BOREAS FOLLOW-ON DSP-09 MOSS COVER CLASSIFICATION AT THREE AREA SCALES
Get Data

Summary

BOREAS Follow-On team DSP-09 mapped surface moss type at three scales (1 km, 30 m, and 10 m) based on observed associations between moss cover and land cover type. In the BOREAS Northern (NSA) and Southern (SSA) Study Areas, we utilized land cover derived from Landsat TM (30 m) and ground measurements/observations, soils maps, and field observations to establish associations between moss and land cover. At the BOREAS regional scale, the 1 km moss cover map was developed using a 1 km AVHRR land cover map for a 619 by 821 km subset of the BOREAS region. Our regional moss cover map is largely based on inferences from the 1 km land cover analysis and from ground observations in the study areas. The 30 m moss map covers the BOREAS Southern Study Area. The 10 m map covers the BOREAS NSA Old Black Spruce tower site.

Data Citation

Cite this data set as follows (citation revised on October 30, 2002):

Rapalee, G., F. G. Hall, L. T. Steyaert, and E. R. Levine. 2001. BOREAS Follow-On DSP-09 Moss Cover Classification at Three Area Scales. Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS Follow-On DSP-09 Moss Cover Classification at Three Area Scales

1.2 Data Set Introduction

This data set contains moss cover maps within the BOREAS region at three different scales: 1) a regional moss cover analysis for a 619-km by 821-km subset of the BOREAS region; (2) moss cover analysis for the BOREAS Southern Study Area (SSA); and (3) moss cover analysis for the BOREAS Northern Study Area Old Black Spruce (NSA-OBS) tower site.

1.3 Objective/Purpose

The major objective of this study was to develop regional moss cover classifications at 1 km and 30 m scales for use by BOREAS investigators. By also including data at the even finer scale of 10 m, we demonstrate the spatial variability of moss within 1 km land cover pixels. Data at 10 and 30 m further demonstrate the under-representation of smaller wetland areas not detected at 1 km scale.

1.4 Summary of Parameters

This data set contains information about the inferred spatial distribution of moss cover within the BOREAS region. The moss classes cover four broad groups: feather moss, sphagnum, brown moss, and lichen. Some classes are a combination of two of the groups.

Moss cover classification maps were derived using: regional 1 km AVHRR land cover classification (AFM-12 documentation; Steyaert et al., 1997), Landsat TM 30 m land cover and biomass density data (TE-18), and 10 m soil map (TE-20; Harden et al., 1997).

Reclassifying land cover images to the moss cover groups mentioned above takes into account similarities in soil drainage, forest cover, tree biomass density, landform, and soil texture. (See table in Section 7.3.2.)

The 1 km moss analysis was based on regrouping the BOREAS AFM-12 AVHRR land cover as follows:

Moss Cover Class	Moss Cover Class ID	AVHRR (AFM-12) Land Cover Class ID
Feather Moss	1	3, 9, 16, 17
Feather Moss/Sphagnum Moss	2	2
Sphagnum Moss	3	1
Feather/Sphagnum/Brown Moss Mix	4	4
None	5	5, 6, 8, 10-14, 18-20
Water	6	7, 15

Note: Missing are lichen (dry upland jack pine) and brown moss (fens). Class 4 on the moss map is the same as Class 4 in the AVHRR land classification.

The 1 km AVHRR land cover classes (AFM-12) are:

```
ID   Class Name
--   ----------
1    Wet Conifer (Low Stand Density)
2    Wet Conifer (Medium Stand Density)
3    Wet Conifer (High Stand Density)
4    Upland Conifer/Fen
5    Rock Outcrops/Bare Ground/Sparse Vegetation/Slow Regeneration Burn Areas
7    Open Water
9    Regeneration (North: Within Canadian Shield Zone)
11   Recent Visible Burn
12   Rangeland/Pasture/Hay/Aspen Patches
13   Mixed Agriculture/Predominately Grains
14   Mixed Agriculture/Predominately Pasture/Hay
15   Grassland Marshes
16   Mixed Forest (80% Coniferous)
```

```
17   Mixed Forest (50% Coniferous)
18   Mixed Forest (80% Deciduous)
19   Regeneration (South: generally south of Shield Zone)
20   Unknown
```

From the BOREAS TE-18 30 m (TM) physically-based land cover image of the SSA, moss cover classes are:

Moss Cover Class	Moss Cover Class ID	TM (TE-18) Land Cover ID
Feather Moss	1	3, 10, 16
Feather Moss/Sphagnum Moss	2	9, 15
Sphagnum Moss	3	14
Brown Moss (Fen)	4	5
Lichen	5	2
None	6	4, 7, 8, 11-13
Water	7	6

The 30 m TM land cover classes (TE-18) include:

```
ID      Class Name
--      ----------
1       Conifer (Wet)
14         Deep sphagnum moss layer on clay
15         Poorly drained soils w/ sphagnum on clay
16         Moderately well-drained soils with feather moss over clay
2       Conifer (Dry)
3       Mixed (Coniferous and Deciduous)
4       Deciduous
5       Fen
6       Water
7       Disturbed
8       Fire Blackened
9       New Regeneration Conifer
10      Medium-Age Regeneration- Conifer
11      New Regeneration Deciduous
12      Medium-Age Regeneration-Deciduous
13      Grass
```

Classes 14, 15, and 16 in the wet conifers are derived from the SSA biomass density image (TE-18), where the range in wet conifer is from 1.4-17.4 kg m^{-2}. Here, Class 14 represents the wetter sites, where biomass ranges from 1-6 kg m^{-2}. Class 15 represents wet sites, with biomass ranging from 6 to 12 kg m^{-2}. Class 16 represents the drier sites and biomass ranges from 12 to 17 kg m^{-2}.

From TE-20 10 m soil polygon map of NSA-OBS tower site, with moss cover classes from Harden et al. (1997):

Moss Cover Class	Moss Cover Class ID	TE-20 Soil Polygon ID
Feather Moss	1	6, 12, 19, 31
Feather Moss/Sphagnum Moss	2	8, 13, 14, 17, 18, 22, 24
Feather Moss/Sphagnum Moss (bog veneer)	2	15, 16, 20, 21, 23
Sphagnum Moss	3	1, 7, 10, 25, 26, 29
Brown Moss (fen)	4	2-5, 9, 11, 27, 28, 30

The Soil Drainage and Moss cover map classes of NSA-OBS (TE-20) include:

```
1   Feather moss -- moderately well-drained, covering 31% of mapped area
2   Feather moss/Sphagnum moss -- imperfect to poorly drained, covering 15% of
    mapped area
2   Feather moss/Sphagnum moss (bog veneer) -- poorly drained, covering 30% of
    mapped area
3   Sphagnum moss -- poor to very poorly drained, covering 14% of mapped area
4   Brown moss (fen) -- very poorly drained, covering 10% of mapped area
```

Moss Cover Class The moss cover classes for the 10 m map listed above are based on soil drainage, site characteristics, landform, soil texture, and land cover. (See table in Section 7.3.2.) The percentages of areal coverage listed are from Figure 1 in Harden et al. (1997). For more detailed site information on this and other tower sites in the Northern Study Area, see BOREAS TE-20 Supplementary Soil & Site Information. (See Section 1.6.)

1.5 Discussion

The moss cover data sets were developed from four sources:

1. 1-km AVHRR land cover image that was derived from multi-temporal AVHRR and field observations as described by Steyaert et al. (1997). Field observations, collected during the pre-BOREAS operations in 1993 and BOREAS Intensive Field Campaigns (IFCs) of 1994, were the primary source of information to analyze, combine, and interpret the clusters according to land cover class. These field data were the primary source of information for Steyaert et al.'s (1997) analysis of regional forest fire disturbance-regenerating vegetation patterns.
2. 30-m TM land cover image derived to characterize the successional and disturbance dynamics of the boreal forest for use in carbon modeling. A technique was implemented that uses reflectances of various land cover types along with a geometric optical canopy model to produce spectral trajectories. These trajectories are used in a way that is similar to using training data to classify the pixels into different land cover classes. The technique that was used to produce this data set can also be used to determine the amount of canopy cover within the given class and makes it possible to derive other biophysical parameters from the imagery.
3. 30-m TM biomass density image of SSA. The pixels for which biomass density is computed include areas that are in conifer land cover classes only. The biomass density values represent the amount of overstory biomass (i.e., tree biomass only) per unit area. The technique that was used to create this image is very similar to the technique that was used to create the physical classification of the SSA. This technique involves the use of trajectories that can be thought of as a set of points in red/near-infrared space. Each of these points represents a linear combination of reflectances of three end members that make up the land surface. The three end-member features include sunlit canopy, sunlit background, and shadow. The points of the trajectory range from 0% canopy to 100% canopy. A geometric optical canopy model was used to determine the areal proportions of each of these elements. The trajectory "nearest" to each pixel of the Landsat TM image was used to derive the biomass density based on the amount of canopy that exists in a pixel.
4. 10-m soil polygon image derived from aerial photographs and field observations from a soil survey. The TE-20 data set contains information about the spatial distribution of soil classes around the NSA-MSA and the NSA tower sites along with soil class properties such as parent material, landform, texture, slope class, and water table depth.

1.6 Related Data Sets

The following links are to the documents for these related data sets. The actual data from these data sets can be found on the original BOREAS CD-ROM Set or at the ORNL DAAC.

BOREAS AFM-12 1-km AVHRR Seasonal Land Cover Classification
BOREAS TE-18 Landsat TM Physical Classification Image of the SSA

BOREAS TE-18 Biomass Density Image of the SSA
BOREAS TE-20 Soils Data Over the NSA-MSA and Tower Sites in Raster Format
BOREAS TE-20 Supplementary Soil & Site Information for NSA MSA and Tower Sites

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2. Investigator(s)

2.1 Investigator(s) Name and Title
Gloria Rapalee, Research Associate
Forrest G. Hall, Scientist
Louis T. Steyaert
Elissa R. Levine, Scientist

2.2 Title of Investigation
DSP-9 Moss Cover Classification of the BOREAS Region at 3 Scales in Raster Format

2.3 Contact Information

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3. Theory of Measurements

The moss coverage was determined by using a combination of land cover classifications, a soil survey, and notes of field observations. The rationale for providing moss cover at three scales is to enable the user to both recognize variability in the landscape and to utilize the moss cover at the scale needed. These digital map data provide investigators with a continuous surface of moss cover parameters that can be used for modeling purposes.

Please refer to the Theory of Measurements section of the BOREAS documentation submitted by the AFM-12, TE-18, and TE-20 science teams regarding the development of the land cover and soils data sets. See the related documentation for datasets listed in Section 1.6.

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4. Equipment

Please refer to the BOREAS documentation submitted by the AFM-12, TE-18, and TE-20 science teams regarding the items in this section as they apply to the land cover classification and soils mapping. See the related documentation for datasets listed in Section 1.6.

4.1 Sensor/Instrument Description

Not applicable

4.1.1 Collection Environment

Not applicable

4.1.2 Source/Platform

Not applicable

4.1.3 Source/Platform Mission Objectives

Not applicable

4.1.4 Key Variables

Moss cover classes.

4.1.5 Principles of Operation

Not applicable.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

Not applicable.

4.2 Calibration

4.2.1 Specifications

Unknown.

4.2.1.1 Tolerance

Unknown.

4.2.2 Frequency of Calibration

Not applicable.

4.2.3 Other Calibration Information

Not applicable.

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5. Data Acquisition Methods

Detailed documentation of TE-18 and AFM-12 methods are available in the BOREAS documentation for the respective data sets. See Section 1.6 for list of data set names.

A detailed report of the soils mapping effort in the NSA, submitted by Hugo Veldhuis (TE-20 Supplementary Soil & Site Information), is also available. Part 2 of the report (Methodology) provides detailed information about data acquisition methods. See Section 1.6.

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6. Observations

6.1 Data Notes

The soils report by the TE-20 group provides observations and descriptions of soils. See Section 1.6. also TE-18 and AFM-12 documentation. See Section 1.6.

6.2 Field Notes

The TE-20 Supplementary Soil & Site Information data set contains detailed field notes of the soil survey and a field manual. See Section 1.6.

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7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

7.1.1.1 AHVRR-based moss map, 1 km

The regional 1-km AVHRR moss cover data are contained within a 672 row by 862 column raster image. The image contains the actual moss cover classes (pixel values 1-6) for a 619-km by 821-km subset of the BOREAS region, plus a set of zero-value pixels that form the boundary of the raster image. The subsetted land cover classification has a domain of approximately 52-57 deg. N and 96-108 deg. W, which includes the BOREAS SW-NE transect from southwest of Saskatoon, Saskatchewan, to northeast of Gillam, Manitoba.

The corners of the data set are as follows. These coordinates are in the BOREAS Grid Albers Equal Area Conic (AEAC) projection.

Corner	BOREAS Grid X	Y
Northwest	174.0707	785.4531
Northeast	1036.0707	785.4531
Southwest	174.0707	113.4531
Southeast	1036.0707	113.4531

7.1.1.2 TM-based moss map, 30 m

The moss cover image of the SSA covers an area that is approximately 144 km by 114 km and includes areas just north of Prince Albert, Saskatchewan. The corners of the data set are below. The BOREAS Grid coordinates are in the AEAC projection described in section 7.1.4.

Corner	BOREAS Grid X	Y	Longitude	Latitude
Northwest	297.810	392.490	106.401° W	54.438° N
Northeast	441.810	392.490	104.190° W	54.333° N
Southwest	297.810	278.490	106.515° W	53.417° N
Southeast	441.810	278.490	104.357° W	53.314° N

7.1.1.3 Ground-based moss map, 10 m

The moss cover image of the NSA-OBS is projected in the BOREAS Grid system and is bounded by the following points. These coordinates are based on the NAD83 datum.

Corner	BOREAS Grid X	Y	Longitude	Latitude
Northwest	777.540	614.230	98.48997° W	55.88746° N
Northeast	778.840	614.230	98.46950° W	55.88538° N
Southwest	777.540	612.930	98.49369° W	55.87599° N
Southeast	778.840	612.930	98.47323° W	55.87390° N

7.1.2 Spatial Coverage Map

None.

7.1.3 Spatial Resolution

NSA-OBS -- each pixel represents a 10-meter by 10-meter area on the ground.
SSA TM -- each pixel represents a 30-meter by 30-meter area on the ground.
Regional AVHRR -- each pixel represents a 1-km by 1-km area on the ground.

7.1.4 Projection

The area mapped in each image is projected in the Albers Equal-Area Conic (AEAC) projection. For the 1-km AVHRR image, the projection has the following parameters:

```
Datum: None
Ellipsoid: Sphere
```

```
Origin:   111.000° W  51.000° N
Standard Parallels: 52° 30' 00" N
                    58° 30' 00" N
Units of Measure: kilometers
```

It is important to emphasize that the 1-km AVHRR image is projected using a Sphere as the Earth model and not the WGS84 ellipsoid used for most other BOREAS data sets (see below). The other projection parameters listed above are the same as many other BOREAS georeferenced data sets. This difference in Earth models used can result in spatial misregistration of approximately 2 to 4 pixels. This difference should be considered when comparing this classification to other georeferenced imagery. See AFM-12 documentation.

Both the 30 and 10 m moss maps are projected in the BOREAS Grid projection, which is based on the ellipsoidal version of the AEAC projection. The projection has the following parameters:

```
Datum:  NAD83
Ellipsoid:  Geodetic Reference System of 1980 (GRS80) or Worldwide Geodetic
            System of 1984 (WGS84)
Origin:   111.000° W  51.000° N
Standard Parallels:  52° 30' 00"N
                     58° 30' 00"N
Units of Measure:  kilometers
```

7.1.5 Grid Description

The data are referenced to the BOREAS Grid described in section 7.1.4.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

7.2.1.1 AHVRR-based moss map, 1 km

Monthly NDVI image composites for the period April-September 1992 were used to develop the input 1992 1-km AVHRR/land cover data set (AFM-12).

7.2.1.2 TM-based moss map, 30 m

The TM image of the SSA that this product was based on was collected on 02-Sep-1994. The scene is a Path 37, Row 22-23 (shifted) scene of the Landsat World Reference System (WRS). The solar elevation angle at the time of image acquisition was 40.1 degrees. The solar azimuth angle was 146 degrees.

7.2.1.3 Ground-based moss map, 10 m

Field samples for mapping the soils of the NSA-OBS tower site were collected in 1994. The aerial photos used to map the land cover associations of the OBS tower site were taken in 1971 and 1972 at a scale of 1:15,840.

7.2.2 Temporal Coverage Map

None.

7.2.3 Temporal Resolution

7.2.3.1 AHVRR-based moss map, 1 km

Monthly NDVI image composites for the period April-September, 1992 were used to develop the 1992 1-km AVHRR/land cover data set.

7.2.3.2 TM-based moss map, 30 m

The TE-18 data set represents the land cover and biomass density as it existed on 02-Sep-1994.

7.2.3.3 Ground-based moss map, 10 m

The aerial photos used to map the OBS tower site were taken in 1971 and 1972 at a scale of 1:15,840.

7.3 Data Characteristics

7.3.1 Parameter/Variable

Moss Cover Type.

7.3.2 Variable Description/Definition

The moss cover classes listed in Section 1.4 can be grouped into four broad categories consisting of: (1) feather moss; (2) sphagnum moss; (3) brown moss; and (4) lichen.

7.3.2.1 Feather Moss

Feather moss (Pleurozium, Hyclomium spp.) is the dominant ground cover associated with three of the AFM-12 AVHRR vegetation mosaics: (i) wet conifer, (ii) mixed coniferous-deciduous, and (iii) regeneration (in the north within the Canadian Shield Zone).

Descriptions of these mosaics directly follow as taken from Steyaert et al. (1997) and AFM-12 documentation (see Section 1.6):

i. "The AVHRR wet conifer mosaic consists of black spruce and various embedded subpixel fens and bogs, scattered tamarack (Larix laricina), mixed water-vegetation pixels, small pockets of dry jack pine (Pinus banksiana) on sandy hilltops, and scattered deciduous trees. This mosaic is characterized by the very consistent vegetative patterns in the 'low lying' areas (black spruce, fens, and bogs) as opposed to more upland terrain (more productive black spruce in combination with jack pine on sandy soils and scattered deciduous trees) environments throughout the entire BOREAS region. This classification does not resolve in all cases these 'lowland' versus 'upland' components of the wet conifer mosaic. The subpixel fens, bogs, and small water bodies are also not resolved in this classification.

Based on extensive field data, the 1-km AVHRR spectral-temporal clusters do permit the characterization of the wet conifer mosaic into 'low', 'medium,' and 'high' tree density levels (Classes 1-3, respectively)." (Steyaert et al., 1997; AFM-12

documentation).

Tree density levels correspond with drainage class and, hence, moss cover. In the wet conifer mosaic of the BOREAS region, feather moss is found in the upland moderately well-drained sites with high density tree cover; a mix of feather and sphagnum (Sphagnum spp.) mosses in imperfectly and poorly drained sites with medium density tree cover; and sphagnum moss in low lying areas with low density tree cover.

Although feather moss is the dominant ground cover, the user is advised that there are pockets of each moss type in the wet conifer mosaics and that there is significant lichen (Cladina spp.) in medium density spruce stands near Cree Lake and northwest of La Ronge in Saskatchewan.

ii. "The AVHRR mixed coniferous-deciduous forest mosaic consists of 80 percent conifer-20 percent deciduous (Class 16) and codominant mixed forest (Class 17). These mixed forest classes are generally distributed along a southwest-northeast gradient ranging from deciduous dominant in the south to coniferous dominant in the north. The effects of forest succession are evident in this mixed class, especially in stands with mature deciduous trees and successional spruce under the deciduous canopy. In the northern extremes, this AVHRR mixed forest (Class 16) is predominantly upland black spruce with scattered jack pine on sandy soils and approximately 20 percent aspen trees (Populus tremuloides) with scattered birch (Betula papyrifera) and balsam poplar (Populus balsamifera) trees. These trees are typically on rocky hills throughout the central and northern portions of the BOREAS region. The mixed forest class in the central region (Class 17) consists of codominant coniferous and deciduous trees that are quite well developed. The conifers are dominated by tall jack pine, black spruce, and some white spruce (Picea glauca), while the deciduous trees consist of mature aspen and birch." (Steyaert et al., 1997; AFM-12 documentation)

iii. "The regeneration mosaic includes individual land cover classes for fire disturbance-regenerating vegetation patches in the north (AVHRR Class 9) that are located within the Canadian Shield Zone and are typically associated with old burns of various ages. This mixed vegetation class consists of jack pine, aspen, and young black spruce trees. The stand density and tree sizes depend on the age of the burn and the soil conditions. The jack pine and aspen trees are taller than young black spruce." (Steyaert et al., 1997; AFM-12 documentation)

7.3.2.2 Sphagnum Moss

Sphagnum mosses are found in poorly to very poorly drained sites with low density black spruce cover of the AVHRR wet conifer mosaic (Class 1) discussed in (i) above. These sites are level to gently sloping on clayey, peaty Luvic Gleysols and Terric Mesic Fibrisols. Here, sphagnum is dominant and may be mixed with feather and other mosses.

Sphagnum moss cover is also found on peatlands consisting of varying peat materials that are well- to poorly-drained at the surface, and have frozen peat and/or mineral at depth (palsas and peat plateau bogs) with Fibric and Mesic Organic Cryosols. Here, sphagnum is the dominant ground cover and

may be mixed with feather moss at the drier sites. Forest cover is black spruce.

7.3.2.3 Brown Moss

Brown mosses (Depranocladus spp.) and sedges (Carex spp.) are found in the very poorly drained fens and permafrost collapse scar bogs with deep Typic Fibrisols.

In the 1-km AVHRR classification brown mosses are found within Class 4 (upland conifer/fen), described below within the mixed feather/sphagnum/brown moss class. Because fens and collapse bogs are often smaller than 1 km^2, these wetlands are not always detected on the 1-km AVHRR classification. At the 30-m scale of the TM classification, however, areas with brown moss and sedges are found in the land cover class 5 (Fen).

7.3.2.3 Lichen

Lichens are found in upland, well-drained sites on sandy Eluviated Dystric Brunisols with jack pine cover.

Areas of lichen cover show up best in the dry conifer (jack pine dominant) sites (Class 2) of the TM land cover classification.

7.3.2.4 Feather/Sphagnum/Brown Moss Mix

DSP-09 mapped the AVHRR upland conifer/fen class (Class 4) as feather/sphagnum/brown moss mix because this AVHRR class is a result of landscape elements with a patch size distribution falling below the 1 to 4 km spatial resolution of the composited AVHRR images used for classification. The upland conifer consists primarily of spruce and jack pine stands growing on moderately well-drained loamy soils with a feather moss background. Patches of fen mixed within the upland conifer AVHRR pixels are dominated by brown and sphagnum mosses.

The table below summarizes moss cover classes described in this section.

Moss Cover Types

Moss Cover	Drainage	Forest Cover	Tree Biomass Density	Landform	Soil Texture
Feather Moss	Moderately Well	Spruce, Mixed Spruce/Jack Pine	High	Upland	Clay
Feather Moss/ Sphagnum Moss	Imperfect	Spruce	Medium	Upland	Clay
Sphagnum Moss/ Feather Moss	Poor	Spruce	Low	Bog Veneer	Clay
Brown Moss	Very Poor	---	---	Fen	Clay
Lichen	Well Moderately Well	Jack Pine Spruce	--- ---	Upland Upland	Sand Clay

Compiled from: Harden et al. (1997), TE-18, and Rapalee et al. (1998).

7.3.3 Unit of Measurement

Moss cover type is unitless.

7.3.4 Data Source

AVHRR imagery was received from EROS Data Center, USGS, Sioux Falls, SD. Landsat-5 TM scene on 02-Sep-1994 from the CCRS. Aerial photography was acquired by Hugo Veldhuis. No additional information is available about this photography.

7.3.5 Data Range

Moss Map	Value Range
1-km AVHRR	0-6
30-m TM	0-7
10-m ground-base maps	0-4

Boundary pixels have values of zero.

7.4 Sample Data Record

Not applicable to image data.

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8. Data Organization

8.1 Data Granularity

There is one image file for each of the 3 different scales of moss maps.

8.2 Data Format(s)

This BOREAS moss cover classification data set contains 4 files as follows:

```
File 1      0_readme.txt
            80-byte American Standard Code for Information Interchange (ASCII)
            text records

File 2      moss_avhrr.img
            672 records of 862 bytes each
            1 byte per pixel

File 3      moss_ssa.img
            3,800 records of 4,800 bytes each
            1 byte per pixel

File 4      moss_nsa-obs.img
            130 records of 130 bytes each
            1 byte per pixel
```

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9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

None.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables

None.

9.4 Graphs and Plots

None.

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10. Errors

10.1 Sources of Error

The sources of error in the moss classification could be the result of a number of factors. Errors in land cover mapping could be the result of spectral mixing of various features that fall within a 1-km pixel. The spectral signature of one feature could also be similar to that of another feature, resulting in confusion. The similarity in spectral signatures could be the result of similar background components and variations in tree density.

The locational accuracy of the AVHRR-based product may be off by as much as 3 or 4 pixels due to the compositing of the multi-temporal data.

The accuracy of the 1-km moss classes depend in part on the reliability of the moss and land cover associations. In addition, the 1-km moss analysis is constrained by the limitations of the input land cover classes.

10.2 Quality Assessment

10.2.1 Data Validation by Source

See the Data Validation by Source section of the documentation for BOREAS-related data

sets of AFM-12, TE-18, and TE-20 science teams. (See Section 1.6.)

10.2.2 Confidence Level/Accuracy Judgment

Although efforts have been made to make the moss cover classification as accurate as possible, there is bound to be some confusion between classes used to infer moss cover. The most noticeable problem is confusion between dense jack pine and dense black spruce in the land cover classifications (AFM-12 and TE-18). Spectrally, they are very similar. Hence, classification for the 1-km moss cover image includes a "Feather/Sphagnum/Brown Moss Mix" class.

10.2.3 Measurement Error for Parameters

Not applicable.

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

None.

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11. Notes

11.1 Limitations of the Data

The 1-km and 30-m moss cover products are intended to characterize general spatial patterns; therefore, detailed analysis at the pixel level is not advised.

In the case of the 1 km map, moss classifications are based on inferences of moss cover that is likely to occur within the imbedded mosaics of the land cover image.

11.2 Known Problems with the Data

See relevant sections in BOREAS documentation or the related data sets of AFM-12, TE-18, and TE-20. (See Section 1.6.)

11.3 Usage Guidance

Before uncompressing the files, be sure that you have enough disk space to hold the uncompressed data files. Then use the appropriate decompression software for your specific system.

11.4 Other Relevant Information

None.

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12. Application of the Data Set

This data set was created for BOREAS investigators who need moss cover data of the BOREAS region for further modeling.

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13. Future Modifications and Plans

None given.

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14. Software

14.1 Software Description

IDRISI GIS software was used to reclassify the AVHRR (AFM-12) and TM (TE-18) land cover images and the soil polygon image of the NSA-OBS tower site (TE-20).

14.2 Software Access

IDRISI is available from:

Clark Labs
Clark University
950 Main St.
Worcester MA 01610-1477
508-793-7526
508-793-8842 (fax)
e-mail: idrisi@clarku.edu
Web site: http://www.clarklabs.org/[Internet Link]

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15. Data Access

15.1 Contact for Data Center/Data Access Information

These BOREAS data are available from the Earth Observing System Data and Information System (EOS-DIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC). The BOREAS contact at ORNL is:

ORNL DAAC User Services
Oak Ridge National Laboratory
(865) 241-3952
ornldaac@ornl.gov
ornl@eos.nasa.gov

15.2 Procedures for Obtaining Data

BOREAS data may be obtained through the ORNL DAAC World Wide Web site at http://www.daac.ornl.gov/ [Internet Link] or users may place requests for data by telephone or electronic mail.

15.3 Output Products and Availability

Requested data can be provided electronically on the ORNL DAAC's anonymous FTP site or on various media including, CD-ROMs, 8-MM tapes, or diskettes.

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16. Output Products and Availability

16.1 Tape Products

The moss image data are available on 8-mm tape media.

16.2 Film Products

None.

16.3 Other Products

None.

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17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

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

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, BOREAS in 1997: Experiment overview, scientific results and future directions, Journal of Geophysical Research, BOREAS Special Issue, 102 (D24), 28,731-28,770, 1997.

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17.3 Archive/DBMS Usage Documentation

None.

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18. Glossary of Terms

None.

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19. List of Acronyms

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AEAC      - Albers Equal Area Conic
AFM       - Airborne Fluxes and Meteorology
APT       - Automatic Picture Transmission
ASCII     - American Standard Code for Information Interchange
BOREAS    - Boreal Ecosystem-Atmosphere Study
BORIS     - BOREAS Information System
BPI       - Bytes Per Inch
CCRS      - Canadian Centre for Remote Sensing
CD-ROM    - Compact Disk-Read-Only-Memory
DAAC      - Distributed Active Archive Center
DAT       - Digital Archive Tape
DEM       - Digital Elevation Model
EDC       - EROS Data Center
EOS       - Earth Observing System
EOSAT     - Earth Observing Satellite Company
EOSDIS    - EOS Data and Information System
EROS      - Earth Resources Observation System
GAC       - Global Area Coverage
GCM       - Global Circulation Model
GMT       - Greenwich Mean Time
GPS       - Global Positioning System
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GRS80     - Geodetic Reference System of 1980
GSFC      - Goddard Space Flight Center
HRPT      - Higher Resolution Picture Transmission
IFC       - Intensive Field Campaign
IFOV      - Instantaneous Field of View
LAC       - Local Area Coverage
LST       - Local Standard Time
MSA       - Modeling Sub-Area
NAD27     - North American Datum 1927
NAD83     - North American Datum 1983
NASA      - National Aeronautics and Space Administration
NeDT      - Noise Equivalent Differential Temperature
NDVI      - Normalized Difference Vegetation Index
NOAA      - National Oceanic and Atmospheric Administration
NRL       - Naval Research Laboratory
NSA       - Northern Study Area
OBS       - Old Black Spruce
ORNL      - Oak Ridge National Laboratory
PANP      - Prince Albert National Park
RSS       - Remote Sensing Science
SSA       - Southern Study Area
SST       - Sea Surface Temperature
SVAT      - Surface Vegetation and Atmosphere
TE        - Terrestrial Ecology
TF        - Tower Fluxes
TGB       - Trace Gas Biogeochemistry
TIROS     - Television and Infrared Observation Satellite
TM        - Thematic Mapper
URL       - Uniform Resource Locator
USGS      - United States Geological Survey
UTM       - Universal Transverse Mercator
WGS84     - World Geodetic System of 1984
WRS       - Worldwide Reference System
WWW       - World Wide Web
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These data were classified to be included as a part of the BOREAS Follow-on Hydrometerological Modeling Group data set, using AVHRR, Landsat 5 TM, and field and soil survey data from AFM-12, TE-18, and TE-20 science groups. The data sources are: the EROS Data Center (EDC), Sioux Falls SD; the Canadian Centre for Remote Sensing (CCRS); and aerial photography acquired by Hugo Veldhuis. Any publication of these data should also acknowledge the sources of the moss classification as: Harden et al. (1997); Steyaert et al. (1997); and the TE-18 and AFM-12 science groups. The investigators gratefully acknowledge the contributions of Jill Bubier who helped with moss identification and classification.

20.5 Document Curator:

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