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The Geophysical Institute Magnetometer Array

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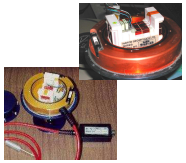
Abstract

The Geophysical Institute Magnetometer Array (GIMA) consists of twelve magnetometer stations distributed across Alaska cutting the auroral oval. Each station is equipped with a ring-core, fluxgate magnetometer, GPS clock and data logger. Data are returned from each station to the Geophysical Institute, University of Alaska where it is verified, archived, and made available to the space science community. The GIMA web page, at http://magnet.gi.alaska.edu/, provides the data from eight stations online in real-time. The GIMA web page also provides data from five Russian magnetometer stations (NOK, Norilsk; PBK, Pebek; TIK, Tixie Bay; CCS, Cape Chelynskin; and DIK, Dixon). In addition to GIMA, other magnetometer stations in Alaska have online data available. The GIMA data set available online spans the time period 1995 to the present. This presentation includes a review of the array, its capabilities (data collection parameters), the web site, and methods for acessing the data set. Interesting examples of the data will be used to illustrate the performance and capability of GIMA.

Instrumentation



The Narod ring-core magnetometer used by the Geophysical Institute is manufactured by Narod Geophysics Ltd. of Canada. The magnetometer is a fluxgate design using a triaxial set of cores. The sensor cores are shown here in the GI enclosure. A carefully machined ceramic block (the white block in the center) holds each of the three cores in mutually orthogonal directions. The cores are wrapped in copper wire. Two can be seen in this photo. The ceramic block is mounted to the base of an aluminum enclosure designed and manufactured at the Geophysical Institute. The blue-anodized aluminum cover encloses and seals the sensor block from the elements. The gold-anodized aluminum housing is mounted on a platform which can be leveled and oriented to any azimuth. The red cable attaches the sensors to the preamplifier (the black box on the table).

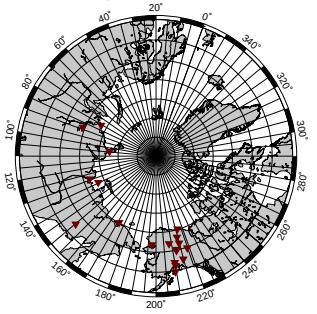
The characteristics of the Narod system are: Temperature stability: $< 0.1\mathrm{n}\mathrm{T}/^{\circ}$ (sensor); Long term drift: < 10 pT/day; Noise: 7 pT/$\sqrt{\mathrm{Hz}}$ @ 1Hz; Orthogonality error: $< 0.1^{\circ}$; Digitization: 16 bits.

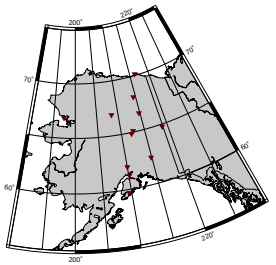
The Array

GIMA consists of 12 magnetometers currently operating (9 of which are archived daily) forming a north-south chain across Alaska. In addition, the Project for Upgrading Russian AE Stations (PURAES) dataset is processed, archived, and available with the GIMA data set. The stations locations and operational dates are described below.

Station	Geographic Latitutde	Geographic Longitude	Geomagnetic Latitude	Geomagnetic Longitude	Near Real-Time	Operational Year/Day of Year
GIMA/Arctic	68.118	214.44	68.70	269.05	no	2000/245 - 2005/160
GIMA/Bettles	66.901	208.45	66.57	256.15	no	1997/006 - 2005/280
GIMA/CIGO	64.873	212.14	65.38	261.63	yes	1999/032 - 2005/280
GIMA/Eagle	64.78	218.838	66.48	268.07	no	1995/258 - present
GIMA/FtYukon	66.56	214.78	67.37	262.27	yes	1996/337 - present
GIMA/Gakona	62.393	214.87	63.59	266.51	yes	1998/295 - present
GIMA/HLMS	61.235	210.128	61.68	262.94	yes	2004/324 - present
GIMA/Homer	59.7	209.53	60.14	263.5	yes	2004/325 - present
GIMA/Kaktovik	70.135	216.35	70.79	258.90	no	1999/013 - 2005/264
GIMA/Kodiak	57.6	207.8	57.9	263.3	yes	being installed
GIMA/Koror	73.3	134.4	63.7	196.6	no	1994/218 - 1994/365
GIMA/Kotzebue	66.85	197.39	64.66	246.70	no	1994/244 - 1996/119
GIMA/Poker	65.119	212.57	65.68	261.78	yes	2000/021 - present
GIMA/Talkeetna	62	210	62	262	no	1997/011 - 2000/019
GIMA/Trapper	62.24	209.58	62.51	261.62	yes	2004/323 - present
PURAES/Cape Chelynskin	77.7	104.3	67.5	177.8	no	2002/091 - present
PURAES/Dixon	73.5	80.6	64.0	162.5	yes	2005/222 - present
PURAES/Norilsk	69.4	88.4	59.6	166.4	no	2002/091 - present
PURAES/Pebek	70.1	170.9	63.8	223.3	no	2002/170 - present
PURAES/Tixie Bay	71.6	129.0	61.8	193.7	no	2002/170 - present

IGRF-10, 2005





Data Access

The GIMA and PURAES data sets are both available through the GIMA web at http://magnet.gi.alaska.edu/ Available data streams include one minute averaged magnetic field measurements, one second sampled magnetic field measurements, and 8 Hz sampled magnetic field measurements (not all streams are available for each station). The PURAES stations include both component magnetic field observations and absolute total field measurements. The GIMA web site has requires online registration for data retrieval. Present efforts include streamlining data access methods. We are providing code in idl, matlab, perl, and python to directly access the dataset.

Sample IDL software is shown below. `gima` is a returned structure with station information and data.

To retrieve a single station from a day:

```
IDL> mjh_retrieve_gima,year=2005,month=1,$
       day=20,station='Arctic',gima=gima
```

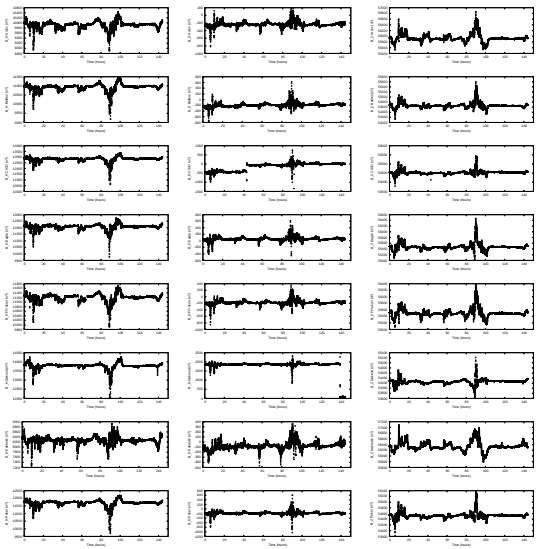
To retrieve all GIMA data from a given day:

```
IDL> mjh_retrieve_gima,year=2005,month=1,$
       day=20,gima=gima
```

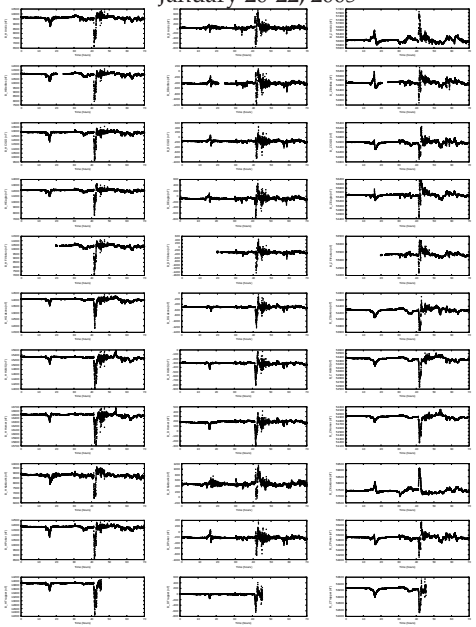
To retrieve all GIMA data for a multi-day span:

```
IDL> mjh_retrieve_gima,start_year=2002,$
       start_month=9,start_day=4,$
       stop_year=2002,stop_month=9,$
       stop_day=9,gima=gima
```

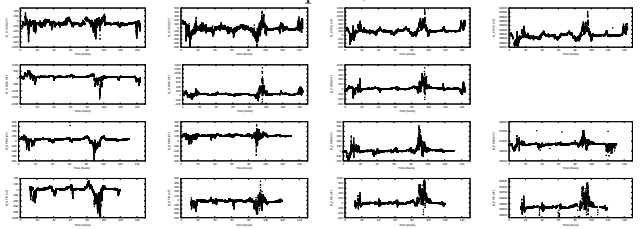
September 4-9, 2002



January 20-22, 2005



PURAES Sept 4-9, 2002



Data Samples

The new GIMA access software (perl version) was used to generated the plots showing the GIMA data archive for two GEM challenge storms (Sept 4-9, 2002 and Jan 20-22, 2005). The H, D, and Z components of the GIMA measurements are plotted. Additionally the PURAES data record for the 2002 storm is shown above. The H, D, and Z components are plotted along with F–the full scalar magnetic field. We solicit feedback on improving GIMA and PURAES data access.

Acknowledgements

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The PURAES magnetometer are operated by Arctic and Antarctic Research Institute (AARI), St. Petersburg, Russia, and data from these stations have been made available through a team effort with participants from the following organizations: World Data Center for Geomagnetism, Kyoto University (WDC Kyoto); National Institute of Information and Communications Technology (NICT), Japan; Institute for Dynamics of Geospheres (IDG), Russian Academy of Science; AARI, Russia; Geophysical Institute (GI), University of Alaska; Johns Hopkins University Applied Physics Laboratory (JHU/APL), USA.