



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

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## USER GUIDE

### How to Cite These Data

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

Blankenship, D. D., Kempf, S. D., Young, D. A., Richter, T. G., Siegert, M. J., Roberts, J. L., van Ommen, T., & Lemeur, E. (2012, updated 2014). *IceBridge BGM-3 Gravimeter L1B Time-Tagged Accelerations* (IGBGM1B, Version 1) [Data set]. 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](mailto:NSIDC@NSIDC.ORG)

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



National Snow and Ice Data Center

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# 1 DATA DESCRIPTION

## 1.1 Summary

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This data set contains vertical acceleration values for Antarctica using the BGM-3 Gravimeter. The data were collected by scientists working on the International Collaborative Exploration of the Cryosphere through Airborne Profiling (ICECAP) project, which is funded by the National Science Foundation (NSF) and the Natural Environment Research Council (NERC) with additional support from NASA Operation IceBridge.

## 1.2 Format

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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.

## 1.3 File Naming Convention

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

IGBGM1B\_YYYYDOY\_AAA\_JKBnx\_XXXX\_accel.xxx

IGBGM1B\_2011346\_TOT\_JKB2e\_X15b\_accel.txt

IGBGM1B\_2011346\_TOT\_JKB2e\_X15b\_accel.txt.xml

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

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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

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The entire data set is approximately 204 MB.

## 1.6 Spatial Coverage

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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

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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

## 1.9 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.

## 2 DATA ACQUISITION AND PROCESSING

### 2.1 Theory of Measurements

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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.

### 2.2 Data Acquisition Methods

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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.

### 2.3 Derivation Techniques and Algorithms

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

#### 2.3.1 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.

#### 2.3.2 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 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.

## 4 ERRORS AND LIMITATIONS

### 4.1 Instrumental Errors

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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.

### 4.2 Environmental Conditions

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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.

### 4.3 Sensor or Instrument Description

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

**Type:** Two-axis stabilized platform scalar gravimeter.

**Resolution:** 1 Hz in time.

## 5 REFERENCES

**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.

## 5.1 Related Data Collections

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- [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](#)

## 6 ACKNOWLEDGMENTS

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## 7 DOCUMENT INFORMATION

### 7.1 Publication Date

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June 2014

### 7.2 Date Last Updated

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March 2025