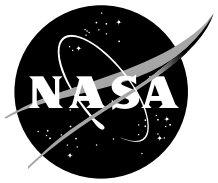
NASA/TM—2000–209891, Vol. 34



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

Forrest G. Hall and David E. Knapp, Editors

Volume 34

BOREAS HYD-8 1994 Gravimetric Moss Moisture Data

X. Wang

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

July 2000

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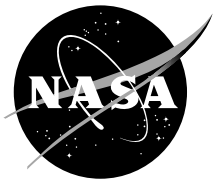

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Xuewen Wang, University of Toronto

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Space Administration

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Greenbelt, Maryland 20771

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BOREAS HYD-8 1994 Gravimetric Moss Moisture Data

Xuewen Wang

Summary

The BOREAS HYD-8 team made measurements of surface hydrological processes that were collected at the NSA-OBS Tower Flux site in 1994 and at Joey Lake, Manitoba, to support its research into point hydrological processes and the spatial variation of these processes. The data collected may be useful in characterizing canopy interception, drip, throughfall, moss interception, drainage, evaporation, and capacity during the growing season at daily temporal resolution. This particular data set contains the gravimetric moss moisture measurements from June to September 1994. A nested spatial sampling plan was implemented to support research into spatial variations of the measured hydrological processes and ultimately the impact of these variations on modeled carbon and water budgets. These data are stored in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS HYD-08 1994 Gravimetric Moss Moisture Data

1.2 Data Set Introduction

This particular data set contains the gravimetric moss moisture measurements by the Hydrology (HYD)-08 team at the BOReal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA)-Old Black Spruce (OBS) site and the Joey Lake, Manitoba, site from June to September 1994. A nested spatial sampling plan was implemented to support research into spatial variations of the measured hydrological processes and ultimately the impact of these variations on modeled carbon and water budgets. These data are stored in American Standard Code for Information Interchange (ASCII) text files.

1.3 Objective/Purpose

The objective of these moss data is to provide the BOREAS investigators with a data product that characterizes the role of moss on the water budget at the forest floor in the NSA-Modeling Sub-Area (MSA). These data are to be used for modeling purposes.

1.4 Summary of Parameters

This data set contains the weight of moss turfs for different layers of moss under conditions where the turfs were contained in plastic, to contain water within the moss turf, and without plastic, to let water flow through the moss.

1.5 Discussion

Hydrological processes such as canopy evaporation, moss storage, and moss evaporation may play a significant role in controlling water fluxes during the growing season in boreal wetlands. Canopy interception, moss storage, and moss evaporation were measured using mass balance methods (throughfall catch buckets and lysimeters) to give a quantitative estimate of these processes for sparse black spruce stands. More importantly, the spatial sampling scheme allowed quantification of the expected variation of these processes within the footprint of a colocated flux measurement tower. This will allow consideration of the subtower-footprint controls on vapor fluxes that the tower is measuring. In addition, the data set will be useful in parameterizing flux models for the targeted site, as well as determining the typical variation in fine-scale processes that the models may have to account for when scaling to watershed and regional extents.

1.6 Related Data Sets

BOREAS HYD-01 Volumetric Soil Moisture Data
BOREAS HYD-01 Under Canopy Precipitation
BOREAS HYD-06 Moss/Humus Moisture Data
BOREAS HYD-08 Throughfall Data
BOREAS HYD-08 1996 Gravimetric Moss Moisture Data
BOREAS HYD-08 Gross Precipitation Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Lawrence Band
University of North Carolina
Chapel Hill, NC

Formerly at:
University of Toronto
Department of Geography
Toronto, Ontario

2.2 Title of Investigation

Simulation of Boreal Ecosystem Carbon and Water Budgets: Scaling from Local to Regional Extents

2.3 Contact Information

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David.Knapp@gsfc.nasa.gov

3. Theory of Measurements

Turfs were located randomly; however, some turfs were relocated because of the presence of live roots. A set of 20-cm x 20-cm-square turfs was extracted by hand either to the bottom of the live moss layer (defined by the presence of a horizontal litter mat) for Pleurozium schreberi turfs, or by the end of thalli for sphagnum turfs. Turfs were placed on a mesh tray and then replaced in the pit from which they were extracted. Turfs were weighed daily and after rain events by placing them directly on a leveled electronic scale. If turfs were over field capacity (water dripped from them), the phenomenon was noted and weighing proceeded after the majority of drip water had ceased. Any large litter components that appeared on turfs during the measurement period were removed and placed on the moss surface beside the turf. Turf water equivalent depth was computed by later oven drying the turfs and determining dry turf + lysimeter tray weights to compute water weight, assuming a constant 1,000 kg/m^3 density of H_2O to compute water equivalent depth.

4. Equipment

4.1 Sensor/Instrument Description

Turf Lysimeter Mesh Base

A 20-cm x 20-cm aluminum mesh tray with 10-gauge wire mesh and 1-cm mesh holes was used as the base of each lysimeter. Monofilament fishing line was used to form handles to extract the lysimeter

from the turf pit.

Electronic Weigh Scales

The two scales used were manufactured by MARS, and were both in the MS3000W series. The scale used to measure weights less than 1 kg was a 900-g range scale (accurate to ± 0.1 g). The scale used to measure weights greater than 1 kg was a 2,000-g range scale (accurate to ± 1.0 g). Both balances were tared before and after weighing and had been calibrated immediately before the field campaign and at the University of Toronto after the measurement campaign. The balances had an auto-off condition where taring was not possible or when battery power was low.

4.1.1 Collection Environment

These measurements were made in a spruce forest, near the NSA-OBS tower site and the Joey Lake site, where moss covered the ground.

4.1.2 Source/Platform

None.

4.1.3 Source/Platform Mission Objectives

None.

4.1.4 Key Variables

Moss turf weights.

4.1.5 Principles of Operation

See Section 3.

4.1.6 Sensor/Instrument Measurement Geometry

All throughfall and catch gauges were repositioned using a bubble level to ensure that they were upright. The turf lysimeters were extracted vertically from the pits even for pits on the sides of hummocks.

4.1.7 Manufacturer of Sensor/Instrument

Gauges and Lysimeters - Darryl Carlysle Moses and Kira Dunham
(University of Toronto, Dept. of Geography)

Weigh Scales - (2) MARS MS3000W Series

4.2 Calibration

The weigh scales were calibrated to within the manufacturer's specifications immediately before the measurement campaign and at the University of Toronto after the campaign. The effect of the weigh scales being off level was also tested with no appreciable difference for tilt angles less than 20 degrees (which were defined by the first indent in the bubble level gauge used in the field).

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

The weigh scales were calibrated to within the manufacturer's specifications immediately before the measurement campaign and at the University of Toronto after the campaign.

4.2.3 Other Calibration Information
None.

5. Data Acquisition Methods

The living moss carpet was cut in 20-cm by 20-cm squares with varying depths: L layer consists of the living moss carpet and a small portion of the brown senescing moss shoot bases; LF layer includes L layer plus a brown, well-defined layer of partially decomposed but still recognizable organic material; and LFH layer is LF plus the very dark layer of more humified organic material above the Ae horizon of the mineral soil. Two treatments were applied, one with a plastic sheet at the bottom to prevent drainage from the turf and the other without plastic. The cut turfs were placed back in their original holes and taken out for weighing on a regular basis.

6. Observations

6.1 Data Notes
None given.

6.2 Field Notes
None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage
At the Joey Lake site, these data were collected at four different plots. At the NSA-OBS site, the data were taken from two plots located near the flux tower. The plots were about 30 meters apart, about 10 m by 10 m square each. The samples within each plot were about 5 meters apart. Each turf sample was 20 cm by 20 cm in size.

The approximate locations of the various plots (based on the North American Datum of 1983 (NAD83)) are as follows:

			BOREAS Grid	
Site	Longitude	Latitude	X	Y
NSA (Joey Lake)	98.15026W	55.46676N	807.025	571.969
NSA-OBS (Flux Twr.)	98.48139W	55.88007N	778.216	613.516

7.1.2 Spatial Coverage Map
None.

7.1.3 Spatial Resolution
The samples were 20 cm by 20 cm, randomly distributed around the given locations.

7.1.4 Projection
These data were collected at point locations. They are not in any projection.

7.1.5 Grid Description
None.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

NSA-Joey Lake: 25-Jun-1994 to 07-Sep-1994
NSA-OBS: 15-Aug-1994 to 16-Sep-1994

7.2.2 Temporal Coverage Map

None.

7.2.3 Temporal Resolution

These data were collected once a day (twice a day when it rained) for most days during the measurement period.

7.3 Data Characteristics

7.3.1 Parameter/Variable

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

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
PLOT_ID
WEIGHT
MEASUREMENT_TYPE
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition

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

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

The following is needed to decode the PLOT_ID value. The characters indicate the layer(s) of moss that are in the turf and whether the turf had plastic applied to it or not.

```
L : The litter layer is included.
F : The fibric layer is included.
H : The humus layer is included.
# : A number indicating the plot number of the turf.
p : plastic was applied, restricting the flow of water out of the turf.
```

WEIGHT	The weight of the sample (including tray).
MEASUREMENT_TYPE	Indicates whether the measurement was a "WET" measurement during the course of the field season or a "DRY" measurement after the field season was over.

The information regarding MEASUREMENT_TYPE indicates whether the turf is WET or DRY. There is only one DRY measurement per turf, since the dry measurement was made when the turf was removed from the field, dried, and weighed in a lab.

CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

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

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
PLOT_ID	[none]
WEIGHT	[grams]
MEASUREMENT_TYPE	[none]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

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

Column Name	Data Source
SITE_NAME	[Assigned by BORIS]
SUB_SITE	[Assigned by BORIS]
DATE_OBS	[Supplied by Investigator]
TIME_OBS	[Supplied by Investigator]
PLOT_ID	[Supplied by Investigator]
WEIGHT	[Supplied by Investigator]
MEASUREMENT_TYPE	[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.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-9BS-HYD08	NSA-OBS-FLXTR	None	None	None	None
SUB_SITE	HYD08-MOS01	HYD08-MOS02	None	None	None	None
DATE_OBS	25-JUN-94	16-SEP-94	None	None	None	None
TIME_OBS	18	2309	None	None	None	None
PLOT_ID	L1	LFH4p	None	None	None	None
WEIGHT	18.07	1909.21	-99.9	None	None	None
MEASUREMENT_TYPE	DRY	WET	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	07-JUL-97	10-JUL-97	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.

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,PLOT_ID,WEIGHT,MEASUREMENT_TYPE,CRTFCN_CODE,
REVISION_DATE
'NSA-9BS-HYD08','HYD08-MOS01',25-JUN-94,1800,'L1p',141.5,'WET','CPI',10-JUL-97
'NSA-OBS-FLXTR','HYD08-MOS02',15-AUG-94,2100,'L2',111.4,'WET','CPI',07-JUL-97
```

8. Data Organization

8.1 Data Granularity

The smallest amount of data that can be ordered is all of the data for 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

None.

9.1.1 Derivation Techniques and Algorithms

The mass of water in a lysimeter can be estimated from this data set with the following equation:

mass_water(g) = wet_mass(g) - dry_mass(g) - tray_mass(g)

The computation of water equivalent depth for the lysimeters was performed using:

d (mm) = 1000 (mm/m) * mass_water(g) / (1000 kg/m^3 * area_gauge_bottom(m^2))

9.2 Data Processing Sequence

9.2.1 Processing Steps

- Set up necessary equipment.
- Performed daily weighings and empty weighed gauges.
- Performed the necessary data manipulations and computed water equivalent depth.
- Added the necessary column headings.
- Transferred the information to the BOREAS Information System (BORIS).
- Loaded the data into the relational data base (done by BORIS staff).

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.

10. Errors

10.1 Sources of Error
Sampling error: errors might have occurred because of a limited number of samples.

10.2 Quality Assessment

10.2.1 Data Validation by Source
None given.

10.2.2 Confidence Level/Accuracy Judgment
None given.

10.2.3 Measurement Error for Parameters
None given.

10.2.4 Additional Quality Assessments
None.

10.2.5 Data Verification by Data Center
The data were received from the HYD-08 science team and loaded into the BORIS relational data base. After loading, the data were compared with the original data files to make sure that they were loaded properly.

11. Notes

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
The weights that are reported in these data can be used to compute equivalent water depth. Equivalent water depth can be computed by using dry turf + lysimeter tray weights to compute water weight, assuming a constant 1,000 kg/m^3 density of H_2O to compute water equivalent depth for a 20-cm x 20-cm turf sample.

11.4 Other Relevant Information
The tray weights are included in the weights reported in this data set. When comparing wet and dry turf weights, the weight of the tray cancels out to yield the weight of the water.

12. Application of the Data Set

The data collected may be useful in characterizing canopy interception, drip, throughfall, moss interception, drainage, evaporation, and capacity during the growing season at daily temporal resolution.

13. Future Modifications and Plans

None given.

14. Software

14.1 Software Description

None.

14.2 Software Access

Not applicable.

15. Data Access

The HYD-08 1994 gravimetric moss moisture data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

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

15.2 Data Center Identification

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

15.3 Procedures for Obtaining Data

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

15.4 Data Center Status/Plans

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

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products
None.

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

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation
None.

17.2 Journal Articles and Study Reports
Haddeland, I. and D.P. Lettenmaier. 1995. Hydrologic Modeling of Boreal Forest Ecosystems. Water Resources Series Technical Report No. 143. University of Washington, 123 pp.

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.

Price, A.G., K. Dunham, T. Carleton, and L.E. Band. 1997. Variability of water fluxes through the Black Spruce (Picea Mariana) canopy and Feather Moss (Pleurozium Schreberi) carpet in the Boreal Forest of Northern Manitoba. Journal of Hydrology, 196, 310-323.

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

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

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

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms

None.

19. List of Acronyms

```
ASCII   - American Standard Code for Information Interchange
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
CD-ROM  - Compact Disk-Read-Only Memory
DAAC    - Distributed Active Archive Center
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
FFC-T   - Focused Field Campaign - Thaw
GIS     - Geographic Information System
GMT     - Greenwich Mean Time
GSFC    - Goddard Space Flight Center
HTML    - Hyper-Text Markup Language
HYD     - Hydrology
IFC     - Intensive Field Campaign
MSA     - Modeling Sub-Area
NAD83   - North American Datum of 1983
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
OBS     - Old Black Spruce Tower Site
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
SSA     - Southern Study Area
URL     - Uniform Resource Locator
WWW     - World Wide Web
```

20. Document Information

20.1 Document Revision Date

Written: 15-Nov-1995
Last Revised: 16-Jul-1999

20.2 Document Review Date(s)

BORIS Review: 23-Jul-1998
Science Review:

20.3 Document ID

20.4 Citation

When using these data, please contact the principal investigator, Dr. Lawrence Band (see Section 2.1), before publishing results that are based on these data as well as citing relevant papers in Section 17.2.

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

Band, L.E., "Simulation of Boreal Ecosystem Carbon and Water Budgets: Scaling from Local to Regional Extents." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

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

20.5 Document Curator

20.6 Document URL

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Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
July 2000

3. REPORT TYPE AND DATES COVERED
Technical Memorandum

4. TITLE AND SUBTITLE
Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)
BOREAS HYD-8 1994 Gravimetric Moss Moisture Data

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

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Goddard Space Flight Center
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8. PEFORMING ORGANIZATION REPORT NUMBER
2000-03136-0

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES)
National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
TM—2000–209891
Vol. 34

11. SUPPLEMENTARY NOTES
X. Wang: University of Toronto; D.E. Knapp: Raytheon ITSS

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unclassified–Unlimited
Subject Category: 43
Report available from the NASA Center for AeroSpace Information,
7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The BOREAS HYD-8 team made measurements of surface hydrological processes that were collected at the NSA-OBS Tower Flux site in 1994 and at Joey Lake, Manitoba, to support its research into point hydrological processes and the spatial variation of these processes. The data collected may be useful in characterizing canopy interception, drip, throughfall, moss interception, drainage, evaporation, and capacity during the growing season at daily temporal resolution. This particular data set contains the gravimetric moss moisture measurements from June to September 1994. A nested spatial sampling plan was implemented to support research into spatial variations of the measured hydrological processes and ultimately the impact of these variations on modeled carbon and water budgets. These data are stored in tabular ASCII files.

14. SUBJECT TERMS
BOREAS, hydrology, gravimetric moss moisture.

15. NUMBER OF PAGES
14

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL