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

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BOREAS HYD-6 Moss/Humus Moisture Data

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BOREAS HYD-6 Moss/Humus Moisture Data
Eugene L. Peck, Thomas Carroll

Summary
The BOREAS HYD-6 team collected several data sets related to the moisture content of soil and overlying humus layers. This data set contains water content measurements of the moss/humus layer, where it existed. These data were collected along various flight lines in the SSA and NSA during 1994. The data are available in tabular ASCII files.

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1. Data Set Overview
1.1 Data Set Identification
BOREAS HYD-06 Moss/Humus Moisture Data

1.2 Data Set Introduction
This document describes the in situ water content measurements of the moss/humus layer along flight lines.

1.3 Objective/Purpose
The objectives of this research were: 1) to obtain improved estimates of the soil moisture conditions for the BOReal Ecosystem-Atmosphere Study (BOREAL) experimental areas; 2) to develop techniques for measuring the water content of the moss/humus layer; 3) to provide assistance to the Hydrology (HYD)-04 team in measuring the water equivalent of the snow cover; 4) to provide information for validating and calibrating other remote sensing methods; and 5) to provide information on the soil moisture of the mineral soil, the water content of the moss/humus layer, and the water equivalent of the snow cover to other investigators.
1.4 Summary of Parameters
Transect identifier, sample identifier, latitude and longitude of the in situ ground measurements of the water content of the moss/humus layer.

1.5 Discussion
As part of the BOREAS experiment, natural terrestrial gamma radiation data over a network of 48 flight lines were collected. For each of these flight lines, ground in situ soil moisture measurements of the mineral soil and water content of the moss/humus layer were collected and used, along with other available measurements, to establish one-time calibration of the natural terrestrial radioisotope signal over the flight line network.

1.6 Related Data Sets
BORCAS HYD-06 Aircraft Gamma Ray Soil Moisture Data
BORCAS HYD-06 Ground Gravimetric Soil Moisture Data

2. Investigator(s)

2.1 Investigator(s) Name and Title
Dr. Eugene L. Peck
Hydex Corporation

Dr. Thomas Carroll
National Weather Service (NWS)

2.2 Title of Investigation
Remote Sensing of Hydrologic Variables in Boreal Areas

2.3 Contact Information

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NWS, NOAA
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tc@nohrsc.nws.gov
3. Theory of Measurements

In situ ground samples of the water content of the moss/humus layer are obtained using the gravimetric method (percent by weight of dry soil). The moss/humus layer samples are placed in one or more plastic containers and are later dried out for 24 hours in a drying oven at 105 °C.

4. Equipment

4.1 Sensor/Instrument Description
An Eastern Snow Conference (ESC-30) snow tube with an orifice of 30 cm² is used to collect samples of the moss/humus layer. Depths of the moss/humus layer are measured with a ruler after digging down to the mineral soil.

4.1.1 Collection Environment
The airborne and ground measurements of the soil moisture and moss/humus layer were planned before each day's surveying. The airborne and ground measurements were taken as simultaneously as possible. Ground measurements for calibration purposes were obtained when the flight line areas were fairly dry and never during rain occurrences.

4.1.2 Source/Platform
Human.

4.1.3 Source/Platform Mission Objectives
The objective was to collect cores of moss/humus at various locations.

4.1.4 Key Variables
Moss/humus moisture content.

4.1.5 Principles of Operation
Unknown.

4.1.6 Sensor/Instrument Measurement Geometry
ESC-30 snow tube with an orifice of 30 cm².

4.1.7 Manufacturer of Sensor/Instrument
Unknown.

4.2 Calibration
Unknown.

4.2.1 Specifications
Unknown.
5. Data Acquisition Methods

Ground measurements were collected at over 1,100 locations along 42 of the 48 BOREAS airborne gamma radiation flight lines during the field experiments. Maps showing locations of most BOREAS established flight lines are shown on Figures 5.2.1.4a, 5.2.1.4b, and 5.2.1.4c of version 3.0 of the BOREAS Experimental Plan. Revised computerized maps of all of the 48 flight lines prepared by National Operational Hydrologic Remote Sensing Center (NOHRSC) (March 1995) are available in the BOREAS Information System (BORIS) (containing a few additional lines that were established during the field experiments).

The flight lines are numbered BP100 to BP123 and CR954 to CR960 in the Southern Study Area (SSA) and BP201 to BP213 in the Northern Study Area (NSA). Flight lines BP301 to BP305 are located along the transect between the SSA and NSA. The CR lines in the SSA are part of the operational snow measurement program of the Atmospheric Environment Service (AES) of Canada. See Section 9.2.1 for details on how the ground samples were processed.

6. Observations

6.1 Data Notes
Unknown.

6.2 Field Notes
Field notes for the ground sampling of the water content of the moss/humus layer by members of HYD-04 and HYD-06 are contained in the comments of the actual data. Ground samples of the water equivalent of the snow cover and other measurements obtained during 1993 and the 1994 Intensive Field Campaigns (IFCs) are being placed in BORIS by HYD-04.

7. Data Description

7.1 Spatial Characteristics
These data were collected along various flight lines within the NSA and SSA. The data that provide the location of these flight lines are described in the HYD-06 Airborne Estimate of Soil Moisture Document.

7.1.1 Spatial Coverage
There is a reference table called HYD06_TRANSECT_REF that contains information about the location of the various flight lines. The ground samples of moss/humus water content were made at point locations throughout the NSA and SSA. The bounding coordinates of these areas are:
NSA Spatial Coverage (North American Datum of 1983 (NAD83))

<table>
<thead>
<tr>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>98.82 W 56.247 N</td>
</tr>
<tr>
<td>Northeast</td>
<td>97.24 W 56.081 N</td>
</tr>
<tr>
<td>Southeast</td>
<td>97.49 W 55.377 N</td>
</tr>
<tr>
<td>Southwest</td>
<td>99.05 W 55.54 N</td>
</tr>
</tbody>
</table>

SSA Spatial Coverage

<table>
<thead>
<tr>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>106.23 W 54.319 N</td>
</tr>
<tr>
<td>Northeast</td>
<td>104.24 W 54.223 N</td>
</tr>
<tr>
<td>Southeast</td>
<td>104.37 W 53.419 N</td>
</tr>
<tr>
<td>Southwest</td>
<td>106.32 W 53.513 N</td>
</tr>
</tbody>
</table>

7.1.2 Spatial Coverage Map

See Figures 5.2.1.4a, 5.2.1.4b, and 5.2.1.4c in version 3.0 of the BOREAS Experiment Plan.

7.1.3 Spatial Resolution

The ground samples of moss/humus water content were made at point locations throughout the NSA and SSA.

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 for as many flight lines as possible during the following periods:

- 08-Sep-1993 to 11-Sep-1993 in the SSA
- 07-Feb-1994 to 11-Feb-1994 in the SSA and NSA (in cooperation with HYD-04)
- 24-Jul-1994 to 05-Aug-1994 in the SSA and NSA
- 30-Aug-1994 to 10-Sep-1994 in the SSA

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

Ground samples were collected on a daily basis. For those ground samples collected by members of HYD-06, the observational times the ground samples were obtained are included in the files Mastergd.DAT and Mastermh.DAT. Times of sampling were not noted for those collected by members of HYD-04.
7.3 Data Characteristics

7.3.1 Parameter/Variable
The parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYD06_SITE_ID</td>
</tr>
<tr>
<td>DATE_OBS</td>
</tr>
<tr>
<td>TIME_OBS</td>
</tr>
<tr>
<td>FLIGHT_LINE</td>
</tr>
<tr>
<td>SAMPLE_NUM</td>
</tr>
<tr>
<td>SUBSAMPLE_NUM</td>
</tr>
<tr>
<td>LONGITUDE</td>
</tr>
<tr>
<td>LATITUDE</td>
</tr>
<tr>
<td>BOREAS_X</td>
</tr>
<tr>
<td>BOREAS_Y</td>
</tr>
<tr>
<td>TOTAL_WEIGHT</td>
</tr>
<tr>
<td>DRY_WEIGHT</td>
</tr>
<tr>
<td>WATER_WEIGHT</td>
</tr>
<tr>
<td>WATER_CONTENT_PARTIAL</td>
</tr>
<tr>
<td>WATERCONTENT_MOSS_HUMUS</td>
</tr>
<tr>
<td>COMMENTS</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
</tr>
<tr>
<td>REVISION_DATE</td>
</tr>
</tbody>
</table>

7.3.2 Variable Description/Definition
The descriptions of the parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYD06_SITE_ID</td>
<td>The identifier assigned to the site by BOREAS, in the format AAA-FFF-GGGGG-SMAC01 where AAA is the study area, FFF is the flight line number, GGGGG is the science group, and SMAC01 stands for Soil Moisture Aircraft.</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>The date on which the data were collected.</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>The Greenwich Mean Time (GMT) when the data were collected.</td>
</tr>
<tr>
<td>FLIGHT_LINE</td>
<td>The designation for the line/transect over which the aircraft flew.</td>
</tr>
<tr>
<td>SAMPLE_NUM</td>
<td>The number of the sample.</td>
</tr>
<tr>
<td>SUBSAMPLE_NUM</td>
<td>The designation of the in situ sub sample.</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>The NAD83 based longitude coordinate at the site.</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>The NAD83 based latitude coordinate at the site.</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>The x component of the BOREAS grid coordinate at the site.</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>The y component of the BOREAS grid coordinate at the site.</td>
</tr>
<tr>
<td>TOTAL_WEIGHT</td>
<td>The total weight of the soil sample and the container with the lid.</td>
</tr>
<tr>
<td>DRY_WEIGHT</td>
<td>The dry weight of the soil sample and the container without the lid.</td>
</tr>
<tr>
<td>WATER_WEIGHT</td>
<td>The calculated weight of the water in the sample.</td>
</tr>
</tbody>
</table>
WATER_CONTENT_PARTIAL
The water content of a portion of the whole sample. The portions are designated as A, B, etc.

WATER_CONTENT_MOSS_HUMUS
The water content of the moss/humus layer.

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:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYD06_SITE_ID</td>
<td>[none]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>[HHMM GMT]</td>
</tr>
<tr>
<td>FLIGHT_LINE</td>
<td>[none]</td>
</tr>
<tr>
<td>SAMPLE_NUM</td>
<td>[none]</td>
</tr>
<tr>
<td>SUBSAMPLE_NUM</td>
<td>[none]</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>[degrees]</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>[degrees]</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>[kilometers]</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>[kilometers]</td>
</tr>
<tr>
<td>TOTAL_WEIGHT</td>
<td>[grams]</td>
</tr>
<tr>
<td>DRY_WEIGHT</td>
<td>[grams]</td>
</tr>
<tr>
<td>WATER_WEIGHT</td>
<td>[grams]</td>
</tr>
<tr>
<td>WATER_CONTENT_PARTIAL</td>
<td>[millimeters]</td>
</tr>
<tr>
<td>WATER_CONTENT_MOSS_HUMUS</td>
<td>[millimeters]</td>
</tr>
<tr>
<td>COMMENTS</td>
<td>[none]</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>[none]</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>[DD-MON-YY]</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYD06_SITE_ID</td>
<td>[Assigned by BORIS]</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>FLIGHT_LINE</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>SAMPLE_NUM</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>SUBSAMPLE_NUM</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>[Calculated by BORIS from LATITUDE and LONGITUDE]</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>[Calculated by BORIS from LATITUDE and LONGITUDE]</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>[Calculated by BORIS from LATITUDE and LONGITUDE]</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>[Calculated by BORIS from LATITUDE and LONGITUDE]</td>
</tr>
<tr>
<td>TOTAL_WEIGHT</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>DRY_WEIGHT</td>
<td>[Supplied by Investigator]</td>
</tr>
<tr>
<td>WATER_WEIGHT</td>
<td>[Supplied by Investigator]</td>
</tr>
</tbody>
</table>
7.3.5 Data Range

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Minimum Data Value</th>
<th>Maximum Data Value</th>
<th>Missng Data Value</th>
<th>Unrel Data Value</th>
<th>Below Detect Limit</th>
<th>Data Not Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYD06_SITE_ID</td>
<td>N/A</td>
<td>N/A</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>09-SEP-93</td>
<td>05-SEP-94</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>TIME_OBS</td>
<td>0</td>
<td>2304</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>FLIGHT_LINE</td>
<td>BP114</td>
<td>BP305</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SAMPLE_NUM</td>
<td>1</td>
<td>97</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SUBSAMPLE_NUM</td>
<td>A</td>
<td>F</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>-105.322</td>
<td>-98.23027</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>53.6443</td>
<td>55.94011</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>BOREAS_X</td>
<td>374.691</td>
<td>802.6</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>BOREAS_Y</td>
<td>309.531</td>
<td>619.075</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>TOTAL_WEIGHT</td>
<td>16.6</td>
<td>1433.9</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>DRY_WEIGHT</td>
<td>14.52</td>
<td>592.7</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>WATER_WEIGHT</td>
<td>.81</td>
<td>109.45</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>WATER_CONTENT_PARTIAL</td>
<td>.3</td>
<td>127.8</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>WATERCONTENT_MOSS_HUMUS</td>
<td>0</td>
<td>284</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>COMMENTS</td>
<td>N/A</td>
<td>N/A</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Blank</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
<td>CPI</td>
<td>CPI</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>REVISION_DATE</td>
<td>12-JUL-95</td>
<td>12-JUL-95</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

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 Collected -- 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.

HYD06_SITE_ID,DATE_OBS,TIME_OBS,FLIGHT_LINE,SAMPLE_NUM,SUBSAMPLE_NUM,LONGITUDE,
LATITUDE,BOREAS_X,BOREAS_Y,TOTAL_WEIGHT,DRY_WEIGHT,WATER_WEIGHT,
WATER_CONTENT_PARTIAL,WATER_CONTENT_MOSS_HUMUS,COMMENTS,CRTFCN_CODE,REVISION_DATE
'SSA-115-HYD06-SMAC01',09-SEP-93,0,'BP115',11,'A','-105.12005,53.98835,384.854,
348.765,51.0,19.79,26.51,8.8,9.0 'using ESC30 tube moss and humus','CPI',
12-JUL-95
'SSA-115-HYD06-SMAC01',09-SEP-93,0,'BP115',12,'A','-105.12005,53.98835,384.854,
348.765,67.66,24.96,38.0,12.7,18.0 'using ESC30 tube humus only','CPI',12-JUL-95

8. Data Organization

8.1 Data Granularity

The smallest unit 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 9.3.

9.1.1 Derivation Techniques and Algorithms

See Section 9.3.

9.2 Data Processing Sequence

9.2.1 Processing Steps

The moss/humus layer samples in the sealed plastic containers obtained in the field are weighed
(M-H total), the lids are removed, and the samples are dried in ovens and weighed again (dry). The
weight of the water (water) in the moss/humus layer for each portion of the sample (A, B, etc.) is
determined by subtracting the dry weight (dry) and the weight of an average plastic lid for that day
from the total weight (M-H total) for the portion of the sample. The weights of the plastic lids and the
plastic containers vary from shipment to shipment, and the average weights of those being used each
day are recorded on the laboratory form with the total and dry weights. The water content of the
portion of the sample is obtained by dividing the water in the portion of the sample by 30 (the
cross-sectional area (in square centimeters) of the ESC sampler). This is multiplied by 10 to yield
water content in millimeters. The water content of each sample is computed by adding the water
content of all of the portions (A, B, etc.) of the sample.

Samples processed by members of HYD-04 are sealed and taken to AES offices in Downsview,
Ontario, for processing. The measurements obtained by members of HYD-04 do not have entries in
column water or water content part. They compute the water content of a sample directly ((M-H total
minus dry)/(30)) * 10.

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.
- Performing the conversions on measurements into System International (SI) units.
- Working with the HYD-06 team to document the data set.
- Extracting the standardized data into logical files.

9.2.2 Processing Changes
Not applicable.

9.3 Calculations
The following equation yields water content in millimeters:

Water Content = (Moss Humus total weight - dry weight of soil)/30 * 10

9.3.1 Special Corrections/Adjustments
None.

9.3.2 Calculated Variables
None.

9.4 Graphs and Plots
The following maps are provided courtesy of the HYD-04 BOREAS team, led by Dr. Barry
Goodison.

Map of flight lines in the
BOREAS Northern Study Area (NSA)

Map of flight lines in the
BOREAS Southern Study Area (SSA)
10. Errors

10.1 Sources of Error

There are many possible sources of error measuring the water content of the moss/humus layer. Obtaining a sample in deep layers of moss/humus can be very difficult. In some cases, the depth is greater than the length of the ESC snow tube, and the moss/humus layer has to be dug down to the mineral soil and more than one core of the layer cut. In some cases, the root system in the moss/humus layer is so heavy that it is impossible to cut through the layer with the ESC tube. In other cases, there are air pockets in the moss/humus layer that may not be representative of the average layers in the area. Selecting a measurement site that represents the general conditions is also difficult. For this reason, four extra measurements of the depth of the moss/humus layer were made at 5-meter distances from the measuring site.

Even though there are difficulties in obtaining the measurements of the water content of the moss/humus layer, the data for most flight lines appear to be a reasonable indication of the average for the flight lines (and bins). In one case, measurements were made at different times over the same bin of the flight line with a heavy moss/humus layer. It was evident that two of the measurement sites had depths much greater than the average for the entire bin of the flight line (BP115, bin 3, 31-Aug-1994), and the computed average of the water content for the bin for that day was greater than expected.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Confidence in the in situ measurement of the water content of the moss/humus layer depends on many factors regarding the accuracy of locating the sampling points along the flight line as well as the experience and training of the field personnel.

10.2.2 Confidence Level/Accuracy Judgment

The confidence level varies with the experience of the person selecting the flight line and marking the location of the ground measurement. In very flat areas, the exact location of a ground measurement is more difficult to identify on a map than for a location near a stream or in areas of variable terrain.

10.2.3 Measurement Error for Parameters

A precise estimate of the error of a water content measurement of the moss/humus layer cannot be determined. The selection of sites for in situ measurements of the water content of the moss/humus layer along a flight line is very critical in determining the calibration data for flight lines with considerable depth of moss/humus. Experience with the airborne gamma radiation system during the recent field experiments (FIFE) in Kansas (Carroll et al., 1988) illustrates the need to obtain ground measurements representative of the average of the area from which ground-based gamma are received by the airborne detectors.

During the BOREAS field experiments, careful attention has been given to obtaining as representative measurements of water content of the moss/humus layer as possible for flight lines having considerable depth of moss/humus. For the flight lines over the primary tower sites in the SSA, more than one set of ground measurements was obtained.

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

BORIS personnel reviewed the data and documentation for clarity and consistency.
11. Notes

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
The water content and depths of the moss/humus layer may be only representative for the soil and vegetative conditions of the particular flight line. Considerable change in moss/humus conditions may be found over very small distances (10s of meters). Careful review of the soil and vegetative conditions is necessary to transfer the moss/humus estimates to nearby areas. However, the use of the moss/humus measurements for similar conditions for flux analyses and other studies can add considerable information on the spatial and temporal variation in the moss/humus layer. For some flight lines, the number of depth measurements of the moss/humus layer probably has more reliability than fewer measurements of the water content of the moss/humus layer. There is merit in applying the average water content as a density to the average depth determined from the larger number of depth measurements. The average density (water content/average depth) for one flight line correlates well with average density for nearby lines.

11.4 Other Relevant Information
Ground measurements collected by members of HYD-06 were collected under slightly different methods than those collected by members of HYD-04. Those observed by members of HYD-04 have observation times of 0000 hours.

Members of HYD-04 followed sampling procedures established for the operational airborne gamma radiation snow surveys that have been collected in the BOREAS area for many years. Sampling points are selected on a set distance from the beginning of the flight line (at either 1-km or 2-km intervals depending on the length of the flight line). This approach has proven useful for the operational snow measuring program. Using this approach, the measurement sites are selected at nearly the same location along the flight line during snow and nonsnow periods. Members of HYD-06 collected only during nonsnow periods and selected measurements sites that tended to best represent the average conditions along the entire 305-m-wide foot path of the area measured by the airborne gamma radiation surveys.

12. Application of the Data Set
These data could be used to analyze the moisture holding capacity of the moss and humus layers in the areas sampled.

13. Future Modifications and Plans
None.

14. Software

14.1 Software Description
None given.

14.2 Software Access
None given.
15. Data Access

The HYD-06 moss/humus 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/ [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
Video tapes taken over each flight line during calibration showing the area directly under the aircraft are available (at NOHRSC). At the present time, no decision has been made on storing these tapes in BORIS.

16.3 Other Products
Maps showing the flight lines for which gamma data were obtained have been digitized by NOHRSC and submitted to BORIS. 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


17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms

None.
19. List of Acronyms

AES - Atmospheric Environment Service of Canada
ASCII - American Standard Code for Information Interchange
BOREAS - BOReal Ecosystem-Atmosphere Study
BORIS - BOREAS Information System
BPI - Bytes Per Inch
CCT - Computer Compatible Tape
CD-ROM - Compact Disk - Read-Only Memory
DAAC - Distributed Active Archive Center
EOS - Earth Observing System
EOSDIS - EOS Data and Information System
ESC - Eastern Snow Conference
EXP - Experiment
FIFE - First ISLSCP Field Experiment
FIS - FIFE Information System (NASA)
GIS - Geographic Information System
GMT - Greenwich Mean Time
GPS - Global Positioning System
GSFC - Goddard Space Flight Center
HTML - Hyper-Text Markup Language
HYD - Hydrology (BOREAS science team)
IFC - Intensive Field Campaign
ISLSCP - International Satellite Land Surface Climatology Project
MeV - Million Electronic Volts
NAD27 - North American Datum of 1927
NAD83 - North American Datum of 1983
NASA - National Aeronautics and Space Administration
NOAA - National Oceanic and Atmospheric Administration
NOHRSC - National Operational Hydrologic Remote Sensing Center
NSA - Northern Study Area
NWS - National Weather Service
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
SI - System International
SM - Soil moisture, percent by weight, of the mineral soil
SSA - Southern Study Area
URL - Uniform Resource Locator
USGS - U.S. Geological Survey
WC - Water content of the moss/humus layer
WE - Water equivalent of the snow layer

20. Document Information

20.1 Document Revision Dates
Written: 08-Jun-1995
Updated: 04-May-1999

20.2 Document Review Dates
BORIS Review: 07-Nov-1997
Science Review: 12-Dec-1997
When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

Eugene L. Peck, President, Hydex Corporation
Thomas Carroll, Chief, NOHRSC

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


Also, cite the BOREAS CD-ROM set as:

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**Supplementary Notes**


**Abstract**

The BOREAS HYD-6 team collected several data sets related to the moisture content of soil and overlying humus layers. This data set contains water content measurements of the moss/humus layer, where it existed. These data were collected along various flight lines in the SSA and NSA during 1994. The data are available in tabular ASCII files.