are questionable.

6.2 Field Notes

None Available

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7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

Site	Latitude	Longitude	Notes
NSA-BRN-1989	55° 54' 24" N	098° 58' 48" W	just west of Footprint River
NSA-BRN-1981	55° 51' 52.8" N	098° 28' 37.1" W	approx. 1 mile south of OBS
NSA-BRN-1964	55° 55' 4.8" N	098° 21' 59.2" W	
NSA-BRN-1930	55° 54' 48" N	098° 31' 23" W	Upland Black Spruce (UBS) site

7.1.2 Spatial Coverage Map

Not applicable.

7.1.3 Spatial Resolution

The data represent point source measurements taken at the given locations. The location and size of the footprint from which the measurements were made varied with ambient meteorological conditions.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Measurements were made from August 1999 to September 2000.

7.2.2 Temporal Coverage Map

NSA-BRN-1989 - Measurements made continuously from 23-Jul-2000 to 14-Sep-2000.
NSA-BRN-1981 - Measurements made continuously from 23-Jul-2000 to 30-Sep-2000.
NSA-BRN-1964 - Measurements made continuously from 28-May-2000 to 11-Jul-2000.
NSA-BRN-1930 - Measurements made continuously from 11-Aug 1999 to 08-Sep-2000.

Given in Section 1.3

7.2.3 Temporal Resolution

In both 1999 and 2000, data for flux measurements (output from sonic anemometer and IRGA) were continuously recorded at 4 Hz while output from air temperature, relative humidity, incident and reflected PPFD, incident and reflected solar radiation and net radiation sensors were recorded at 0.5 Hz. The data were stored on a laptop PC and downloaded twice per week. Fluxes and meteorological variables were calculated on half-hourly basis.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files are:

```
         Column Name
------------------------------
SITE_NAME
DATE_OBS
TIME_OBS
SENSIBLE_HEAT_FLUX_ABV_CNPY
LATENT_HEAT_FLUX_ABV_CNPY
NET_RAD_ABV_CNPY
CO2_FLUX_ABV_CNPY
CO2_CONC_ABV_CNPY
DOWN_PPFD_ABV_CNPY
DOWN_PPFD_ABV_CNPY
```

```
MOMENTUM_FLUX_ABV_CNPY
WIND_DIR_MAG_ABV_CNPY
WIND_SPEED_ABV_CNPY
FRICTION_VELOC_ABV_CNPY
AIR_TEMP_ABV_CNPY
RELATIVE_HUM_ABV_CNPY
CRTFCN_CODE
REVISION_DATE
```

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-BRN-YYYY where SSS identifies the portion of the study area: NSA, and YYYY identifies the age of forest (year of burn).- 1930, 1964, 1981, or 1989.
DATE_OBS	The date on which data were collected
TIME_OBS	The start of the 30-minute period when the data were collected, in Greenwich Mean Time (GMT).
SENSIBLE_HEAT_FLUX_ABV_CNPY	The sensible heat flux measured above the canopy.
LATENT_HEAT_FLUX_ABV_CNPY	The latent heat flux measured above the canopy.
NET_RAD_ABV_CNPY	The net radiation measured above the canopy.
CO2_FLUX_ABV_CNPY	The carbon dioxide flux measured above the canopy
CO2_CONC_ABV_CNPY	The carbon dioxide concentration measured above the canopy.
DOWN_PPFD_ABV_CNPY	The incoming photosynthetic photon flux density measured above the canopy.
UP_PPFD_ABV_CNPY	The downward photosynthetic photon flux density measured above the canopy.
MOMENTUM_FLUX_ABV_CNPY	The momentum flux measured above the canopy.
WIND_DIR_MAG_ABV_CNPY	The wind direction measured above the canopy from magnetic north.
WIND_SPEED_ABV_CNPY	The wind speed measured above the canopy.
FRICTION_VELOC_ABV_CNPY	The friction velocity above the canopy.
AIR_TEMP_ABV_CNPY	The air temperature measured above the canopy.
RELATIVE_HUM_ABV_CNPY	The relative humidity measured above the canopy
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files are:

Column Name	Units
SITE_NAME	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HH.H GMT]
SENSIBLE_HEAT_FLUX_ABV_CNPY	[Watts][meter^-2]
LATENT_HEAT_FLUX_ABV_CNPY	[Watts][meter^-2]
NET_RAD_ABV_CNPY	[Watts][meter^-2]
CO2_FLUX_ABV_CNPY	[micromoles][meter^-2][second^-1]

```
CO2_CONC_ABV_CNPY              [parts per million]
DOWN_PPFD_ABV_CNPY             [micromoles][meter^-2][second^-1]
UP_PPFD_ABV_CNPY               [micromoles][meter^-2][second^-1]
MOMENTUM_FLUX_ABV_CNPY         [newton] [meter^-2]
WIND_DIR_MAG_ABV_CNPY          [degrees from magnetic North]
WIND_SPEED_ABV_CNPY            [meters][second^-1]
FRICTION_VELOC_ABV_CNPY        [meters][second^-1]
AIR_TEMP_ABV_CNPY              [degrees Celsius]
RELATIVE_HUM_ABV_CNPY          [percent]
CRTFCN_CODE                    [none]
REVISION_DATE                  [DD-MON-YY]
```

7.3.4 Data Source

The source of the parameter values contained in the data files are:

Column Name	Data Source
SITE_NAME	[Investigator]
DATE_OBS	[Investigator]
TIME_OBS	[Investigator]
SENSIBLE_HEAT_FLUX_ABV_CNPY	[Gill Solent sonic anemometer for NSA-BRN-1930 site, CSAT3 Campbell sonic for other sites]
LATENT_HEAT_FLUX_ABV_CNPY	[Closed path Infrared Gas Analyzer for NSA-BRN-1930 site, Open path Infrared Gas Analyzer for other sites]
NET_RAD_ABV_CNPY	[Net radiometer]
CO2_FLUX_ABV_CNPY	[Closed path Infrared Gas Analyzer for NSA-BRN-1930 site, Open path Infrared Gas Analyzer for other sites]
CO2_CONC_ABV_CNPY	[Closed path Infrared Gas Analyzer for NSA-BRN-1930 site, Open path Infrared Gas Analyzer for other sites]
DOWN_PPFD_ABV_CNPY	[Quantum sensor]
UP_PPFD_ABV_CNPY	[Quantum sensor]
MOMENTUM_FLUX_ABV_CNPY	[Gill Solent sonic anemometer for NSA-BRN-1930 site, CSAT3 Campbell sonic for other sites]
WIND_DIR_MAG_ABV_CNPY	[Gill Solent sonic anemometer for NSA-BRN-1930 site, CSAT3 Campbell sonic for other sites]
WIND_SPEED_ABV_CNPY	[Gill Solent sonic anemometer for NSA-BRN-1930 site, CSAT3 Campbell sonic for other sites]
FRICTION_VELOC_ABV_CNPY	[Gill Solent sonic anemometer for NSA-BRN-1930 site CSAT3 Campbell sonic for other sites]
AIR_TEMP_ABV_CNPY	[thermocouple]
RELATIVE_HUM_ABV_CNPY	[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:

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-BRN-1930	NSA-BRN-1989	None	None	None	None
DATE_OBS	11-Aug-99	14-Sep-00	None	None	None	None
TIME_OBS	0	23.5	None	None	None	None
SENSIBLE_HEAT_FLUX_	-80.365	455.64	-999	None	None	None

```
ABV_CNPY
LATENT_HEAT_FLUX_ABV_  -56.59        368.94         -999   None   None    None
CNPY
NET_RAD_ABV_CNPY       -87.03        694.9          -999   None   None    None
CO2_FLUX_ABV_CNPY      -15.66        15.431         -999   None   None    None
CO2_CONC_ABV_CNPY      327.11        430.48         -999   None   None    None
DOWN_PPFD_ABV_CNPY     -0.30         1991.13        -999   None   None    None
UP_PPFD_ABV_CNPY       -0.35         96.45          -999   None   None    None
MOMENTUM_FLUX_ABV_CNPY -2.10         0.09           -999   None   None    None
WIND_DIR_MAG_ABV_      0             360            -999   None   None    None
CNPY
WIND_SPEED_ABV_CNPY    .05           10.22          -999   None   None    None
FRICTION_VELOC_ABV_    0.00           1.45          -999   None   None    None
CNPY
AIR_TEMP_ABV_CNPY      -5.41         34.39          -999   None   None    None
RH_ABV_CNPY            .21           100.91         -999   None   None    None
CRTFCN_CODE            CPI           CPI            None   None   None    None
REVISION_DATE          30-Nov-00     30-Nov-00      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 is a sample of the first few records from the data file on the CD-ROM:

```
SITE_NAME,DATE_OBS,TIME_OBS,SENSIBLE_HEAT_FLUX_ABV_CNPY,LATENT_HEAT_FLUX_ABV_CNPY,
NET_RAD_ABV_CNPY,CO2_FLUX_ABV_CNPY,CO2_CONC_ABV_CNPY,DOWN_PPFD_ABV_CNPY,
UP_PPFD_ABV_CNPY,MOMENTUM_FLUX_ABV_CNPY,WIND_DIR_MAG_ABV_CNPY,WIND_SPEED_ABV_CNPY,
FRICTION_VELOC_ABV_CNPY,AIR_TEMP_ABV_CNPY,RH_ABV_CNPY,CRTFCN_CODE,REVISION_DATE
NSA-BRN-1964,28-May-00,1400,28.9864578,35.4339218,11.61626816,-2.0155973,
370.6107483,3.285819371,-999,-0.3087664,203.9116364,3.1118889,0.555667526,
11.8465862,88.6176147,CPI,28-Dec-00
NSA-BRN-1964,28-May-00,1430,52.702198,41.338665,12.74547348,-2.4076433,
370.0732727,3.614854555,-999,-0.260648,210.7561188,2.3937347,0.510536972,
12.1309137,87.373703,CPI,28-Dec-00
NSA-BRN-1964,28-May-00,1500,40.8094673,30.4141216,8.78569412,-1.405153,
```

```
369.855072,2.582177149,-999,-0.2668377,207.1391754,2.5296218,0.516563355,
12.114151,87.424324,CPI,28-Dec-00
```

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8. Data Organization

8.1 Data Granularity

The data are contained in single-month files for each of the four sites.

8.2 Data Format

The data file contains numerical and character fields of varying length separated by commas. There are no spaces between the fields. Missing fields contain a -999.

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9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

None.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None

9.3.2 Calculated Variables

None.

9.4 Graphs and Plots

None.

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10. Errors

10.1 Sources of Error

Errors in flux measurements may be associated with wind from behind the tower, calm ambient conditions (friction velocity < .2 m/s), and the damping of high-frequency fluctuations. The Solent HS sonic anemometer differs fundamentally in the way it calculates speed of sound temperature compared to the sonic (ATI) Harvard uses at NOBS. Gill Instruments conceded that a major bug in the HS firmware might explain this discrepancy. Unfortunately, this bug not only compromises the validity of the sensible heat fluxes calculated in the 70-year old site, but also prevents a valid comparison of the sensible heat fluxes between the OBS and the 70 year old sites. CO_2 concentration numbers are only good ±10 ppm because of the calibration tank specifications.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Raw flux data were examined for errors associated with malfunctioning instruments. These periods were excluded.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

None given.

10.2.5 Data Verification by Data Center

BORIS staff reviewed these data, modified column names and format, and organized the data by site and month. BORIS staff also worked with the team to document the data set.

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11. Notes

11.1 Limitations of the Data

None given.

11.2 Known Problems with the Data

CO_2 fluxes may be underestimated when the friction velocity is less than 0.2 m/sec. The closed-path IRGA and long sampling tube resulted in an underestimation of water vapor and CO_2 flux because of the damping of high-frequency fluctuations. The Solent HS sonic anemometer differs fundamentally in the way it calculates speed of sound temperature compared to the sonic (ATI) Harvard uses at NOBS. Gill Instruments conceded a major bug in the HS firmware associated with this discrepancy. Unfortunately, this discrepancy not only prevented a valid comparison of sensible heat flux between the OBS and the 70-year old site, but also puts into question the sensible heat fluxes calculated at the 70-year old site. Errors in flux data may also be associated with wind directions coming from behind the tower. See section 6.1 for details. CO_2 concentration numbers are only good ±15ppm because of the calibration tank specifications.

11.3 Usage Guidance

Please contact the investigators for permission regarding the use of these data sets.

11.4 Other Relevant Information

None given.

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12. Application of the Data Set

This suite of measurements should provide information to assess the affect of age since disturbance on CO_2 and energy exchange in boreal forests.

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13. Future Modifications and Plans

We are currently testing a year-round solar-powered eddy flux system (Fall-Winter, 2000), and will begin making year-round measurements in all chronosequence sites in Spring 2001.

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14. Software

14.1 Software Description

None given.

14.2 Software Access

None given.

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15. Data Access

15.1 Contact for Data Center/Data Access Information

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

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

15.2 Procedures for Obtaining Data

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

15.3 Output Products and Availability

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

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16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

The data are available as tabular American Standard Code for Information Interchange (ASCII) text files.

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17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

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17.2 Journal Articles and Study Reports

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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):28731-28770.

17.3 Archive/DBMS Usage Documentation

None.

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18. Glossary of Terms

None.

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19. List of Acronyms

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ASCII   - American Standard Code for Information Interchange
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
DAAC    - Distributed Active Archive Center
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
GMT     - Greenwich Mean Time
GSFC    - Goddard Space Flight Center
IRGA    - Infrared Gas Analyzer
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
OBS     - Old Black Spruce
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
PAR     - Photosynthetically Active Radiation
SSA     - Southern Study Area
PPFD    - Photosynthetic Photon Flux Density
UBS     - Upland Black Spruce
URL     - Uniform Resource Locator
WMO     - World Meteorological Organization
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20.5 Document Curator:

webmaster@daac.ornl.gov

20.6 Document URL:

http://daac.ornl.gov/BOREAS/FollowOn/guides/flx04_nsa_burn_flux_met_doc.html

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METEOROLOGY
SENSIBLE HEAT FLUX
LATENT HEAT FLUX
CARBON DIOXIDE FLUX
CARBON DIOXIDE CONCENTRATION
PHOTOSYNTHETIC PHOTON FLUX DENSITY
PHOTOSYNTHETICALLY ACTIVE RADIATION
PPFD
PAR
NET RADIATION
AIR TEMPERATURE
SOIL TEMPERATURE
WIND SPEED

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