FINAL REPORT

NASA GRANT NAG5-3719

"A Web Server for MACCS Magnetometer Data"

Period of Grant:	Feb. 1, 1997 -- Jan. 31, 1998
Performing Institution:	Augsburg College, Minneapolis, MN 55454
Principal Investigator:	Mark J. Engebretson Professor of Physics
Date:	February 16, 1998

Overview:

NASA Grant NAG5-3719 was provided to Augsbug College to support the development of a web server for the Magnetometer Array for Cusp and Cleft Studies (MACCS), a two-dimensional array of fluxgate magnetometers located at cusp latitudes in Arctic Canada. MACCS was developed as part of the National Science Foundation's GEM (Geospace Environment Modeling) Program, which was designed in part to complement NASA's Global Geospace Science programs during the decade of the 1990s.

This report describes the successful use of these grant funds to support a working web page that provides both daily plots and file access to any user accessing the worldwide web. The MACCS home page can be accessed at http://space.augsburg.edu/space/MaccsHome.html.

I. Data Set

The MACCS project is a joint effort of Augsburg College's Physics Department (Mark Engebretson, PI), and Boston University's Astronomy Department (W.Jeffrey Hughes, PI). Roughly similar grants from NSF were provided to Augsburg College and Boston University to cover the installation and operation of the western and eastern half of the MACCS array, respectively.

The MACCS project began in September 1992 with the deployment of Narod fluxgate magnetometer systems at four remote Inuit villages in Canada's Northwest Territories: Pangnirtung, Cape Dorset, Coral Harbour, and Repulse Bay to form a longitudinal chain near 75 degrees geomagnetic latitude.

Another four systems were deployed in August 1993 at Clyde River, Igloolik, Pelly Bay, and Gjoa Haven to form a similar longitudinal chain near 80 degrees geomagnetic latitude.

At each site vector magnetic field data are measured eight times per second and averaged and recorded at 1/2 second intervals using a data recording system based on a personal computer. Data tapes (now Zip disks) are sent by mail to the Principal Investigators monthly.

Beginning in late 1993 we obtained permission to install data recording systems at four Canadian Standard Observatories (Cambridge Bay, Baker Lake, Resolute Bay, and Iqaluit) to record data at 1 sample per second, a rate faster than that typically used for these observatories. Data from these stations is also routinely included in MACCS data sets, but permission must be obtained from the Geological Survey of Canada before these data can be used in scientific publications.

Scientific data analysis and routine data monitoring tasks are divided between Augsburg College and Boston University. Of most relevance to this project is that Boston University prepares the combined data set into a compact binary data file format and writes level 2 processed data, averaged one sample per 5 seconds, onto CD-ROMs, and Augsburg College makes this 5-s averaged data set available to the space physics user community via the MACCS web pages.

Scientists who access the MACCS data will note that data coverage is not continuous. Computer hardware problems in the first 3 years, particularly with the miniature tape recorder systems used until summer 1997, combined with the difficulty of travel to the Canadian Arctic during the long winter season, led to significant data gaps at particular stations. The use of twelve sites, however, makes it possible to provide at least some coverage on every day, and there are many intervals with nearly complete coverage at all MACCS stations.

II. Description of the Web Site

The MACCS web site, which was established before the beginning of this NASA grant, provides first-time users with several sub-pages related to the MACCS project. The two main categories of sub-pages are "General MACCS Information" and "MACCS Data Services." The latter category of sub-pages was developed with support from this NASA grant. A copy of the MACCS home page is included as the next page of this report.

There are four MACCS Data Services sub-pages:

* MACCS binary data Read Me
* Download MACCS binary data

* MACCS Plot Page Read Me
* View MACCS data daily plots

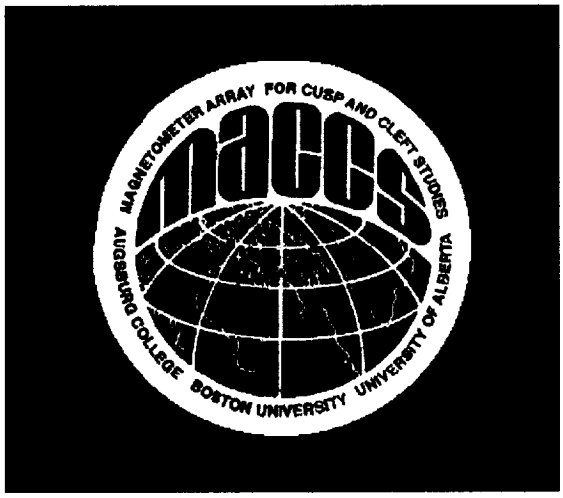
These will be described briefly in the following sections

III. Data File Access

All available MACCS data from the beginning of array operations in September 1992 through December 1996 are now available online for downloading. Data are available as daily binary files, and are grouped by station and by year and date. A special README page includes both a description of the data set, including sample rate, coordinate definitions (geographic), and a description of the format of the binary data file. Also available here is a fragment of IDL (Interactive Data Language) code that will read the data files and translate them into ASCII.

Copies of the MACCS Data Read Me Page and the MACCS Data Page are also included in the following pages.

Welcome to the Augsburg MACCS Project Information Center.



General MACCS Information

- The history of the MACCS Program.
- Coordinates and map of MACCS stations.
- Papers produced by the MACCS Program.
- See links to other related sites.

MACCS Data Services

Download Binary Data

- MACCS binary data Read Me.
- Download MACCS binary data.

View MACCS Daily Summary Plots

- MACCS Plot Page Read Me.
- View MACCS data daily plots.

If you have any questions or comments, please contact posch@augsburg.edu.

This document was last modified on 19 January 1998.

MACCS Data Read Me Page

Magnetometer Array for Cusp and Cleft Studies

Downloading Tips for the MACCS Data Page

When typing in a date, make sure that there is not a leading zero in the number. Leading zeros will cause the server to download an incorrect image. For example, typing 041 will cause the server to download an incorrect image, while typing 41 will download the correct image. The date on a given plot is correct.

General Information on the MACCS Program

These web pages contain magnetometer data from the Magnetometer Array for Cusp and Cleft Studies (MACCS), an array of magnetometers in Arctic Canada run by Boston University and Augsburg College with assistance from the University of Alberta and the Geological Survey of Canada, and supported by the National Science Foundation's Magnetospheric Physics Program. Further details of the MACCS array can be found in W. J. Hughes and M. J. Engebretson, MACCS: Magnetometer Array for Cusp and Cleft Studies, in Satellite-Ground Based Coordination Sourcebook, (eds. M. Lockwood, M.N. Wild H. J. Opgenoorth), ESA-SP-1198, pp. 119-130, 1997

These pages also contain data from a number of Canadian Magnetic Observatories operated by the Geomagnetism Unit of the Geological Survey of Canada. Because these data complement the MACCS data, they are provided to the GEM community courtesy of the Geological Survey of Canada. ANY USE OF THESE DATA MUST INCLUDE A PROPER ACKNOWLEDGEMENT OF THEIR SOURCE.

The MACCS Data Page contains data at 5 second resolution. Vector magnetic field samples were obtained eight times a second, and the data originally recorded as 0.5 second averages. This data set is averaged over the 5 second interval centered on the time of the given measurement. The data, originally recorded in local geomagnetic coordinates, have been rotated into geographic coordinates. Similarly, the plots produced by the MACCS Plot Page are made from 1 minute resolution data in geographic coordinates. All data provided have been subjected to routine quality checks, but these may not catch all errors. Persons wishing to use MACCS data in publications or presentations should contact one of the MACCS investigators to verify the quality of these data.

MACCS Investigators

Dr. Mark Engebretson engebret@augsburg.edu
Dr. W. J. Hughes hughes@bu.edu

The following information is included in this readme file:

1. Station Coordinates.
2. 5 second file structure.
3. Information about IDL code included on this page.

1. Table of the MACCS station codes and locations.

The Magnetic Observatories of the Geological Survey of Canada are included in the list and denoted with an asterisk. The magnetic coordinates are altitude adjusted corrected magnetic coordinates (aagcm) computed with code provided by the Johns Hopkins University Applied Physics Laboratory using the epoch 1995 IGRF. The UT time of noon MLT was computed using a 1991 Tsyganenko model.

MACCS Magnetometer Station Coordinates

Station Name	Abbrev.	Geographic Lat.	Geographic Lon.	Corr Geomag Lat.	Corr Geomag Lon.	T-Model Local Noon
Pangnirtung	(PG)	66.1	294.2	75.2	20.1	15:00
Clyde River	(CY)	70.5	291.4	79.6	18.5	15:30
*Iqaluit	(IQ)	63.8	291.5	73.4	14.7	15:45
Cape Dorset	(CD)	64.2	283.4	74.6	1.2	16:45
Igloolik	(IG)	69.3	278.2	79.4	351.5	17:20
Coral Harbour	(CH)	64.1	276.8	74.8	349.2	17:30
Repulse Bay	(RB)	66.5	273.8	76.9	343.2	17:55
Pelly Bay	(PB)	68.5	270.3	78.6	335.5	18:25
*Baker Lake	(BL)	64.3	264.0	74.3	326.1	19:05
Gjoa Haven	(GH)	68.6	264.1	78.2	323.4	19:15
*Cambridge Bay	(CB)	69.1	255.0	77.5	306.9	20:25
*Resolute Bay	(RE)	74.7	265.0	83.5	315.8	19:45

2. The 5 second data files are in binary format. Each 5 sec file contains data for one day for a single station. The naming convention is: 2 letter station abbreviation followed by yearday with the extension '.bin' (meaning binary data) such as 'gh95154.bin'.

The record format of those 5 second binary data files is:

record size(fixed) = 15 bytes
number of records per file = 17280
file size = 259200 bytes
flag for bad or missing data = 32767000

Byte Number	Content	Data Type
1	hour	byte
2	minute	byte
3	second	byte
4-7	Bx(nT x 1000)	4 byte longint
8-11	By(nT x 1000)	4 byte longint
12-15	Bz(nT x 1000)	4 byte longint

3. There is also an IDL program (sec_conv.pro), which will convert the 5 second files from binary to ascii.

[MACCS Home Page] [History of the MACCS Program] [Papers Produced by the MACCS Program]
[Links to Related Sites] [Binary Data Dowloading Read Me] [Plot viewing Read Me]
[Coordinates of MACCS Stations] [Download MACCS binary data] [View MACCS data daily plots]

If you have any questions or comments, please contact posch@augsburg.edu.

This document was last modified on 20 January 1998.

MACCS Data Page

Magnetometer Array for Cusp and Cleft Studies

If this is your first time downloading files from this site, you may need to read the Read Me File, where more information and IDL code to convert the binary data is located.

Station: STATION ***Year:*** YEAR

Please enter in the day (**from 1-366**). ***Day:***

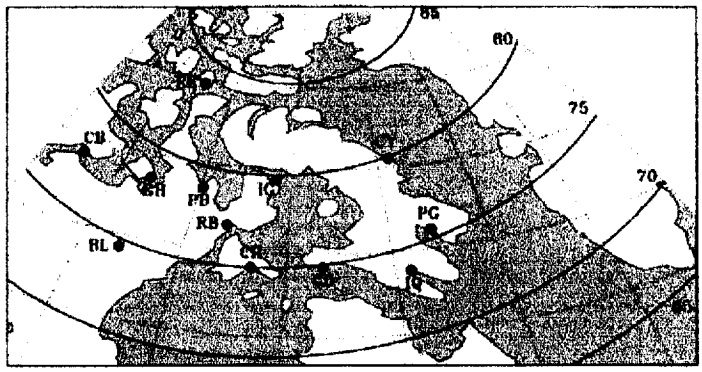
Caution! Hitting return reloads this page.

Download MACCS Data

Clear form.

To find the data availability for a station, simply click on that station.

MACCS MAGNETOMETER NETWORK



[CD] [CH] [CY] [GH] [IG] [PB] [PG] [RB]

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IV. Daily Summary Plot Access

Because many users may wish to examine the MACCS data before downloading it in significant quantities, we also provide daily stacked plots of 1-min BX (geographic north-south) component data on the MACCS web site. Data from all available sites are included in these plots, namely, the four Canadian Standard observatories as well as the eight MACCS sites.

These stacked plots can be accessed by simply specifying the year and day desired. A README page is again provided to assist users in accessing and understanding the data.

A copy of the MACCS Plot Page is included following this page, followed by a sample daily plot.

V. Programmatics

The MACCS web data server was implemented by Augsburg undergraduate students Larye Pohlman and Jack Stover, with the guidance of Mark Engebretson, Professor of Physics, and Charley Sheaffer, Assistant Professor of Computer Science. The web server is based on a Sun SPARC 20 workstation, and data storage is provided using two independent 4-gigabyte hard disk subsystems. These disks will provide storage space adequate for an additional two years of MACCS data. we plan to continue to expand the storage capability of this web server in the future to provide scientists worldwide with continued on-line access to the entire MACCS data set.

The availability of MACCS data on the worldwide web was announced by means of tear-off sheets at two posters at the Fall 1997 AGU meeting, and will be further advertised at the Spring 1998 AGU meeting, at the 1998 GEM Workshops, and at other national and international meetings.

MACCS Plot Page

Magnetometer Array for Cusp and Cleft Studies

If this is your first time looking at plots from this site, you may wish to access Plots Read Me

Year: YEAR

Please enter in the day (**from 1-366**). *Day:*

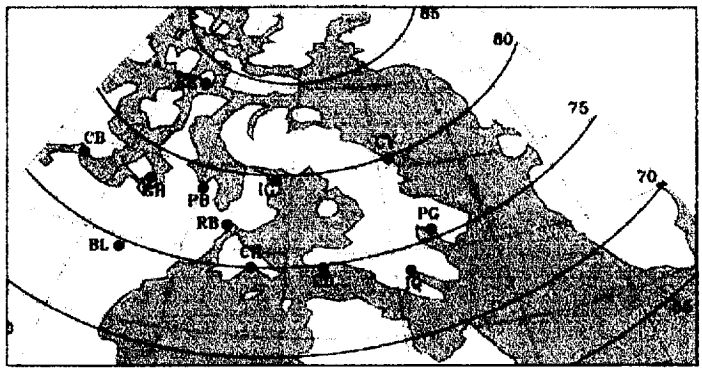
Caution! Hitting return reloads this page.

Download MACCS Plot

Clear form.

To find the data availability for a station, simply click on that station.

MACCS MAGNETOMETER NETWORK



[CD] [CH] [CY] [GH] [IG] [PB] [PG] [RB]

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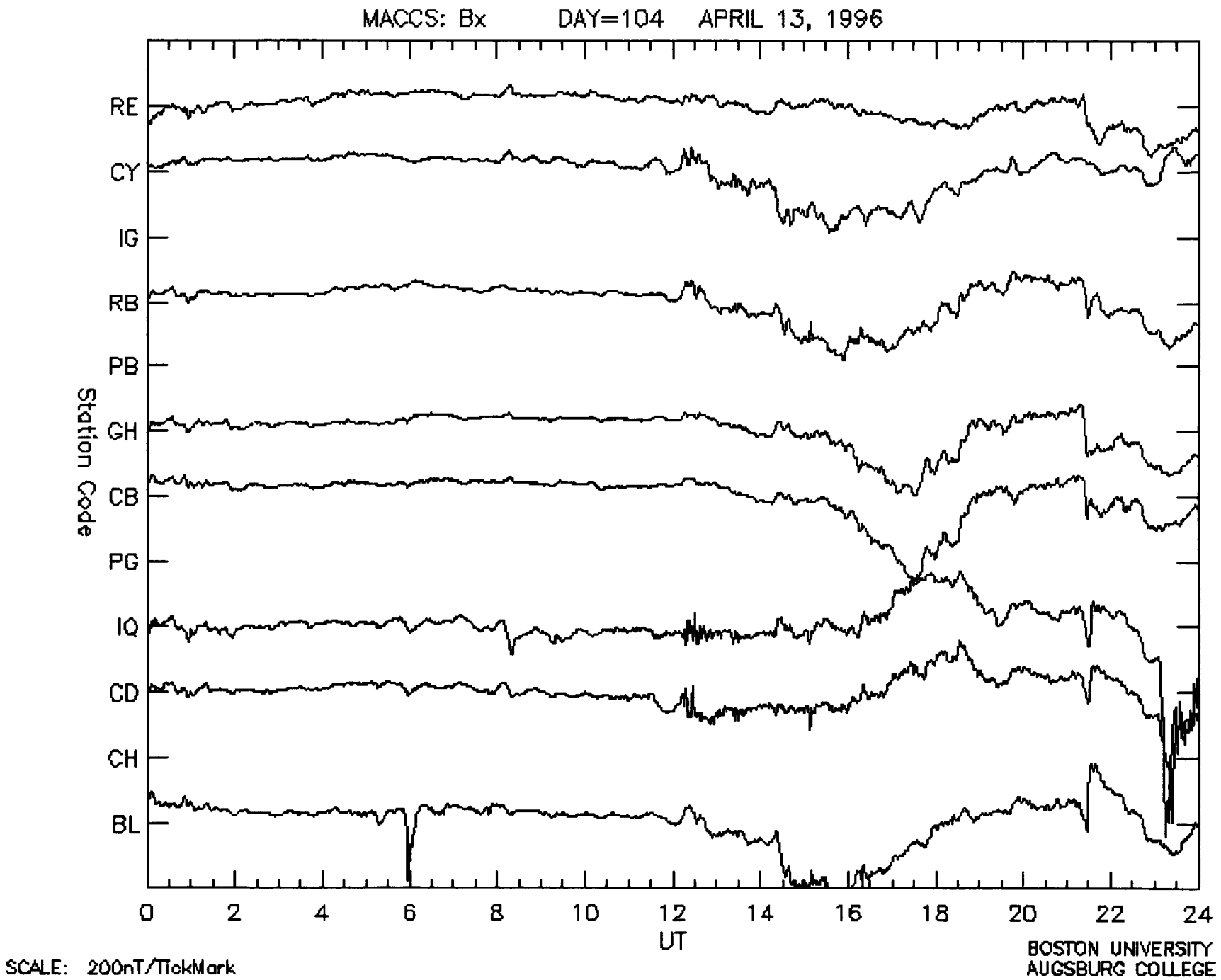
MACCS: Bx DAY=104 APRIL 13, 1996
RE
CY
IG
RB
PB
GH
CB
PG
IQ
CD
CH
BL
Station Code
0 2 4 6 8 10 12 14 16 18 20 22 24
UT
SCALE: 200nT/TickMark
BOSTON UNIVERSITY
AUGSBURG COLLEGE