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Volume 27

BOREAS HYD-4 Standard Snow Course Data

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John R. Metcalfe, Barry E. Goodison, Anne Walker

Summary

The BOREAS HYD-4 work was focused on collecting data during the winter field campaign (FFC-W) to improve the understanding of winter processes within the boreal forest. Knowledge of snow cover and its variability in the boreal forest is fundamental if BOREAS is to achieve its goals of understanding the processes and states involved in the exchange of energy and water. The development and validation of remote sensing algorithms will provide the means to extend the knowledge of these processes and states from the local to the regional scale. A specific thrust of the research is the development and validation of snow cover algorithms from airborne passive microwave measurements.

Snow surveys were conducted at special snow courses throughout the 1993/94, 1994/95, 1995/96, and 1996/97 winter seasons. These snow courses were located in different boreal forest land cover types (i.e., old aspen, old black spruce, young jack pine, forest clearing, etc.) to document snow cover variations throughout the season as a function of different land cover. Measurements of snow depth, density, and water equivalent were acquired on or near the first and fifteenth of each month during the snow cover season. The data are provided in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS HYD-04 Standard Snow Course Data

1.2 Data Set Introduction

Snow surveys are made at regular intervals at designated stations or locations throughout the winter to determine the depth, vertically integrated density, and water equivalent. A snow course is a permanently marked traverse where snow surveys are conducted. Snow surveys stratified by landscape features, specifically, terrain, land use, and vegetative cover, provide the best estimate of areal snow water equivalent (SWE). Because snow depth has been found to be generally more highly variable than snow density, the ratio of density to depth samples may be substantially reduced from 1:1 while retaining statistically valid estimates of the areal SWE. Snow survey data are the usual base of comparison for estimates or measurements of snow on the ground.

Snow surveys were conducted at a special network of snow courses to provide estimates of mean snow depth, density and water equivalent over the BOReal Ecosystem-Atmosphere Study (BOREAS) study areas.

1.3 Objective/Purpose

These data were collected to provide a seasonal time series of snow depth and SWE in the BOREAS Northern Study Area (NSA) and Southern Study Area (SSA) to supplement biweekly regional snow course measurements. These data will provide background information and reference data for detailed hydrological and remote sensing projects (Goodison et al., 1987).

1.4 Summary of Parameters

Biweekly (approximately) SWE, depth, density, and standard deviation of depth.

1.5 Discussion

Four snow courses were located in and near the White Gull River watershed in the SSA and were situated in four different land cover types (i.e., old jack pine, old black spruce, young jack pine, and a regenerating or open area). An additional course was located in an old aspen stand near Namekus Lake in Prince Albert National Park (PANP).

Three snow courses were located in the Sapochi River watershed in the NSA. These courses were situated in three different land cover types (i.e., mixed jack pine and poplar, old black spruce, and a fen).

The snow surveys were done on or near the first and fifteenth of each month throughout the winter beginning with the first snow cover.

Data set one contains measurements from 15-Nov-1993 to 15-Apr-1994 for the SSA sites, and from 20-Nov-1993 to 16-Apr-1994 for the NSA sites.

Data set two contains measurements from 08-Nov-1994 to 05-May-1995 for the SSA sites, and from 12-Nov-1994 to 29-Apr-1995 for the NSA sites. Subsequent data sets contain similar measurements for approximately the same time periods. All reference coordinates are taken from 1:50,000-scale topographical sheets.

1.6 Related Data Sets

HYD-04 Areal Snow Course Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Barry Goodison
Chief, Climate Processes and Earth Observation Division
Climate Research Branch

2.2 Title of Investigation

Determination of Snow Cover Variations in the Boreal Forest Using Passive Microwave Radiometry

2.3 Contact Information

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3. Theory of Measurements

The conventional course is a selected line of marked sampling points along which depth and density measurements are made. The length of the course and the distance between sampling points vary depending on site conditions and the uniformity of the snow cover.

Basic snow sampling equipment consists of a graduated tube with a cutter fixed to its lower end to permit easy penetration of the snow and a spring balance (reading directly in water equivalent units) to weigh the tube and its contents. The density of the snow is determined by dividing the water equivalent by the depth of the snow.

4. Equipment

4.1 Sensor/Instrument Description

The large-diameter Eastern Snow Conference (ESC)-30 metric snow sampler with a cutter area of 30 cm^2 was used for these measurements. This sampler consists of a single tube, approximately a meter in length, and is constructed of plastic, with a stainless steel cutter. A complete description of this sampler along with plans, specifications, and an assessment of errors and accuracy can be found in Farnes et al., 1982. The ESC-30 sampler is the current standard sampler used by the Atmospheric Environment Service (AES) for measurement in shallow snow pack regions. The following is a complete list of equipment supplied to the surveyors:

- 1 ESC-30 snow sampler
- 1 spring balance for ESC-30
- 1 cradle
- 1 measuring stick/ruler (cm)
- field book or snow survey form
- pencil

4.1.1 Collection Environment

These measurements were collected in the winter at various locations in the NSA and SSA.

4.1.2 Source/Platform

Measurements are made at a fixed location or station. The site is selected to provide consistent results over time. The site is accessible by foot, skis, and/or vehicle. Individual sampling points are located remote from ground irregularities such as boulders or logs.

4.1.3 Source/Platform Mission Objectives

The objective of collecting these data was to provide a seasonal time series of snow cover.

4.1.4 Key Variables

Snow depth, density, and water equivalent.

4.1.5 Principles of Operation

The snow sampler is lowered vertically into the snow pack with a steady thrust downward. A small amount of twisting aids in driving the tube and cutting thin ice layers; however, considerable force and driving of the sampler may be required to penetrate hard layers of ground ice. Penetration to extract a soil plug helps to prevent the loss of the snow core from the tube; a trace of soil or litter in the cutter indicates that no loss has occurred. Observation of the length of the snow core permits a quick assessment of whether a complete core is obtained; the depth of snow is measured when the sampler is inserted in the snow pack. The sample is weighed in the tube, and the combined weight (in water equivalent units) is read directly with the spring balance. The tare weight of the tube is subtracted to obtain the SWE. The density of the snow is determined by dividing the water equivalent by the depth of the snow. A graduated meter stick is used in obtaining ancillary snow depth measurements.

More detailed information on suggested snow survey procedures is available in Snow Survey and Water Supply Forecasting (U.S. Soil Conservation Service, 1972), Snow Surveying (Atmospheric Environment Service, 1973), and Guide to Hydrological Practices (World Meteorological Organization, 1974).

4.1.6 Sensor/Instrument Measurement Geometry

The ESC snow sampler extracts a snow core with a surface area of 30 cm^2.

4.1.7 Manufacturer of Sensor/Instrument

The ESC-30 snow sampler and spring balance are manufactured and calibrated according to AES specifications. The ESC-30 snow sampler was made under contract for AES. There are no commercial manufacturers of this instrument. Please see specifications on how to make the snow tube in Farnes et al., 1982.

4.2 Calibration

The spring balance is used to weigh snow samples. The balance is held in a free position, and the snow sampler tube containing the snow sample is suspended from the balance in a special cradle. The inner and outer tubes of the balance are made of anodized aluminum. The anchorages for the spring in the outer and inner tubes are designed to permit free, unrestricted flexing of the spring over its entire effective length. The balance has a ring at the top for hanging the balance and a hook at the other end from which the snow sampler cradle is hung. The inner tube has a scale engraved into it, which reads from 0 at the bottom to 125 at the top. The scale indicates the SWE in centimeters.

4.2.1 Specifications

Calibration is performed by the manufacturer using a set of known weights to adjust the magnification of the spring. For more information see AES Spring Balance Calibration Procedure, February 1987, issue 2.

4.2.1.1 Tolerance

A balance must read within ±0.3 cm of the actual weight at all levels up to 60.5 cm and ±0.4 cm at levels above 60.5 cm.

4.2.2 Frequency of Calibration

Spring balances are checked annually before snow surveys begin. A pail and water (1 liter) can be used to check the accuracy of the balance. First, use a pail of water to register a positive reading on the balance, then add 1 liter of water to the pail. The difference between the two scale readings should equal 37.8 ±0.3 cm.

4.2.3 Other Calibration Information

The spring balance should be checked from time to time during the season. Consistent repeat readings (i.e., tare) should be observed, with no indication of appreciable sticking of the spring in the balance. This ensures that the balance is not giving a false reading because the spring is not moving freely.

5. Data Acquisition Methods

The following guidelines for completing the snow surveys were provided to the survey teams:

- Locate the first survey point. Note: The order in which the survey points are done is not important; however, the number used to indicate the measurement site (i.e., T-bar post) should remain constant throughout the measurement season.
- Allow the snow sampler to cool to ambient temperature before starting the survey; e.g., it can be kept in the back of a pickup truck or car trunk. The tare or dry weight of the sampler should be recorded at each sample site.
- Insert snow tube vertically into the snow and turn it clockwise until the cutting teeth just meet the ground surface. If ice layers in the snow are encountered, use a light sawing motion to cut through the ice layer before continuing down through the snow pack. Applying excessive force will collapse the underlying snow and result in a poor sample.
- Read the depth of snow at the sample point from the outside scale on the snow sampler to the nearest 0.5 cm.
- Push the tube sufficiently into the surface soil litter, (i.e., moss/leaves) to obtain a soil plug that will hold the snow sample in the tube as the tube and contents are extracted from the snow pack.
- Once the tube is removed from the snow, remove the soil/litter plug from the end of the tube (a knife is a useful aid for removing the plug and cleaning the cutter teeth). The sample tube and snow contents are then placed on the cradle, which is suspended from the balance, and the weight of the tube and snow is recorded to the nearest 0.1 cm. It is useful to hang the balance from a solid support such as a ski pole or tree branch if available.
- Note the length of the snow core (minus the soil plug) as a check on the representativeness of the sample.
- Empty the snow sampler by pouring the snow out of the top of the sample tube.
- Proceed to the next sample point (i.e., site #2), which is 100 m from the first sample location. Record the depth of snow to the nearest 0.5 cm at 10 equally spaced locations along the transect between these sites using the snow stick/ruler.
- Repeat procedures 1 through 8 at sites #2 through #5.
- Record any unusual snow conditions (e.g., ice layers or crusts) as well as general weather conditions.

6. Observations

6.1 Data Notes

Pay attention to specific references to missing observations or estimated observations. In particular, the fen site in the NSA was difficult to access in the fall and spring, resulting in some estimation of snow cover using nearby courses.

6.2 Field Notes

Copies of field notes are available from the primary contact given in Section 2.3. Observations include a general description of weather conditions during the survey and also some references to the snow pack state (i.e., melting).

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The centers of the snow courses are approximately located at the following coordinates. These coordinates were determined from 1:50,000-scale maps. The latitudes and longitudes were converted to the North American Datum of 1983 (NAD83).

			NAD83		
SITE	BOREAS_X	BOREAS_Y	LONGITUDE	LATITUDE	LANDCOVER/VEGETATION
NTS	776.362	616.140	98.50308W	55.90621N	mature black spruce (NSA)
NIY	418.972	336.623	104.61854W	53.85286N	young jack pine (SSA)
NTJ	769.335	618.054	98.60838W	55.93431N	mixed jack pine & aspen (NSA)
PAA	323.261	328.311	106.07970W	53.84815N	mature aspen (SSA)
NIB	421.547	325.673	104.59484W	53.75285N	mature black spruce (SSA)
NTF	780.986	618.841	98.42247W	55.92261N	fen (NSA)
NIO	421.563	325.853	104.59434W	53.75445N	open regenerating (SSA)
NIM	421.752	325.815	104.59154W	53.75395N	mature jack pine (SSA)

7.1.2 Spatial Coverage Map

Not applicable.

7.1.3 Spatial Resolution

These data are point source measurements at the given locations.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Measurements were taken on or near the first and fifteenth of each month from approximately mid-November to spring melt during the period from November 1993 to May 1996.

7.2.2 Temporal Coverage Map
None.

7.2.3 Temporal Resolution
These data were made approximately every 2 weeks.

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
STATION_ID
MEAN_SNOW_DENSITY_HYD04
MEAN_SWE
SDEV_SWE
MEAN_SNOW_DEPTH
COMMENTS
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.
STATION_ID	This is the station identifier from which the measurement came.
MEAN_SNOW_DENSITY_HYD04	The mean snow density calculated from the mean SWE divided by the mean of the measured core depths.
MEAN_SWE	Mean snow water equivalent (SWE) calculated from the average snow depth times the mean snow density.
SDEV_SWE	Standard deviation of snow water equivalent (SWE) measurements.

MEAN_SNOW_DEPTH	The mean depth of snow.
COMMENTS	Descriptive information to clarify or enhance the understanding of the other entered data.
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]
STATION_ID	[none]
MEAN_SNOW_DENSITY_HYD04	[kilograms][meter^-3]
MEAN_SWE	[millimeters]
SDEV_SWE	[millimeters]
MEAN_SNOW_DEPTH	[millimeters]
COMMENTS	[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]
STATION_ID	[Supplied by Investigator]
MEAN_SNOW_DENSITY_HYD04	[Supplied by Investigator]
MEAN_SWE	[Supplied by Investigator]
SDEV_SWE	[Supplied by Investigator]
MEAN_SNOW_DEPTH	[Supplied by Investigator]
COMMENTS	[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-9TETR	SSA-999-PAA01	None	None	None	None
SUB_SITE	HYD04-SWE01	HYD04-SWE01	None	None	None	None
DATE_OBS	15-NOV-93	17-MAY-96	None	None	None	None

STATION_ID	NIB	PAA	None	None	None	None
MEAN_SNOW_DENSITY_HYD04	58	400	-999	None	None	Blank
MEAN_SWE	0	141	-999	None	None	None
SDEV_SWE	0	145	-999	None	None	None
MEAN_SNOW_DEPTH	0	794	-999	None	None	None
COMMENTS	N/A	N/A	None	None	None	Blank
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	26-JUN-95	29-OCT-96	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,STATION_ID,MEAN_SNOW_DENSITY_HYD04,MEAN_SWE,
SDEV_SWE,MEAN_SNOW_DEPTH,COMMENTS,CRTFCN_CODE,REVISION_DATE
'SSA-999-NIB01','HYD04-SWE01',15-NOV-93,'NIB',104.0,9.0,33.0,84.0,'','CPI',
26-JUN-95
'SSA-999-NIM01','HYD04-SWE01',15-NOV-93,'NIM',104.0,13.0,26.0,121.0,'','CPI',
26-JUN-95
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data from a given site on a given day.

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 Algorithm

density = (swe/(depth*10))*1000

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables

Snow density.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Errors in the data collected by the snow survey teams may arise from several sources:

- Warm temperatures, which can cause snow to stick in the tube.
- Changes to scale precision caused by air temperature fluctuations.
- Scale readings by different observers or during windy conditions, which can yield erratic scale readings.

10.2 Quality Assessment

The quality of the data collected by the survey teams is thought to range from good to excellent; generally it is considered to be excellent. Generally the lowest level of data quality exists when the snow pack is shallowest; that is, early in the season and late in the melt phase. No formal quality assurance is done; however, a coarse check is routinely made after the completion of each survey. Missing values are represented by -999.0 and are inserted when the data are not available.

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

This data set represents the best estimate of snow depth and SWE by land cover/vegetation type for the immediate vicinity of the snow course on the date of the survey. Care should be exercised when extrapolating the measurements in time and/or to a much larger geographic area.

10.2.3 Measurement Error for Parameters

Given by standard error (e.g., depth).

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

The data were spot checked by BORIS to make sure that no conversion errors occurred during loading.

11. Notes

11.1 Limitations of the Data

This data set represents the best estimate of snow depth and SWE by land cover/vegetation type for the immediate vicinity of the snow course on the date of the survey. Care should be exercised when extrapolating the measurements in time and/or to a much larger geographic area.

11.2 Known Problems with the Data

None given.

11.3 Usage Guidance

This data set represents the best estimate of snow depth and SWE by land cover/vegetation type for the immediate vicinity of the snow course on the date of the survey. Care should be exercised when extrapolating the measurements in time and/or to a much larger geographic area.

11.4 Other Relevant Information

None.

12. Application of the Data Set

This data set can be used to develop and validate snow cover algorithms from airborne passive microwave measurements or other remote sensing techniques where SWE can be estimated.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

None.

14.2 Software Access

None.

15. Data Access

The HYD-04 standard snow course 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
Atmospheric Environment Service. 1973. Snow surveying. 2nd Ed. Environ. Can., Downsview. Ont.

Farnes, P.E., N.R. Peterson, B.E. Goodison, and R.P. Richards. 1982. Metrication of Manual Snow Sampling Equipment by Western Snow Conference Metrication Committee. 39th Annual Proceedings of the Eastern Snow Conference, Reno, NV, Apr. 19-23, 1982, pp. 120-132.

Goodison, B.E., J.E. Glynn, K.D. Harvey, and J.E. Slater. 1987. Snow Surveying in Canada: A Perspective. Can. Wat. Res. Jr., Vol. 12, 2, pp. 27-42.

U.S. Soil Conservation Service. 1972. Snow survey and water supply forecasting. Section 22, SCS Nat. Eng. Handb., U.S. Dept. Agric., Washington, DC.

World Meteorological Organization. 1974. Guide to hydrological practices. 3rd Ed. Ch. 2, Instruments and Methods of Observation. WMO No.168, World Meteorological Organization, Geneva, pp. 2.1-2.90.

17.2 Journal Articles and Study Reports
Chang, A.T.C., J.L. Foster, D.K. Hall, B.E. Goodison, A.E. Walker, J.R. Metcalfe, and A. Harby. 1997. Snow parameters derived from microwave measurements during the BOREAS winter field campaign. Journal of Geophysical Research 102(D24): 29,663-29,671.

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).

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

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AES      - Atmospheric Environment Service
ASCII    - American Standard Code for Information Interchange
BOREAS   - BOReal Ecosystem-Atmosphere Study
BORIS    - BOREAS Information System
CD-ROM   - Compact Disk-Read-Only Memory
CGR      - Certified by Group
CPI      - Certified by Principal Investigator
CPI-???  - CPI but questionable
DAAC     - Distributed Active Archive Center
EOS      - Earth Observing System
EOSDIS   - EOS Data and Information System
ESC      - Eastern Snow Conference
FFC-W    - Focused Field Campaign - Winter
GIS      - Geographic Information System
GSFC     - Goddard Space Flight Center
HTML     - HyperText Markup Language
HYD      - Hydrology
NAD83    - North American Datum of 1983
NASA     - National Aeronautics and Space Administration
NSA      - Northern Study Area
ORNL     - Oak Ridge National Laboratory
PANP     - Prince Albert National Park
PI       - Principal Investigator
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PRE      - Preliminary
SSA      - Southern Study Area
SWE      - Snow Water Equivalent
URL      - Uniform Resource Locator
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13. ABSTRACT *(Maximum 200 words)*

The BOREAS HYD-4 work was focused on collecting data during the winter field campaign (FFC-W) to improve the understanding of winter processes within the boreal forest. Knowledge of snow cover and its variability in the boreal forest is fundamental if BOREAS is to achieve its goals of understanding the processes and states involved in the exchange of energy and water. The development and validation of remote sensing algorithms will provide the means to extend the knowledge of these processes and states from the local to the regional scale. A specific thrust of the research is the development and validation of snow cover algorithms from airborne passive microwave measurements. Snow surveys were conducted at special snow courses throughout the 1993/94, 1994/95, 1995/96, and 1996/97 winter seasons. These snow courses were located in different boreal forest land cover types (i.e., old aspen, old black spruce, young jack pine, forest clearing, etc.) to document snow cover variations throughout the season as a function of different land cover. Measurements of snow depth, density, and water equivalent were acquired on or near the first and fifteenth of each month during the snow cover season. The data are provided in tabular ASCII files.

14. SUBJECT TERMS

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