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Volume 18

BOREAS HYD-1 Under-Canopy Precipitation Data

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Richard H. Cuenca, Shaun F. Kelly, David Stangel

Summary

Under-canopy precipitation measurements were made by the BOREAS HYD-1 science team in 1994, 1995, and 1996 at various flux tower sites in the NSA and SSA. In 1994, these data were collected at the NSA-OJP, NSA-YJP, SSA-OJP, and SSA-YJP sites. Starting in 1995 and ending in 1997, data were collected at the NSA-OBS, NSA-OJP, NSA-YJP, and SSA-OA. These data were collected to support HYD-01 research by measuring the amount of water that falls through the canopy and is intercepted by the ground or moss. These data coincide with volumetric soil moisture measurements made by HYD-01. The data are stored in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS HYD-01 Under-Canopy Precipitation Data

1.2 Data Set Introduction

Under-canopy precipitation measurements were made by the BOReal Ecosystem-Atmosphere Study (BOREAS) Hydrology(HYD)-01 team in 1994, 1995, and 1996 at various flux tower sites in the Northern Study Area (NSA) and the Southern Study Area (SSA). In 1994, these data were collected at the NSA-Old Jack Pine (OJP), NSA-Young Jack Pine (YJP), SSA-OJP, and SSA-YJP sites. Starting in 1995 and ending in 1997, data were collected at the NSA-Old Black Spruce (OBS), NSA-OJP, NSA-YJP, and SSA-Old Aspen (OA) sites.

1.3 Objective/Purpose

The objective of this study was to measure under-canopy precipitation at the flux towers where soil moisture was being measured.

1.4 Summary of Parameters

Under-canopy precipitation.

1.5 Discussion

Under-canopy precipitation was used to close the local hydrologic balance in the vicinity of the soil profiles. By placing an under-canopy rain gauge device in the vicinity of each soil moisture profile, ideally, the volumetric soil moisture increase in the profile should equal the applied precipitation measured by the rain gauge. This provides an important check for the soil moisture measurements. Additionally, the under-canopy precipitation can be used to estimate canopy interception by comparing to gauges mounted above the canopy on the towers.

1.6 Related Data Sets

BOREAS HYD-01 Volumetric Soil Moisture Data
BOREAS HYD-01 Soil Hydraulic Properties
BOREAS HYD-06 Moss/Humus Moisture Data
BOREAS HYD-06 Ground Measurements of Soil Moisture
BOREAS HYD-06 Aircraft Gamma Ray Soil Moisture Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Richard H. Cuenca, Professor
Department of Bioresource Engineering
Oregon State University

2.2 Title of Investigation

Coupled Atmosphere-Forest Canopy-Soil Profile Monitoring and Simulation

2.3 Contact Information

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For questions regarding 1994 data collection:

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3. Theory of Measurements

These measurements of under-canopy precipitation were made to determine the amount of precipitation that hit the soil, below a forested canopy. These measurements are useful in determining the amount of water that went into the soil, increasing the volumetric soil moisture.

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

The wedge-shaped rain gauge is inserted into a bracket that is supplied with the gauge. The bracket is mounted on a short wood stake that has been driven into the ground a few inches. To read the gauge, water levels are recorded within the gauge with the highest accuracy possible for the corresponding water level. After each reading, the gauge is removed from the bracket and emptied of its contents.

Tipping bucket rain gauges were mounted on a 0.5-in.-diameter metal pipe (3 ft long) inserted into

the ground. The tipping bucket was secured to the pipe using hose clamps at a height of 0.5 m (from funnel lip). The tipping bucket was leveled and debris cleaned from the screen during site visits. Under-canopy rain gauges were located in the vicinity of soil moisture measurement profiles.

4.1.2 Source/Platform

The rain gauge is mounted on a wooden stake.

4.1.3 Source/Platform Mission Objectives

The wooden stake is used to hold the rain gauge.

4.1.4 Key Variables

Under-canopy precipitation.

4.1.5 Principles of Operation

Rain Gauge

The wedge-shaped rain gauge is mounted on a stake at ground level. It can measure up to 150 cm of water, and the accuracy decreases as more water accumulates in the gauge. Measurement line density varies from +/- 0.1 cm at the bottom to +/- 2.5 cm at the top.

The tipping bucket rain gauge is a smaller adaptation of the standard Weather Bureau tipping bucket rain gauge. It measures precipitation at rates up to 2 in. per hour with an accuracy of +/-1%. Output is a switch closure for each bucket tip. A tip occurs with each 0.1 mm of precipitation.

In 1994, the rain gauges were read every other day during the Intensive Field Campaigns (IFCs) corresponding to a neutron probe water content measurement. All water contents are for the time interval between the date of the measurement and the last recorded precipitation event. The rain gauges were located at the OJP and YJP sites in both the NSA and the SSA. The rain gauges were installed less than 2 feet from the neutron probe access tubes. In general terms, the gauges were located between 50 and 150 meters in a northeasterly direction out from the flux tower.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

Wedge-shaped Rain Gauges:

Tru-Check
Edwards Mfg. Co
Box 166
Albert Lea, MN 56007
(507) 373-8206

Tipping Bucket Rain Gauges:

Texas Electronics
P.O. Box 7225, Inwood-Station
Dallas, TX 75209
(214) 631-2490

4.2 Calibration

4.2.1 Specifications

Wedge-shaped Rain Gauges: None given.

TE525 Tipping Bucket Rain Gauge
Range of Indication: Infinite, in increments of 0.1 mm
Accuracy: 1.0% at 2 inch/hr or less
Signal Output: Momentary switch closure approximately 135 ms
Environmental Limits:
Temperature: 0 to 50 °C
Humidity: 0 - 100%
Physical Data:
Diameter: 6.25 in. overall
Height: 12 in.
Weight: 2.5 lbs.
Receiving Orifice: Gold anodized spun aluminum knife-edge collector ring and funnel assembly
Ring Diameter: 9.664 in.
Resolution: 0.1 mm
Calibration: 16.00 fluid oz. (100 bucket tips)
Mounting: Side bracket with clamps mounted to pole
Material: Aluminum
Cable: 2-conductor standard shielded cable

4.2.1.1 Tolerance
None given.

4.2.2 Frequency of Calibration
The wedge rain gauge was not field calibrated.

TE525 Tipping Bucket Rain Gauge

Calibration/Cleaning Frequency:
Sensor is factory calibrated and does not require field calibration.
Debris filters, funnel orifices, and bucket reservoirs were cleaned during site inspections.

4.2.3 Other Calibration Information
None.

5. Data Acquisition Methods

The data were acquired by reading the wedge-shaped rain gauges (1994) on a regular basis, when soil moisture was measured. After the 1994 data collection, the data were read from the tipping bucket rain gauges.

6. Observations

6.1 Data Notes

Some clogging occurred during the measurement periods at long-term measurement sites, which allowed water to pool in the funnel.

6.2 Field Notes

None.

7. Data Description

7.1 Spatial Characteristics

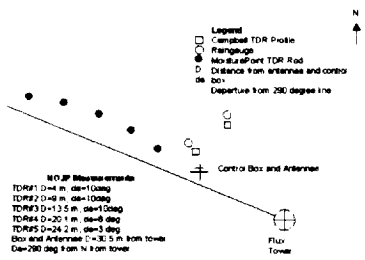
7.1.1 Spatial Coverage

Multiple in situ measurements were made in the vicinity of the flux towers for each respective site. In 1994, these data were collected at the OJP and YJP sites in the NSA and SSA. After 1994, they were collected at the OBS, OJP, and YJP sites in the NSA and at the OA in the SSA. The North American Datum of 1983 (NAD83) coordinates of the sites are:

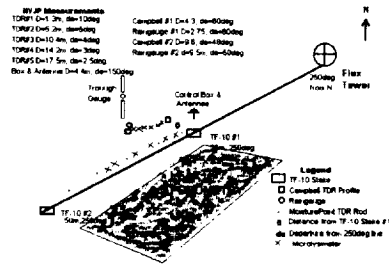
SITE	LONGITUDE	LATITUDE
NSA-OJP	98.62396° W	55.92842° N
NSA-YJP	98.28706° W	55.89575° N
NSA-OBS	98.48139° W	55.88007° N
SSA-OA	106.19779° W	53.62890° N
SSA-OJP	104.69203° W	53.91634° N
SSA-YJP	104.64529° W	53.87581° N

7.1.2 Spatial Coverage Map

The following maps were provided showing the sites where measurements were made in 1996.



1996 Measurements at NSA-OJP



1996 Measurements at NSA-YJP

7.1.3 Spatial Resolution

These data represent point measurements at the designated sites.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

The periods over which data were collected at each site varied. The overall period of data collection was from 23-May-1994 to 24-Jun-1997.

7.2.2 Temporal Coverage Map

	1994 Data Collection	
Site	**Start**	**End**
NSA-OJP	15-Jun-1994	15-Sep-1994
NSA-YJP	30-May-1994	15-Sep-1994
SSA-OJP	23-May-1994	06-Sep-1994
SSA-YJP	23-May-1994	06-Sep-1994

	1995 to 1997 Data Collection	
Site	**Start**	**End**
NSA-OJP	25-Jun-1996	06-Nov-1996
NSA-YJP	27-Jun-1996	06-Nov-1996
NSA-OBS	14-Jul-1995	24-Jun-1997
SSA-OA	17-Jun-1996	02-Nov-1996

7.2.3 Temporal Resolution

In 1994, the measurements were made every other day during the field campaigns, corresponding to soil moisture measurements. After 1994, with the automated equipment in place, measurements were taken every hour while precipitation events were occurring.

7.3 Data Characteristics

7.3.1 Parameter/Variable

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

```
1994 Data Column Name
------------------------------
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
TUBE_ROD_ID
PRECIP_UNDER_CANOPY
CRTFCN_CODE
REVISION_DATE
```

1995 to 1997 Data Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
PRECIP_UNDER_CANOPY_1
PRECIP_UNDER_CANOPY_2
MEAN_PRECIP_UNDER_CANOPY
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition

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

1994 Data Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
TUBE_ROD_ID	The identifier for the Tube or Rod at which the data was collected.
PRECIP_UNDER_CANOPY	The under-canopy precipitation.
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.

1995 to 1997 Data Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is

	the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
PRECIP_UNDER_CANOPY_1	The under-canopy precipitation measured at gauge 1.
PRECIP_UNDER_CANOPY_2	The under-canopy precipitation measured at gauge 2.
MEAN_PRECIP_UNDER_CANOPY	The mean under-canopy precipitation.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

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

1994 Data Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
TUBE_ROD_ID	[unitless]
PRECIP_UNDER_CANOPY	[millimeters]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

1995 to 1997 Data Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
PRECIP_UNDER_CANOPY_1	[millimeters]
PRECIP_UNDER_CANOPY_2	[millimeters]
MEAN_PRECIP_UNDER_CANOPY	[millimeters]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

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

1994 Data Column Name	Data Source
SITE_NAME	[Assigned by BORIS]
SUB_SITE	[Assigned by BORIS]
DATE_OBS	[Supplied by Investigator]
TIME_OBS	[Supplied by Investigator]
TUBE_ROD_ID	[Supplied by Investigator]
PRECIP_UNDER_CANOPY	[Supplied by Investigator]
CRTFCN_CODE	[Assigned by BORIS]
REVISION_DATE	[Assigned by BORIS]

1995 to 1997 Data Column Name	Data Source
SITE_NAME	[Assigned by BORIS]
SUB_SITE	[Assigned by BORIS]
DATE_OBS	[Supplied by Investigator]
TIME_OBS	[Supplied by Investigator]
PRECIP_UNDER_CANOPY_1	[Supplied by Investigator]
PRECIP_UNDER_CANOPY_2	[Supplied by Investigator]
MEAN_PRECIP_UNDER_CANOPY	[Supplied by Investigator]
CRTFCN_CODE	[Assigned by BORIS]
REVISION_DATE	[Assigned by BORIS]

7.3.5 Data Range

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

1994 Data

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-OJP-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	HYD01-UCP01	HYD01-UCP07	None	None	None	None
DATE_OBS	23-MAY-94	15-SEP-94	None	None	None	None
TIME_OBS	0	0	None	None	None	None
TUBE_ROD_ID	1	7	None	None	None	None
PRECIP_UNDER_CANOPY	-9999	130	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	05-MAY-95	05-MAY-95	None	None	None	None

1995 to 1997 Data

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-OBS-FLXTR	SSA-9OA-FLXTR	None	None	None	None
SUB_SITE	HYD01-UCP01	HYD01-UCP08	None	None	None	None
DATE_OBS	14-JUL-95	24-JUN-97	None	None	None	None
TIME_OBS	0	2300	None	None	None	None

```
PRECIP_UNDER_CANOPY_ 0              21.08          None    None    None    None
1
PRECIP_UNDER_CANOPY_ 0              18.03          None    None    None    Blank
2
MEAN_PRECIP_UNDER_   .05            18.67          None    None    None    Blank
CANOPY
CRTFCN_CODE          CPI            CPI            None    None    None    None
REVISION_DATE        30-OCT-98      30-OCT-98      None    None    None    None
-------------------------------------------------------------------------------

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value  -- The value that indicates missing data. This is used to
                      indicate that an attempt was made to determine the
                      parameter value, but the attempt was unsuccessful.
Unrel Data Value   -- The value that indicates unreliable data.  This is used
                      to indicate an attempt was made to determine the
                      parameter value, but the value was deemed to be
                      unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the
                      instruments detection limits.  This is used to
                      indicate that an attempt was made to determine the
                      parameter value, but the analysis personnel determined
                      that the parameter value was below the detection
                      limit of the instrumentation.
Data Not Cllctd    -- This value indicates that no attempt was made to
                      determine the parameter value.  This usually
                      indicates that BORIS combined several similar but
                      not identical data sets into the same data base table
                      but this particular science team did not
                      measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A   -- Indicates that the value is not applicable to the respective column.
None  -- Indicates that no values of that sort were found in the column.
-------------------------------------------------------------------------------
```

7.4 Sample Data Record

The following are wrapped versions of data records from a sample data file on the CD-ROM.

```
1994 Data

SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,TUBE_ROD_ID,PRECIP_UNDER_CANOPY,
CRTFCN_CODE,REVISION_DATE
'NSA-OJP-FLXTR','HYD01-UCP02',15-JUN-94,0,'2',21.5,'CPI',05-MAY-95
'NSA-OJP-FLXTR','HYD01-UCP02',20-JUL-94,0,'2',10.0,'CPI',05-MAY-95

1995 to 1997 Data

SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,PRECIP_UNDER_CANOPY_1,
PRECIP_UNDER_CANOPY_2,MEAN_PRECIP_UNDER_CANOPY,CRTFCN_CODE,REVISION_DATE
'NSA-OJP-FLXTR','HYD01-UCP07',28-JUN-96,300,.2,.1,.15,'CPI',30-OCT-98
'NSA-OJP-FLXTR','HYD01-UCP07',29-JUN-96,500,1.3,1.6,1.45,'CPI',30-OCT-98
```

8. Data Organization

8.1 Data Granularity

The smallest amount of data that can be ordered from this data set is the data for a given month at a given site.

8.2 Data Format(s)

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

The amount of precipitation is read directly from the wedge-shaped gauge. For the tipping bucket gauges, the amount of precipitation is determined from the number of tips (see Section 4.2.1).

9.2 Data Processing Sequence

9.2.1 Processing Steps

The BOREAS Information System (BORIS) staff processed the 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 HYD-01 team to document the data set.
- Extracting the standardized 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

None given.

9.4 Graphs and Plots

None given.

10. Errors

10.1 Sources of Error

Wedge Rain Gauge

The device is so simple that errors were reduced to leaves falling in the gauges or a gauge being tipped over. The high frequency of data collection ensured that evaporation from the gauges was a minor factor in the readings. The only major limitation is simply the accuracy in which one can read the level of water within the gauge.

Tipping Bucket Rain Gauge

Unattended automated tipping bucket devices did not function in the winter during freezing conditions. Spring and fall readings may indicate collected snow and subsequent melting in the funnel.

10.2 Quality Assessment

10.2.1 Data Validation by Source
None given.

10.2.2 Confidence Level/Accuracy Judgment
Unattended tipping bucket rain gauges used from 1995-97 were periodically cleaned, yet they almost all invariably included debris that collected in the screen, and some were completely clogged. For this reason, at most sites a minimum of two gauges was installed. Rarely were both gauges clogged. Questionable data may be noted when large differences exist between gauges.

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
The data that were received from HYD-01 were loaded into the relational data base and checked to make sure that no errors were introduced in loading the data.

11. Notes

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
None given.

11.4 Other Relevant Information
None given.

12. Application of the Data Set

This data set can be used with the volumetric soil moisture data to determine how soil moisture changes with time during rain events and during dry periods. These under-canopy precipitation data indicate how much precipitation falls on the soil. These data can be used in various kinds of hydrological and ecological models.

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 under-canopy precipitation data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

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

15.2 Data Center Identification

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

None.

16.2 Film Products

None.

16.3 Other Products

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

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

None given.

17.2 Journal Articles and Study Reports

Cuenca, R.H., D.E. Stangel, and S.F. Kelly. 1997. Soil water balance in a boreal forest. Journal of Geophysical Research 102(D24):29,355-29,365.

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

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17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms

None.

19. List of Acronyms

ASCII	- American Standard Code for Information Interchange
BOREAS	- BOReal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
CD-ROM	- Compact Disk - Read Only Memory
DAAC	- Distributed Active Archive Center
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
GIS	- Geographic Information System
GMT	- Greenwich Mean Time
GSFC	- Goddard Space Flight Center
HTML	- HyperText Markup Language
HYD	- Hydrology
IFC	- Intensive Field Campaign
NASA	- National Aeronautics and Space Administration
NSA	- Northern Study Area
OA	- Old Aspen
OBS	- Old Black Spruce
OJP	- Old Jack Pine
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
SSA	- Southern Study Area
TE	- Terrestrial Ecology
URL	- Uniform Resource Locator
YA	- Young Aspen
YJP	- Young Jack Pine

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Under-canopy precipitation measurements were made by the BOREAS HYD-1 science team in 1994, 1995, and 1996 at various flux tower sites in the NSA and SSA. In 1994, these data were collected at the NSA-OJP, NSA-YJP, SSA-OJP, and SSA-YJP sites. Starting in 1995 and ending in 1997, data were collected at the NSA-OBS, NSA-OJP, NSA-YJP, and SSA-OA. These data were collected to support HYD-01 research by measuring the amount of water that falls through the canopy and is intercepted by the ground or moss. These data coincide with volumetric soil moisture measurements made by HYD-01. The data are stored in tabular ASCII files.

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