BOREAS HYD-8 DEM Data over
the NSA-MSA and SSA-MSA in the
AEAC Projection

David E. Knapp, Raytheon ITSS
Xuewen Wang and L.E. Band, University of Toronto

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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David Knapp, Xuewen Wang, L.E. Band

Summary

These data were derived from the original DEMs produced by the BOREAS HYD-8 team. The original DEMs were in the UTM projection, while this product is projected in the AEAC projection (see Section 7 for further projection details). The pixel size of the data is 100 meters, which is appropriate for the 1:50,000-scale contours from which the DEMs were made. The original data were compiled from information available in the 1970s and 1980s. This data set covers the two MSAs that are contained within the SSA and the NSA. The data are stored in binary, image format files.

Note that the binary files of this data set 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 DEM Data over the NSA-MSA and SSA-MSA in the AEAC Projection

1.2 Data Set Introduction
These Digital Elevation Models (DEMs) were resampled into the BOREal Ecosystem-Atmosphere Study (BOREAS) grid projection from the original DEMs produced by the BOREAS Hydrology (HYD)-08 team. The original DEMs were in the Universal Transverse Mercator (UTM) projection. The pixel size of the data is 100 meters, which is appropriate for the 1:50,000-scale contours from which these DEMs were made.
1.3 Objective/Purpose

These data are provided as part of the BOREAS Staff Science Geographic Information System (GIS) Data Collection Program, which included the collection of pertinent map data in both hardcopy and digital form. This data set has been processed to provide raster files that can be used for modeling or for comparison purposes. The objective of these DEMs is to provide the BOREAS investigators with a data product that characterizes the topography of the Modeling Sub-Areas (MSAs) in the Albers Equal-Area Conic (AEAC) projection. The original DEMs were produced by HYD-08 in the UTM projection.

1.4 Summary of Parameters

Elevation above mean sea level

1.5 Discussion

These DEMs were resampled into the AEAC projection from the original DEMs produced by HYD-08. The original DEMs were in the UTM projection. The pixel size of the data is 100 meters, which is appropriate for the 1:50,000-scale contours from which the DEMs were made.

1.6 Related Data Sets

BOREAS Regional DEM in Raster Format and AEAC Projection
BOREAS HYD-08 DEM Data over the NSA-MSA and SSA-MSA in the UTM Projection

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. L.E. Band

2.2 Title of Investigation

Simulation of Boreal Ecosystem Carbon and Water Budgets: Scaling from Local to Regional Extents

2.3 Contact Information

Contact 1:
Xuewen Wang
Dept. Geography, U. Toronto
Toronto, Ontario
Canada M5T 1A1
(416) 978-5070
wangx@esker.geog.utoronto.ca

Contact 2:
L.E. Band
Dept. Geography, U. Toronto
Toronto, Ontario
Canada M5T 1A1
(416) 978-3375
lband@eos.geog.utoronto.ca
3. Theory of Measurements

This data set was produced for modeling purposes. The DEMs can be used to determine the elevation of a given location and the drainage patterns in the MSAs, which are important for understanding the vegetative cover and hydrology of these areas.

4. Equipment

4.1 Sensor/Instrument Description
The equipment and other data-gathering methods used for compiling the original data are unknown.

4.1.1 Collection Environment
Unknown.

4.1.2 Source/Platform
Unknown.

4.1.3 Source/Platform Mission Objectives
Unknown.

4.1.4 Key Variables
Elevation above mean sea level

4.1.5 Principles of Operation
Unknown.

4.1.6 Sensor/Instrument Measurement Geometry
Unknown.

4.1.7 Manufacturer of Sensor/Instrument
Unknown.

4.2 Calibration
Unknown.

4.2.1 Specifications
Unknown.

4.2.1.1 Tolerance
Unknown.
4.2.2 Frequency of Calibration
Unknown.

4.2.3 Other Calibration Information
Unknown.

5. Data Acquisition Methods

The original data were acquired from the National Topographical Data Base and received by the HYD-08 team from the Canadian Centre for Remote Sensing (CCRS). The data came in Standard Interchange Format (SIF), digitized from 1:50,000 topographic maps. HYD-08 used these contours in the TOPOG software package to create gridded DEMs. BOREAS Staff Science received the DEMs from HYD-08 in the UTM projection and reprojected them in the AEAC projection.

6. Observations

6.1 Data Notes
None.

6.2 Field Notes
Not applicable.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

Northern Study Area (NSA):
The area covered by the data is approximately 54 km x 37 km. This area includes areas northwest of Thompson and south of Nelson House, Manitoba. The corner coordinates of the data set are:

<table>
<thead>
<tr>
<th></th>
<th>Longitude</th>
<th>Latitude</th>
<th>BOREAS X</th>
<th>BOREAS Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>98.92610W</td>
<td>56.13748N</td>
<td>745.900</td>
<td>636.900</td>
</tr>
<tr>
<td>Northeast</td>
<td>97.97973W</td>
<td>56.04133N</td>
<td>805.700</td>
<td>636.900</td>
</tr>
<tr>
<td>Southwest</td>
<td>99.05263W</td>
<td>55.73102N</td>
<td>745.900</td>
<td>590.900</td>
</tr>
<tr>
<td>Southeast</td>
<td>98.11573W</td>
<td>55.63586N</td>
<td>805.700</td>
<td>590.900</td>
</tr>
</tbody>
</table>

Southern Study Area (SSA):
The image area that was modeled covers an area that is approximately 54 km x 44 km. This area includes areas just north and east of Candle Lake, Saskatchewan. The corners of the data set are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Longitude</th>
<th>Latitude</th>
<th>BOREAS X</th>
<th>BOREAS Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>105.22872W</td>
<td>54.13540N</td>
<td>376.400</td>
<td>364.500</td>
</tr>
<tr>
<td>Northeast</td>
<td>104.35586W</td>
<td>54.08517N</td>
<td>433.700</td>
<td>364.500</td>
</tr>
<tr>
<td>Southwest</td>
<td>105.29095W</td>
<td>53.69173N</td>
<td>376.400</td>
<td>314.900</td>
</tr>
<tr>
<td>Southeast</td>
<td>104.42667W</td>
<td>53.64642N</td>
<td>433.700</td>
<td>314.900</td>
</tr>
</tbody>
</table>
7.1.2 Spatial Coverage Map
See Section 7.1.1.

7.1.3 Spatial Resolution
These data were gridded to a cell size of 100 meters in both the X and Y directions.

7.1.4 Projection
The area mapped is projected in the ellipsoidal version of the AEAC projection. The projection has the following parameters:

Datum: North American Datum of 1983 (NAD83)
Ellipsoid: GRS80 or WGS84
Origin: 111.000° W 51.000° N
Standard Parallels: 52° 30' 00"N
58° 30' 00"N
Units of Measure: km

7.1.5 Grid Description
See Section 7.1.3.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
Most of the maps from which these contours were digitized were made in the 1970s or 1980s.

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
These elevations represent the state of the terrain at a point in time. Most of the elevation data from which the DEMs were produced were collected in the 1970s or 1980s.

7.3 Data Characteristics

7.3.1 Parameter/Variable
Elevation above mean sea level

7.3.2 Variable Description/Definition
Elevation above mean sea level - The vertical distance between a plane at mean sea level and a parallel plane intersecting this point.

7.3.3 Unit of Measurement
Meters

7.3.4 Data Source
The HYD-08 team received the original data from the CCRS, which acquired it from the National Topographical Data Base.

7.3.5 Data Range
Not available at this revision.

7.4 Sample Data Record
Not applicable to image data.
8. Data Organization

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

8.2 Data Format(s)

8.2.1 Uncompressed Data Files
The data set on tape consists of three files with the following descriptions:
• File 1: ASCII Header File listing the files that are on the tape. The file contains 9 records of 80 bytes each.
• File 2: DEM data file for the NSA. This is a binary file containing 1,196 bytes in each of 460 records. Each binary record is a line of the image file and contains 598 2-byte (16-bit) values stored as low-order byte first. Each binary value is the mean elevation above sea level of the location in meters.
• File 3: DEM data file for the SSA. This is a binary file containing 1,146 bytes in each of 496 records. Each binary record is a line of the image file and contains 573 2-byte (16-bit) values stored as low-order byte first. Each binary value is the mean elevation above sea level of the location in meters.

8.2.2 Compressed CD-ROM Files
On the BOREAS CD-ROMs, file 1 listed above is stored as ASCII text; however, files 2 and 3 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
These data were reprojected from UTM coordinates to the AEAC projection as defined within NAD83. The origin of the grid is at 111°W, 51°N with standard parallels set to 52.5°N and 58.5°N as prescribed in Snyder (1987).

9.1.1 Derivation Techniques and Algorithms
The original UTM data were placed in the AEAC projection using the nearest-neighbor resampling method.

9.2 Data Processing Sequence

9.2.1 Processing Steps
BOREAS Information System (BORIS) personnel processed the data by:
• Converting the corners of the original DEM to BOREAS grid coordinates
• Using the four corners of the image as ground control points
• Resampling the DEM into the BOREAS grid coordinate using a first order polynomial and or resampling
• Writing the reprojected data file to tape
• Copying the ASCII and compressing 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
Please see the documentation for the original DEM for information regarding error.

10.2 Quality Assessment
Please see the documentation for the original DEM for information regarding quality assessment.

10.2.1 Data Validation by Source
None.

10.2.2 Confidence Level/Accuracy Judgment
Not available.

10.2.3 Measurement Error for Parameters
Not available.

10.2.4 Additional Quality Assessments
Not applicable.

10.2.5 Data Verification by Data Center
BORIS staff visually reviewed the images to see that they did appear to represent a DEM data layer without any obvious anomalies. The only quantitative assessment made was to see that the minimum and maximum elevation values in the raster files approximated those shown on topographic maps of the area.

11. Notes

11.1 Limitations of the Data
There are elevational variations within the lakes, especially large lakes, because there are no contours in the lakes that can cause a stair step effect in the lakes.

Because these DEMs were reprojected from the original DEMs, there may be minor differences in the relationship between neighboring pixels that can result in significant differences if the DEM is used to determine drainage patterns. If your application of these DEMs is sensitive to this problem, it is suggested that the original DEMs (in the UTM projection) be used.
11.2 Known Problems with the Data
See Section 11.1.

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
These data can be used as a reference for the elevation trmsds over the NSA. Also, see Section 11.1.

13. Future Modifications and Plans
None.

14. Software

14.1 Software Description
The data manipulation capabilities in the EASI/PACE software package (Version 5.2) were used to reproject/grid the data. However, almost any image processing package could have been used to resample this imagery.

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)

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 DEM data over the NSA-MSA and SSA-MSA in the AEAC projection 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: omldaac@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

The DEM data can be made available on 8-mm, Digital Archive Tape (DAT), or 9-track tapes at 1600 or 6250 Bytes Per Inch (BPI).

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


17.2 Journal Articles and Study Reports


17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms
None.
19. List of Acronyms

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
CD-ROM - Compact Disk-Read-Only-Memory
DAAC - Distributed Active Archive Center
DAT - Digital Archive Tape
DEM - Digital Elevation Model
EOS - Earth Observing System
EOSDIS - EOS Data and Information System
GIS - Geographic Information System
GMT - Greenwich Mean Time
GSFC - Goddard Space Flight Center
MSA - Modeling Sub-Area
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
PANP - Prince Albert National Park
SIF - Standard Interchange Format
SSA - Southern Study Area
URL - Uniform Resource Locator
UTM - Universal Transverse Mercator
WWW - World Wide Web

20. Document Information

20.1 Document Revision Dates
Written: 15-Mar-1995
Last Updated: 05-Feb-1999

20.2 Document Review Dates
BORIS Review: 05-Jun-1997
Science Review:

20.3 Document ID

20.4 Citation
When using these data, please include the following acknowledgement as well as citations of relevant papers in Section 17.2:
The NSA and SSA DEM product was processed by BORIS personnel from the original data supplied by Dr. Larry Band. The contributions of Dr. Band and BORIS staff in completing this data set are greatly appreciated.
If using data from the BOREAS CD-ROM series, also reference the data as:


Also, cite the BOREAS CD-ROM set as:


20.5 Document Curator

20.6 Document URL
**Title and Subtitle:** Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)  
**BOREAS HYD-8 DEM Data over the NSA-MSA and SSA-MSA in the AEAC Projection**

**Authors:** David E. Knapp, Xuewen Wang, and L.E. Band  
Forrest G. Hall, Editor

**Performing Organization Name(s) and Address(es):**  
Goddard Space Flight Center  
Greenbelt, Maryland 20771

**Sponsoring/Monitoring Agency Name(s) and Address(es):**  
National Aeronautics and Space Administration  
Washington, DC 20546-0001

**Abstract:**  
These data were derived from the original DEMs produced by the BOREAS HYD-8 team. The original DEMs were in the UTM projection, while this product is projected in the AEAC projection (see Section 7 for further projection details). The pixel size of the data is 100 meters, which is appropriate for the 1:50,000-scale contours from which the DEMs were made. The original data were compiled from information available in the 1970s and 1980s. This data set covers the two MSAs that are contained within the SSA and the NSA. The data are stored in binary, image format files.