IceBridge BGM-3 Gravimeter L1B Time-Tagged Accelerations, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Blankenship, D. D., S. D. Kempf, D. A. Young, T. G. Richter, M. J. Siegert, J. L. Roberts, T. van Ommen, and E. Lemeur. 2012, updated 2014. *IceBridge BGM-3 Gravimeter L1B Time-Tagged Accelerations, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/5CHZMTE5DLU8 [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/IGBGM1B

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

The data files are in space-delimited ASCII text format, with a header offset by # leading characters, corresponding to the NASA Aerogeophysical ASCII data standard. Each data file has an associated XML file that contains location, platform, and instrument metadata.

1.2 File and Directory Structure

Data are available via HTTPS in the https://n5eil01u.ecs.nsidc.org/ICEBRIDGE/IGBGM1B.001/ directory. Within this directory are folders organized by date, for example /2011.12.13/. Data stored in the /2008.12.31/ folder were collected as part of the 2009 campaign.

1.3 File Naming Convention

The ASCII text files are named according to the following convention and as described in Table 1:

IGBGM1B_2011346_TOT_JKB2e_X15b_accel.txt
IGBGM1B_2011346_TOT_JKB2e_X15b_accel.txt.xml
IGBGM1B_YYYYDOY_AAA_JKBnx_XXXX_accel.xxx

Table 1. Naming Convention

Variable	Description
IGBGM1B	File name prefix indicating IceBridge BGM-3 Gravimeter L1B Time-Tagged Accelerations
YYYY	Four-digit year of survey
DOY	Day of year of survey
AAA	Geographic area
JKBnx	Host platform
XXXX	Geographic track line
accel	Acceleration values
.xxx	Indicates ASCII text file (.txt), or XML file (.xml)

1.4 File Size

The data files range from approximately 16 KB to 1.5 MB. XML files range from approximately 10 KB to 56 KB.

1.5 Volume

The entire data set is approximately 204 MB.

1.6 Spatial Coverage

These data were primarily collected over the Wilkes Subglacial Basin and Aurora Subglacial Basin in East Antarctica.

Spatial coverage for this data set is Antarctica, represented by this extent:

Southernmost Latitude: 90° S

Northernmost Latitude: 53° S

Westernmost Longitude: 90° E

Easternmost Longitude: 180° E

1.6.1 Spatial Resolution

Not applicable to these raw instrument outputs.

1.6.2 Projection and Grid Description

WGS-84 ellipsoid: ITRF 2008

1.7 Temporal Coverage

These data were collected from 31 December 2008 to 24 December 2011 as part of ICECAP, NSF, NERC, and Operation IceBridge funded campaigns. Data collected in late December 2008 are part of the 2009 campaign.

1.7.1 Temporal Resolution

ICECAP campaigns were conducted on an annual basis. East Antarctic campaigns for this data set typically extend from November to early January.

1.8 Parameter or Variable

1.8.1 Parameter Description

The gravimeter L-1B time-tagged accelerations files contain the fields described in Table 2.

Table 2. File Parameter Description

Parameter	Description	Units
YEAR	Year of survey	UTC
DOY	Day of Year of survey	UTC
SOD	Second of day	UTC
SEQ	Packet sequence number	n/a
LON	Longitude	Decimal degrees WGS-84
LAT	Latitude	Decimal degrees WGS-84
AC-ELEVATION	Aircraft elevation at CG antenna	Meters WGS-84
ROLL	Roll, right wing down positive	Degrees
PITCH	Pitch, nose up positive	Degrees
HEADING	Heading, w.r.t north	Degrees
VERT_ACCELERATION	Vertical acceleration	milligals

1.8.2 Sample Data Record

A sample of the data file: IGBGM1B_2010321_ICP3_JKB2b_TF014a_accel.txt is shown in Figure 1.

```
# YEAR DOY SOD SEQ LON LAT AC_ELEVATION ROLL PITCH HEADING VERT_ACCELERATION
2010 321 83374.0841 93 166.801141 -77.880976 968.73 -8.10 4.50 161.30 985436.72850
2010 321 83375.0841 94 166.807275 -77.880356 971.51 -8.10 4.50 163.40 985611.35550
2010 321 83376.0841 95 166.810193 -77.880462 974.08 -8.90 4.70 165.80 986978.43570
2010 321 83377.0841 96 166.812205 -77.880732 978.03 -9.00 5.10 168.80 989807.39380
2010 321 83378.0841 97 166.814193 -77.881000 982.30 -8.70 5.40 171.90 993319.89200
2010 321 83379.0841 98 166.816229 -77.881258 986.37 -8.00 5.60 174.60 994951.40750
2010 321 83380.0841 99 166.818835 -77.881451 989.78 -8.60 5.60 176.60 993818.82640
2010 321 83381.0841 100 166.821547 -77.881630 992.61 -8.80 5.90 179.00 992167.35350
2010 321 83382.0841 101 166.824277 -77.881804 995.38 -7.50 5.90 -178.20 992127.43870
2010 321 83383.0841 102 166.826999 -77.881975 998.38 -6.40 5.70 -175.20 986709.01120
```

Figure 1. Sample Data Record

2 SOFTWARE AND TOOLS

2.1 Software and Tools

No special tools are required for accessing ASCII text files.

2.2 Quality Assessment

Quality depends on the flight conditions for each data transect and must be assessed on a flight by flight basis. Smooth flight with small trajectory changes will produce good data.

3 DATA ACQUISITION AND PROCESSING

3.1 Theory of Measurements

This data set has four data types:

1. Timestamps: time in UTC
2. Aircraft positions: geodetic location of the reference GPS antenna
3. Aircraft attitudes: three angles to describe the aircraft orientation in reference to direction North and the local vertical.
4. Force on a constrained vertical sensor converted to equivalent acceleration of an unconstrained mass reported as Vertical Acceleration. Vertical Acceleration is the purpose of this data set. The other fields are auxiliary data.

A sensitive accelerometer is held vertical by a 2-axis platform which counters aircraft pitch and roll. The measured force on the accelerometer is reported as the Vertical Acceleration by the device. This is the sum of gravitational force and force due to inertial accelerations in the vertical direction.

3.2 Data Acquisition Methods

The output of the gravimeter consists of accelerations measured in real time. These accelerations are recorded at a rate of 1 Hz by the external data recording system which time stamps the data as they are acquired and recorded.

3.3 Derivation Techniques and Algorithms

Raw instrument outputs are recorded with timestamps then minimally processed to convert from the native instrument output format to ASCII formatted numerical values.

3.3.1 Trajectory and Attitude Data

Trajectory and attitude data from GPS and an IMU external to the instrument are prepended to instrument data to create the data records in these files.

3.3.2 Processing Steps

The raw instrument output format is captured at 1 Hz and time stamped. The raw format is converted to ASCII numeric values and recorded. This raw numeric data consists of a value which is multiplied by a Scale Factor and added to a Bias to obtain the acceleration values in milligals, which is the value recorded in these data files. The header for each file has entries for the Scale Factor and Bias used.

The time stamps are slightly corrected by a few milliseconds to remove jitter from the acquisition system.

3.3.3 Version History

On 02 May 2012, V01 2011 Antarctica data were replaced by V01.1. In V01.1, additional fields were added containing low-precision real-time position and orientation data resampled to match the times of the existing geophysical samples.

On 26 April 2013, the 2009, 2010, and 2011 Antarctica data were replaced. The format of 2009 and 2010 Antarctica data was revised to that of the 2011 Antarctica data, ensuring the time stamps are UTC year, day, and time, and adding georeferencing fields including real time position, roll, pitch and heading. For some campaigns V01.2 includes more flights than V01.1.

3.3.4 Errors and Limitations

3.3.4.1 Instrumental Errors

The gravity instrumentation must be stabilized in temperature over a period of time related to the length of time it has been off and uncontrolled. For most of these data the instrument was well stabilized. For data from the 2010-11 season, the instrument had large issues with drift.

3.3.4.2 Environmental Conditions

The precise accelerations recorded by the gravimeter are subject to degradation by aircraft maneuvering, turbulence and shocks, and to a lesser extent, by smooth changes in altitude. The best results are from smooth, straight, level flight as can be determined by examination of the GPS trajectory.

3.4 Sensor or Instrument Description

Instrument name: Bell Aerospace (now Lockheed-Martin) BGM–3 number #203.

Type: Two–axis stabilized platform scalar gravimeter.

Resolution: 1 Hz in time.

4 REFERENCES AND RELATED PUBLICATIONS

Description of typical field use:

Richter, T. G., J. W. Holt, and D. D. Blankenship. 2001. Airborne Gravimetry Over the Antarctic Ice Sheet, International Symposium on Kinematic Systems in Geodesy, Geomatics and Navigation, (Banff), 576–585, 2001.

Description of BGM–3 gravimeter:

Bell, R. E., and A. B. Watts. 1986. Evaluation of the BGM–3 Sea Gravity Meter System on Board R/V Conrad, Geophysics, 51:1480-1493.

4.1 Related Data Collections

- IceBridge BGM-3 Gravimeter L0 Raw Accelerations
- IceBridge BGM-3 Gravimeter L2 Geolocated Free Air Anomalies
- IceBridge ZLS Dynamic Gravity Meter Time-Registered L1B Vertical Accelerations

4.2 Related Websites

- IceBridge Product Web Site
- IceBridge Web site at NASA
- ICESat/GLAS Web site at NASA Wallops Flight Facility
- ICESat/GLAS Web site at NSIDC
- University of Texas Institute for Geophysics Web site

5 CONTACTS AND ACKNOWLEDGMENTS

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Note: Data file header contains personnel information for each transect.

5.2 Acknowledgments

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6 DOCUMENT INFORMATION

6.1 Publication Date

10 June 2014

6.2 Date Last Updated

29 September 2020