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Forrest G. Hall, Editor

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BOREAS TE-18 Landsat TM Physical Classification Image of the NSA

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Forrest G. Hall, David Knapp

Summary

The BOREAS TE-18 team focused its efforts on using remotely sensed data to characterize the successional and disturbance dynamics of the boreal forest for use in carbon modeling. The objective of this classification is to provide the BOREAS investigators with a data product that characterizes the land cover of the NSA. A Landsat-5 TM image from 21-Jun-1995 was used to derive the classification. 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 training data to classify the image into the different land cover classes. The data are provided in a binary, image file format.

Note that some of the data set files on the BOREAS CD-ROMs have been compressed using the Gzip program. See Section 8.2 for details.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-18 Landsat TM Physical Classification Image of the NSA

1.2 Data Set Introduction

This data set classifies the BOReal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA) into 13 land cover classes. These classes include wet conifer, dry conifer, deciduous, mixed (deciduous and conifer), fen, and various regeneration and other classes. The pixel resolution of this data set is 30 meters, and the data set is georeferenced in the Albers Equal-Area Conic (AEAC) projection.

1.3 Objective/Purpose

The objective of this data set is to provide BOREAS investigators with a land cover product for use in modeling activities. The technique that was used to produced 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.

1.4 Summary of Parameters and Variables

In a joint meeting of the BOREAS Terrestrial Ecology (TE) modelers and the Remote Sensing Science (RSS) algorithm developers in Columbia, MD, July 1992, several land cover classes were identified as necessary inputs to the TE models. One exception to this is the fire-blackened class, which is a consequence of spectral distinctness. The classification was performed using bands 3, 4, and 5 of the Landsat-5 Thematic Mapper (TM) scene. The radiometric status of this scene was acceptable. The parameter that is being described in this data set is the land cover class for each 30-meter pixel. The classes that are used in this data set are:

Image Value	Class
1	Conifer (Wet)
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

1.5 Discussion

The objective of this classification is to provide the BOREAS investigators with a data product that characterizes the land cover of the NSA. This data set can be used for modeling purposes. The technique that was used to produce this classification is based on the work of Dr. Forrest Hall. This technique involves the use of reflectances of various land cover types along with a geometric optical canopy model to model the amount of shadow. The reflectance data and the model are used to produce spectral trajectories of the various land cover classes. The trajectories are used in a way that is similar to training data. Each image pixel is compared to the various points of each trajectory. The pixel is assigned to the class of the point to which it is closest in red/near-infrared reflectance space.

1.6 Related Data Sets

BOREAS Forest Cover Data Layers of the NSA-MSA in Raster Format
BOREAS TE-18 Landsat TM Physical Classification Image of the SSA

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Forrest Hall
Biospheric Sciences Branch
National Aeronautics and Space Administration (NASA)
Goddard Space Flight Center (GSFC)

2.2 Title of Investigation

TE-18 Regional Scale Carbon Flux from Modeling and Remote Sensing

2.3 Contact Information

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David.Knapp@gsfc.nasa.gov

3. Theory of Measurements

The Landsat-5 TM sensor collects imagery of Earth in seven spectral bands ranging from the blue to the thermal-infrared portion of the electromagnetic spectrum. This image was classified from Landsat-5 TM imagery using a technique described by Dr. Forrest Hall (Hall et al., 1997). In this technique, end member reflectances of canopy, background, and shadow are used with a geometric canopy model to compute simulated pixel reflectances for increasing amounts of canopy cover. These simulated reflectances can be plotted as a continuous trajectory for each class (e.g., wet conifer, deciduous, etc.) from 0% to 100% canopy cover. The imagery pixels were classified based on their proximity to the trajectories, with the pixel being assigned to the class of the closest trajectory.

4. Equipment

4.1 Instrument Description

The Landsat-5 TM sensor system records radiation from the seven bands described in Section 4.2.1. It has a telescope that directs the incoming radiant flux obtained along a scan line through a scan line collector to the visible and near-infrared focal plane, or to the mid-infrared and thermal-infrared cooled focal plane. The detectors for the visible and near-infrared bands (1-4) are four staggered linear arrays, each containing 16 silicon detectors. The two mid-infrared detectors are 16 indium-antimonide cells in a staggered linear array, and the thermal-infrared detector is a four-element array of mercury-cadmium-telluride cells.

4.1.1 Collection Environment

The data that were used to produce this classification were collected by the Landsat-5 TM on 21-Jun-1995. Landsat-5 orbits Earth at an altitude of approximately 705 kilometers.

4.1.2 Source/Platform

Landsat-5 satellite

4.1.3 Source/Platform Mission Objectives

The mission of the Landsat-5 satellite is to measure reflected radiation from Earth's surface at a spatial resolution of 30 meters and to measure the temperature of Earth's surface at a spatial resolution of 120 meters.

4.1.4 Key Variables

- Reflected radiation
- Emitted radiation
- Temperature

4.1.5 Principles of Operation

The TM is a scanning optical sensor operating in the visible and infrared wavelengths. It contains a scan mirror assembly that directly projects the reflected Earth radiation onto detectors arrayed in two focal planes. The TM achieves better imagery resolution, sharper color separation, and greater inflight geometric and radiometric accuracy for seven spectral bands simultaneously than the previous Multispectral Scanner (MSS). Data collected by the sensor are transmitted to Earth-receiving stations for processing.

4.1.6 Sensor/Instrument Measurement Geometry

The TM depends on the forward motion of the spacecraft for the along-track scan and uses a moving mirror assembly to scan in the cross-track direction (perpendicular to the spacecraft). The Instantaneous Field of View (IFOV) for each detector from bands 1-5 and band 7 is equivalent to a 30-m square when projected to the ground; band 6 (the thermal-infrared band) has an IFOV equivalent to a 120-meter square.

4.1.7 Manufacturer of Sensor/Instrument

NASA GSFC
Greenbelt, MD 20771

Hughes Aircraft Corporation
Santa Barbara, CA

4.2 Calibration

The internal calibrator, a flex-pivot-mounted shutter assembly, is synchronized with the scan mirror, oscillating at the same 7-Hz frequency. During the turnaround period of the scan mirror, the shutter introduces the calibration source energy and a black direct-current restoration surface into the 100 detector fields of view.

The calibration signals for bands 1-5 and band 7 are derived from three regulated tungsten-filament lamps. The calibration source for band 6 is a blackbody with three temperature selections, commanded from the ground. The method for transmitting radiation to the moving calibration shutter allows the tungsten lamps to provide radiation independently and to contribute proportionately to the illumination of all detectors.

4.2.1 Specifications

The following spectral bands are collected by the TM sensor:

Channel	Wavelength (µm)	Primary Use
1	0.45 - 0.52	Coastal water mapping, soil vegetation differentiation, deciduous/coniferous differentiation.
2	0.52 - 0.60	Green reflectance by healthy vegetation.
3	0.63 - 0.69	Chlorophyll absorption for plant species differentiation.
4	0.76 - 0.90	Biomass surveys, water body delineation.
5	1.55 - 1.72	Vegetation moisture measurement, snow cloud differentiation.
6	10.4 - 12.5	Plant heat stress measurement, other thermal mapping.
7	2.08 - 2.35	Hydrothermal mapping.

Band	Radiometric Sensitivity [NE(dP)]*
1	0.8%
2	0.5%
3	0.5%
4	0.5%
5	1.0%
6	0.5 K [NE(dT)]
7	2.4%

Ground IFOV	30 m (bands 1-5, 7) 120 m (band 6)
Avg. altitude	699.6 km
Data rate	85 Mbps
Quantization levels	256
Orbit angle	8.15 degrees
Orbital nodal period	98.88 minutes
Scan width	185 km
Scan angle	14.9 degrees
Image overlap	7.6 %

* N.B. The radiometric sensitivities are the noise-equivalent reflectance differences for the reflective channels expressed as percentages [NE(dP)] and temperature differences for the thermal-infrared bands [NE(dT)].

4.2.1.1 Tolerance

The TM channels were designed for a noise-equivalent differential represented by the radiometric sensitivity shown in Section 4.2.1.

4.2.2 Frequency of Calibration

The absolute radiometric calibration between bands on both sensors is maintained by using internal calibrators that are located between the telescope and the detectors and are sampled at the end of a scan.

4.2.3 Other Calibration Information

Relative within-band radiometric calibration, to reduce "striping," is provided by a scene-based procedure called histogram equalization. The absolute accuracy and relative precision of this calibration scheme assumes that any change in the optics of the primary telescope or the "effective radiance" from the internal calibrator lamps is insignificant in comparison to the changes in detector sensitivity and electronic gain and bias with time and that the scene-dependent sampling is sufficiently precise for the required within-scan destriping from histogram equalization. Each TM reflective band and the internal calibrator lamps were calibrated prior to launch using lamps in integrating spheres that were in turn calibrated against lamps traceable to calibrated National Bureau of Standards lamps. Sometimes the absolute radiometric calibration constants in the "short-term" and "long-term parameters" files used for ground processing have been modified after launch because of inconsistency within or between bands, changes in the inherent dynamic range of the sensors, or a desire to make quantized and calibrated values from one sensor match those from another.

5. Data Acquisition Methods

These data were acquired from the Landsat-5 TM sensor and received from the Canadian Centre for Remote Sensing (CCRS), who purchased them from the Earth Observation Satellite Company (EOSAT). As received from CCRS, the image had been processed from raw telemetry to a systematically corrected product within the CCRS MOSAICS system. After original delivery to the BOREAS data system, CCRS reprocessed these data, which produced minor differences in the pixel values. The data that were used to produce this data product are from the original data delivery, not the TM image product that currently exists in the BOREAS data set.

6. Observations

6.1 Data Notes

This imagery was collected on 21-Jun-1995. This scene is Path 33, Row 21 in the Landsat Worldwide Reference System (WRS). The solar elevation angle at the time of image acquisition was 40.1 degrees. The solar azimuth angle was 146 degrees. The radiometric quality of this imagery was acceptable.

The TM image from which this classification was produced was atmospherically corrected using aerosol optical thickness data measured by sunphotometers in the study area. These optical thickness data were used in the Second Simulation of the Satellite Signal in the Solar Spectrum (6S) program to determine the spherical albedo, path radiance, gaseous transmission, and scattering transmission. These parameters were used to determine surface reflectance based on equations 4a and 4b of Markham et al. (1992).

6.2 Field Notes

Not applicable.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The classified image covers an area that is approximately 129 km by 86 km and includes areas just west of Thompson, Manitoba. The corners of the data set are as follows. These coordinates are in the BOREAS Grid projection.

Corner	BOREAS Grid X	BOREAS Grid Y	NAD83 Long.	NAD83 Lat.
Northwest	740.000	650.000	98.983W	56.262N
Northeast	850.010	650.000	97.240W	56.081N
Southwest	740.000	569.990	99.202W	55.555N
Southeast	850.010	569.990	97.489W	55.377N

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

Each pixel represents a 30-meter by 30-meter area on the ground.

7.1.4 Projection

The area mapped is projected in the BOREAS Grid projection, which is based on the ellipsoidal version of the AEAC projection. The projection has the following parameters:

```
Datum:  North American Datum of 1983 (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 projection described in Section 7.1.4.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

This original spectral imagery was collected on 21-Jun-1995. The scene is from Path 33, Row 21 in the Landsat WRS. The solar elevation angle at the time of image acquisition was 38.2 degrees. The solar azimuth angle was 136.3 degrees. The radiometric quality of this imagery was acceptable.

7.2.2 Temporal Coverage Map

Not applicable.

7.2.3 Temporal Resolution

This data set represents the land cover as it appeared on 21-Jun-1995.

7.3 Data Characteristics

7.3.1 Parameter/Variable

Land cover type.

7.3.2 Variable Description/Definition

Each pixel in the classification image contains a number between 0 and 13. This number represents one of the following land cover classes:

Pixel Value	Class Name	Class Description
0	No Data	This area is not covered in the classification. This area is most likely blank fill on the edges of the image frame.
1	Conifer (Wet)	Primarily black spruce and jack pine on three major different soil substrates: (i) moderately well drained soils with feather moss over clay, (ii) poorly drained soils with sphagnum on clay, and (iii) sparsely treed fens with a very deep moss layer. Overstory biomass density varies considerably within this class.
2	Conifer (Dry)	Dry Conifer is an area that contains coniferous trees (primarily jack pine) with a lichen (cladina) background. These areas have sandy soils that are well drained. Areas of permafrost supporting conifers with a lichen background are also included in this class.
3	Mixed Deciduous and Coniferous	Mixed deciduous and coniferous contains coniferous and aspen/birch (populus tremuloides/betula papyrifera) trees. The composition of this class contains less than 80% of the dominant species.
4	Deciduous	The deciduous class contains primarily aspen/birch. The composition of this class is generally greater than 80% deciduous trees.
5	Fen	The Fen/Bog class is characterized by areas with a water table very near or at the surface. Fens experience lateral water transport, whereas bogs are enclosed landforms experiencing only vertical transport. Fens typically contain sedges, moss, and bog birch associated with sparse to medium dense tamarack (larix laricina) stands. Bogs are usually treeless.
6	Water	Water bodies such as ponds, lakes, and streams.
7	Disturbed	The disturbed class consists of areas that are dominated by bare soil, recently logged areas, or rock outcrops. This class also includes roads, airports, and urban areas.
8	Fire Blackened	Areas that have been burned in the last 5 or 6 years. Distinguishable for their charred sphagnum background they are usually areas of very intense burn where little or no vegetation survived.
9	New Regeneration Conifer	This class consists primarily of conifers that are regrowing after a burn. It may also include conifer stands where there are a few remaining trees after a low- to medium-intensity burn.
10	Medium-Age Regeneration Conifer	Areas that are predominantly young jack pine or young black spruce. This class typically occurs in stands that were cleared or burned and have been growing back for approximately 10 years.

11	New Regeneration deciduous	This class consists of aspen that is starting to regrow after a recent clearing. This class is younger than the young aspen class. The aspen in this class may also include grasses or other herbaceous vegetation.
12	Medium-Age Regeneration deciduous	The class consists of areas that were cleared or burned and have been growing back as aspen. These stands typically contain 10 year old aspen where the background is almost completely obscured and thinning has not yet taken place.
13	Grass	This class consists primarily of grasses, agricultural fields that have been planted, or shrub-like vegetation.

7.3.3 Unit of Measurement
Unitless but coded value.

7.3.4 Data Source
Landsat-5 TM scene on 21-Jun-1995 from the CCRS.

7.3.5 Data Range
Land cover type: 13 different land cover classes (pixel values from 0 to 13).

7.4 Sample Data Record
Not applicable for image data.

8. Data Organization

8.1 Data Granularity
The smallest amount of data that can be ordered is the entire data set.

8.2 Data Format

8.2.1 Uncompressed Data Files
The NSA classification product contains two files as follows:

- File 1: (80-byte American Standard Code for Information Interchange (ASCII) text records) Text file listing the files on tape
- File 2: (2,667 records of 3,667 bytes each) (1 byte per pixel) Classified image with values from 0 to 13

8.2.2 Compressed CD-ROM Files
On the BOREAS CD-ROMs, file 1 listed above is stored as ASCII text; however, file 2 has been compressed with the Gzip compression program (file name *.gz). These data have been compressed using gzip version 1.2.4 and the high compression (-9) option (Copyright (C) 1992-1993 Jean-loup Gailly). Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP programs. The compressed files may be uncompressed using gzip (-d option) or gunzip. Gzip is available from many Web sites (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

9. Data Manipulations

9.1 Formulae
Not applicable.

9.1.1 Derivation Techniques and Algorithms
The techniques that were used to classify this image are described in Sections 1.5, 3, and 6.1.

9.2 Data Processing Sequence

9.2.1 Processing Steps
- The imagery was converted to surface reflectance before the classification was performed. Atmospheric correction coefficients were computed using optical depths from a sunphotometer in conjunction with 6S (Markham et al., 1992).
- End member reflectances were the same as those used for the Southern Study Area (SSA) classification.
- Trajectories were computed based on end member reflectances, solar geometry, tree height to width ratio, and tree form (i.e., cone or cylinder).
- Additional trajectories for regeneration classes were added using data from regeneration areas of the SSA. No end member reflectances were used to characterize the regeneration and water classes (classes 6-13).
- The trajectories were used as input to the image classifier.
- Post-processing techniques to classify any remaining null-classed pixels were applied.
- The classified image was mapped into the AEAC projection using nearest neighbor resampling.
- The classification image was written to tape. 9) BOREAS Information System (BORIS) staff copied the ASCII and compressed the binary files for release on CD-ROM.

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.

10. Errors

10.1 Sources of Error
The sources of error in this classification can be attributed to several factors. In many cases, the reflectance of one feature could be similar to the reflectance of another feature, resulting in confusion. The similarity in reflectances could be the result of similar background components and variations in tree density. Error could also be a result of spectral mixing of various features that fall within a 30-meter pixel.

10.2 Quality Assessment

10.2.1 Data Validation by Source

The imagery was spot checked at various locations, and the image class was compared to the forest cover map. An error assessment was performed on the classification. The auxiliary sites and a few randomly selected sites were used as ground truth. The location of each ground truth site was identified on the georeferenced image as a 3- by 3-pixel area. Each of the 9 pixels in these areas represents a test point. Some classes were not represented by auxiliary sites or randomly selected sites.

10.2.2 Confidence Level/Accuracy Judgment

Although efforts have been made to make this classification as accurate as possible, there is bound to be some confusion between classes. In some areas, new regeneration conifer can be confused with fen because of differences in canopy density. Also, many of the age classes within the deciduous or conifer classes can be confused because of minor variations in background.

10.2.3 Measurement Error for Parameters

The following tables and statistics were derived to assess the accuracy of the classification:

Confusion Matrix

	Classification												
Truth / Class	1	2	3	4	5	6	7	8	9	10	11	12	13
Wet Conifer (1)	93	0	0	8	0	0	0	0	0	0	9	0	0
Dry Conifer (2)	0	0	0	0	1	0	0	0	7	0	0	0	0
Mixed (3)	0	0	21	5	0	0	0	0	0	0	2	2	0
Deciduous (4)	0	0	0	85	0	0	0	0	1	0	0	0	0
Fen (5)	0	0	6	22	80	0	0	0	0	0	9	0	0
Water (6)	0	0	0	0	0	51	0	0	0	0	0	0	0
Bare Soil (7)	0	1	0	0	0	0	18	0	0	0	0	0	0
Fire Black. (8)	0	0	0	0	0	0	0	0	0	0	0	0	0
New Regen. Conifer (9)	0	0	0	3	1	0	0	0	67	0	0	0	0
Med. Age Regen. Con. (10)	0	0	7	0	0	0	0	0	0	47	0	0	0
New Regen. Deciduous (11)	0	0	0	0	9	0	0	0	0	0	39	0	0
Med. Age Regen. Deciduous (12)	0	0	0	0	0	0	0	0	0	0	0	21	0
Grass (13)	0	0	0	0	0	0	0	0	0	0	0	0	0

Class	% Correct
Wet Conifer	84 %
Dry Conifer	0 %
Mixed	70 %
Deciduous	99 %
Fen	68 %
Water	100 %
Bare Soil	95 %
Fire Blackened	Not represented in NSA
New Regen. Conifer	94 %
Med. Age	

```
Regen. Con.        87 %
New Regen.
Decid.             81 %
Med. Age
Regen.
Decid.            100 %
Grass             Not represented in NSA

Overall            85 %

Kappa = 0.83 or 83 % better than chance agreement (Campbell, 1987).
```

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

The imagery was spot checked at various locations and the image class was compared to the forest cover maps from Manitoba Natural Resources.

11. Notes

11.1 Limitations of the Data

This data set is based on an image that was collected on 21-Jun-1995 and represents the land cover only as it existed on that day. Please see Section 10.2.3 to determine how the amount of error in this product may affect your results.

11.2 Known Problems With the Data

Clouds in this classification show up in the disturbed class, and cloud shadows show up in the water class. The scene is mostly clear, so this problem has a very limited impact.

11.3 Usage Guidance

Before uncompressing the Gzip files on CD-ROM, be sure that you have enough disk space to hold the uncompressed data files. Then use the appropriate decompression program provided on the CD-ROM for your specific system.

11.4 Other Relevant Information

None.

12. Application of the Data Set

This data set may be used for modeling purposes. It can also be used to analyze measurements from aircraft to determine the land cover that was under the aircraft at locations along the aircraft's path.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

Programs written at NASA GSFC to run under EASI/PACE image processing software from PCI, Inc., were used to classify the image. The trajectories were computed using Microsoft Excel (Version 4.0), a spreadsheet program. Questions related to the specific details of the software written to process this data set should be addressed to David Knapp (see Section 2.3). Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP commands.

14.2 Software Access

EASI/PACE is a proprietary software package developed by PCI, Inc. Contact PCI for details.

PCI, Inc.
50 West Wilmot St.
Richmond Hill
Ontario, Canada L4B 1M5
(905) 764-0614
(905) 764-9604 (fax)

Microsoft Excel is a proprietary software package that is widely available in the commercial software market. Gzip is available from many Web sites across the Internet (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

15. Data Access

The BOREAS NSA physical classification image data set is 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

These data can be made available on 8-mm, Digital Archive Tape (DAT), or 9-track tapes.

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

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

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6S       - Second Simulation of the Satellite Signal in the Solar Spectrum
AEAC     - Albers Equal-Area Conic
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
EOS      - Earth Observing System
EOSAT    - Earth Observation Satellite Company
EOSDIS   - EOS Data and Information System
GIS      - Geographic Information System
GMT      - Greenwich Mean Time
GRS80    - Geodetic Reference System of 1980
GSFC     - Goddard Space Flight Center
IFOV     - Instantaneous Field of View
MSA      - Modeling Sub-Area
MSS      - Multispectral Scanner
NAD27    - North American Datum of 1927
NAD83    - North American Datum of 1983
NASA     - National Aeronautics and Space Administration
NSA      - Northern Study Area
ORNL     - Oak Ridge National Laboratory
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PANP       - Prince Albert National Park
RSS        - Remote Sensing Science
SSA        - Southern Study Area
TE         - Terrestrial Ecology
TM         - Thematic Mapper
URL        - Uniform Resource Locator
UTM        - Universal Transverse Mercator
WGS84      - World Geodetic System of 1984
WRS        - Worldwide Reference System
WWW        - World Wide Web
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The BOREAS TE-18 team focused its efforts on using remotely sensed data to characterize the successional and disturbance dynamics of the boreal forest for use in carbon modeling. The objective of this classification is to provide the BOREAS investigators with a data product that characterizes the land cover of the NSA. A Landsat-5 TM image from 21-Jun-1995 was used to derive the classification. 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 training data to classify the image into the different land cover classes. The data are provided in a binary, image file format.

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