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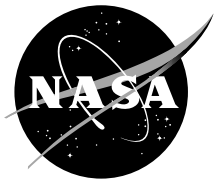

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and David E. Knapp, Editors

Volume 32

BOREAS HYD-8 Gross Precipitation Data

R. Fernandes

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

July 2000

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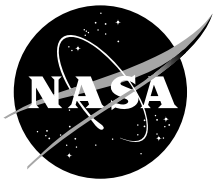

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BOREAS HYD-8 Gross Precipitation Data

Richard Fernandes

Summary

The BOREAS HYD-8 team made measurements of surface hydrological processes at the SSA-OBS Tower Flux site to support its research into point hydrological processes and the spatial variation of these processes. 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 gross precipitation measurements for July to August 1996. Gross precipitation is the precipitation that falls that is not intercepted by tree canopies. These data are stored in ASCII text files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS HYD-08 Gross Precipitation Data

1.2 Data Set Introduction

This particular data set contains the gross precipitation measurements from the BOReal Ecosystem-Atmosphere Study (BOREAS) Hydrology (HYD)-08 team at the Southern Study Area (SSA) Old Black Spruce (OBS) site for July to August 1996. 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 as American Standard Code for Information Interchange (ASCII) text files.

1.3 Objective/Purpose

The objective of the data set was to quantify the magnitude and spatial variation of storages and fluxes at the moss surface and during precipitation events in a selected Picea Mariana stand. Gross precipitation was measured to permit future parameterization of flux models.

1.4 Summary of Parameters

Gross Precipitation (after storm events) (millimeters of H_2O).

1.5 Discussion

Hydrological processes such as canopy evaporation and moss storage and evaporation may play a significant role in controlling water fluxes during the growing season in boreal wetlands. Canopy interception and moss storages and 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 site targeted 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-08 1996 Moss Lysimeter Measurements
BOREAS HYD-08 1996 Moss Dry Weights
BOREAS HYD-08 1996 Throughfall 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

Two shielded catch buckets were located in clearings parallel to the transect of measurement plots but within 100 m of a transect near the SSA-OBS site. The clearings were selected to provide at least a 45-degree unobstructed vertical cone. The bucket was placed in a pit so that the orifice was just above the surrounding surface vegetation (mosses and sedges). The reservoir was manually drained of water once a day and after every rain event; care was taken to shake loose any drops on the inside surface of the reservoir. The drained water was weighed on an electronic balance at a leveled location.

4. Equipment

4.1 Sensor/Instrument Description

Each bucket consisted of a catch funnel mounted on a reservoir. The catch funnel had a 10-cm by 10-cm vertical lip followed by a 10-cm cone to prevent splashing of rain drops outside the cone and wind turbulence evaporating water collected on the cone surface. The reservoir was a closed 2-liter metal container with an orifice to receive the catch funnel drainage at the top and a drain plug at the base.

4.1.1 Collection Environment

These data were collected in a clearing surrounded by trees.

4.1.2 Source/Platform

Gross Precipitation Gauges - Placed in pits in clearings within 100 m of transect of turf lysimeter sites.

4.1.3 Source/Platform Mission Objectives

The objective was to measure gross precipitation after rain events.

4.1.4 Key Variables

Gross precipitation.

4.1.5 Principles of Operation

The gauges were designed to hold an amount of water that fell as precipitation. The amount of water was weighed and the weights were used to determine the water equivalent depth.

4.1.6 Sensor/Instrument Measurement Geometry

None given.

4.1.7 Manufacturer of Sensor/Instrument
Gauges - 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 effects of the weigh scales being off level were 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
Weight Scales
- Weight < 1 kg: accurate to ± 0.1 g
- Weight > 1 kg: accurate to ± 1.0 g

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

Each gauge was placed at a randomly selected location in each stratified plot. The locations were not changed during the field campaign. Measurements were made at each plot for all gauges before moving to another plot. The measurements were made by weighing the amount of water in the gauge. These weights were converted to water depths based on the orifice area of the gauge.

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
The gross precipitation gauge was located within 500 meters of the SSA-OBS flux tower along a single transect leading radially outwards from the tower. The location of the flux tower was determined by Global Positioning System (GPS) and is at the following North American Datum of 1983 (NAD83) coordinates:

Site	Longitude	Latitude	BOREAS Grid X	BOREAS Grid Y
SSA-OBS (Flux Twr.)	105.11779W	53.98717N	385.012	348.646

7.1.2 Spatial Coverage Map

None.

7.1.3 Spatial Resolution

These data represent point measurements, although they may represent the gross precipitation over a larger area based on the "fetch" of the location of the gauge. The fetch of a rain gauge depends on wind speed, precipitation intensity, and the cover over the gauge.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

The data were collected from July to August 1996 with some small gaps.

7.2.2 Temporal Coverage Map

Not applicable.

7.2.3 Temporal Resolution

Data were collected daily and after each rain event where possible. The time of day of data collection is indicated in the data record. However, it typically took 1.5 hours to complete data collection of all sites. The amount of precipitation recorded is the amount that fell since the gauge was last checked.

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
GROSS_PRECIP
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.
GROSS_PRECIP	The gross 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:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
GROSS_PRECIP	[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 onthe 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.]
GROSS_PRECIP	[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	SSA-OBS-FLXTR	SSA-OBS-FLXTR	None	None	None	None
SUB_SITE	HYD08-GPR01	HYD08-GPR01	None	None	None	None
DATE_OBS	04-JUL-96	11-AUG-96	None	None	None	None
TIME_OBS	0	2330	None	None	None	None
GROSS_PRECIP	0	28.2	None	None	None	None
CRTFCN_CODE	PRE	PRE	None	None	None	None
REVISION_DATE	21-MAY-97	21-MAY-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 record from a sample data fileon the CD-ROM.

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,GROSS_PRECIP,CRTFCN_CODE,REVISION_DATE
'SSA-OBS-FLXTR','HYD08-GPR01',04-JUL-96,2030,0.0,'PRE',21-MAY-97
'SSA-OBS-FLXTR','HYD08-GPR01',06-JUL-96,0,1.2,'PRE',21-MAY-97
'SSA-OBS-FLXTR','HYD08-GPR01',06-JUL-96,1530,0.0,'PRE',21-MAY-97
```

8. Data Organization

8.1 Data Granularity

The smallest amount of data that can be ordered from this data set is a day's worth of data.

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

See Section 9.1.1.

9.1.1 Derivation Techniques and Algorithms

The computation of water equivalent depth for gauges 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 emptied weighed gauges.
- Performed the necessary data manipulations to compute 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

See Section 9.1.1.

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables

None.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Quantifiable Error

Gross precipitation gauge errors - Some water drops remain on the sides and funnel of the gauge. The weight of these drops was less than 1 g as determined by comparing the weight of the dry gauge to the weight of the gauge after decanting. This suggests an error of -1 g.

Unquantifiable Error

Errors caused by wind turbulence around the gauge, evaporation from the collector funnel, or condensation on the funnel are possible. It is likely that precipitation is underestimated because of evaporation from the funnel.

10.2 Quality Assessment

10.2.1 Data Validation by Source

These data are preliminary. General trends in the data are reliable; however, individual measurements may be in error.

10.2.2 Confidence Level/Accuracy Judgment

Mean values or plots and gross precipitation accuracy is estimated at approximately 2 out of 5, individual measurements at 1 out of 5.

10.2.3 Measurement Error for Parameters

Estimates of errors of each measurement variable are given below.

- Time: ±2 hours
- Gross Precipitation: The accuracy of the gross precipitation measurements is thought to be approximately 10%. The precision of each measurement is directly related to the precision of the scale that weighed the gauge, as well as other factors.

10.2.4 Additional Quality Assessments

Data quality assessment by the investigator is continuing.

10.2.5 Data Verification by Data Center

Data that were loaded into the data tables were spot checked against the original ASCII data to check for errors that occurred when the data were loaded.

11. Notes

11.1 Limitations of the Data

Isolated data points may be in error because of improper recording or reformatting during documentation. These data are still being reviewed by the investigators.

11.2 Known Problems with the Data

The time specified for data entries may not be precise (i.e., within an hour or two of actual time).

11.3 Usage Guidance

Moss water fluxes are conservative; any strong jumps in time series should be flagged as potential measurement or recording errors unless explained by commensurate inputs.

11.4 Other Relevant Information

None.

12. Application of the Data Set

The HYD-08 data sets can be used for:

- Quantifying rough canopy interception rates for given storm size.
- Quantifying daily moisture fluxes in moss layers.
- Inferring relationships between stand parameters and measured fluxes.
- Parameterizing flux models at stand to local scales.

13. Future Modifications and Plans

Data quality assessment by the investigators is continuing.

14. Software

14.1 Software Description

None.

14.2 Software Access

None.

15. Data Access

The HYD-08 gross 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.

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 given.

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
GPS     - Global Positioning System
GSFC    - Goddard Space Flight Center
HTML    - Hyper-Text Markup Language
HYD     - Hydrology
IFC     - Intensive Field Campaign
NAD83   - North American Datum
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
OBS     - Old Black Spruce
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Laboratory
SSA     - Southern Study Area
URL     - Uniform Resource Locator
```

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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., "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:

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R. Fernandes: University of Toronto; D.E. Knapp: Raytheon ITSS

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12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The BOREAS HYD-8 team made measurements of surfacehydrological processes at the SSA-OBS Tower Flux site to support its research into point hydrological processes and the spatial variation of these processes. 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 gross precipitation measurements for July to August 1996. Gross precipitation is the precipitation that falls that is not intercepted by tree canopies. These data are stored in ASCII text files.

14. SUBJECT TERMS
BOREAS, hydrology, gross precipitation.

15. NUMBER OF PAGES
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