IceBridge ZLS Dynamic Gravity Meter Time-Registered L1B Vertical 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., Young, D. A., & Richter, T. G. (2012, updated 2013). *IceBridge ZLS Dynamic Gravity Meter Time-Registered L1B Vertical Accelerations* (IGZLS1B, Version 1) [Data set]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/XASIHXV1V5B5 [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/IGZLS1B

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DATA DESCRIPTION

1.1 Summary

This data set contains vertical, cross body, and along body acceleration values for geophysical survey flights in Antarctica using the ZLS Dynamic Gravity Meter. The data were collected by scientists working on the International Collaborative Exploration of the Cryosphere through Airborne Profiling (ICECAP) project, which was funded by the National Science Foundation (NSF), the Antarctic Climate and Ecosystems Collaborative Research Center, and the Natural Environment Research Council (NERC) with additional support from NASA Operation IceBridge.

1.2 Format

The data files are in space-delimited ASCII text format. Each data file is paired with an associated XML file. The XML files contain location, platform, and instrument metadata.

1.3 File Naming Convention

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

```
IGZLS1B_YYYYDOY_PPP_JKB5c_TTTT_accel.xxx
IGZLS1B_2011354_ICP4_JKB5c_F22T02a_accel.txt
IGZLS1B_2011354_ICP4_JKB5c_F22T02a_accel.txt.xml
```

Table 1. Naming Convention

Variable	Description
IGZLS1B	Short name for IceBridge ZLS Dynamic Gravity Meter Time-Registered L1B Vertical Accelerations
YYYY	Four-digit year of survey
DOY	Day of year of survey
PPP	Geographic area (Project)
JKB5c	Host platform for timing (System)
TTTT	Transect name within Project
accel	acceleration
xxx	Indicates ASCII text file .txt, or or XML file .xml

1.4 File Size

The ASCII data files range from approximately 46 KB to 1.7 MB.
The XML files range from approximately 10 KB to 35 KB.

1.5 Volume

The entire data set is approximately 29 MB.

1.6 Spatial Coverage

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

Southernmost Latitude: 90° S
Northernmost Latitude: 53° S
Westernmost Longitude: 180° W
Easternmost Longitude: 180° E

1.6.1 Spatial Resolution

The instrument data rate of 1 Hz produced a data packet of approximately 90 m each during flight for the raw data set. However, filtering during post processing will result in an effective resolution in the final result of 5 to 10 km.

1.6.2 Projection and Grid Description

WGS-84

1.7 Temporal Coverage

These data were collected as part of ICECAP, NSF, NERC, and Operation IceBridge funded campaigns from 29 November 2011 to 21 December 2011.

1.7.1 Temporal Resolution

This data set was collected during the November/December 2011 season of ICECAP/IceBridge. Similar data was collected by other instruments during other expeditions but this was a one-season use for this type instrument and these projects.

1.8 Parameter or Variable

1.8.1 Parameter Description

The data files contain fields as described in Table 2.

Table 2. File Parameter Description

Parameter	Units
Year	UTC
Day of Year	UTC
Second of day	UTC
Packet sequence number	n/a
Longitude	Decimal degrees, WGS-84
Latitude	Decimal degrees, WGS-84
Aircraft elevation at CG antenna	Meters; WGS-84
Roll (right wing down positive)	Degrees
Pitch (nose up positive)	Degrees
Heading (with respect to north)	Degrees
Vertical acceleration - 60 second RC filter for QC only	milliGals
Spring tension- proportional to course gravity	counter units
Beam position (beam velocity is proportional to high frequency gravity)	milliVolts
Cross coupling - accounts for transfer of sensor dynamics to gravity signal	milliVolts
Cross body acceleration from platform accelerometers	milliGals using 25.8 scaling from mV
Along body acceleration from platform accelerometers	milliGals using 26.2 scaling from mV
XACC2 cross coupling due to platform leveling errors: Cross body acceleration^2	milliVolts^2
LACC2 cross coupling due to platform leveling errors: Along body acceleration^2	milliVolts^2
VE cross coupling due to damping non-linearity: Beam velocity^2	milliVolts^2
VCC cross coupling due to inherent cross coupling: along body acceleration * beam position	milliVolts
AX cross coupling due to imperfect coupling: cross body acceleration * beam velocity	milliVolts
AL cross coupling due to imperfect coupling: along body acceleration * beam velocity	milliVolts

AX2 cross coupling due to 2nd order imperfect coupling: cross body acceleration^2 * beam velocity	milliVolts
Index for platform period (1=16 minutes; 25=4 minutes; 100=2 minutes)	minutes

Note: Positions are interpolated from the real time GPS feed and have an accuracy of several meters

1.8.2 Sample Data Record

Shown below are the first five records from the data file:

`IGZLS1B_2011354_ICP4_JKB5c_F22T02a_accel.txt`

```
2011 354 84684.2932 9407 136.860 -73.035 3163.760 -5.800 5.900 226.700 981859.550 12177.280 6.100 0.070 18713.600 5423.400 360.000 29.000
0.000 1.000 3.000 1.000 2.000 8.000
2011 354 84685.2928 9408 136.857 -73.035 3163.660 -5.700 5.900 226.900 981859.550 12177.280 7.000 0.010 12518.400 5895.000 169.000 35.000
0.000 1.000 -1.000 -1.000 -1.000 8.000
2011 354 84686.2929 9409 136.854 -73.036 3163.640 -5.500 5.900 227.200 981859.550 12177.280 12.800 0.020 10803.200 4820.800 124.000 23.000
0.000 0.000 1.000 0.000 0.000 8.000
2011 354 84687.2928 9410 136.852 -73.036 3163.870 -5.400 5.800 227.800 981859.550 12177.280 12.200 0.000 10009.600 5135.200 104.000 26.000
0.000 1.000 -1.000 -1.000 0.000 8.000
2011 354 84688.2931 9411 136.849 -73.036 3164.040 -5.200 5.800 228.500 981859.550 12177.280 12.300 0.020 11340.800 5554.400 133.000 31.000
0.000 1.000 0.000 0.000 0.000 8.000
```

Figure 1. Sample Data Record

2 DATA ACQUISITION AND PROCESSING

2.1 Theory of Measurements

The ZLS Dynamic Gravimeter used for this data set uses a proof mass (beam) suspended by a highly damped mechanical spring as the sensitive vertical acceleration sensor mounted aboard a two axis gyroscopically stabilized platform. Accelerations of the mass are measured via monitoring of spring tension and beam velocity. Further description of this instrument is available in Vallient (1992).

2.2 Data Acquisition Methods

The ZLS instrument was installed and operated according to the instrument manuals (see Section 3 for the reference). The instrument real time (ASCII) data output was recorded to a central data acquisition system (JKB5c) which provided GPS referenced time stamps for each data packet. This was separate from the acquisition system (JKB2e) used for most other instruments during the 2011 field season.

2.3 Derivation Techniques and Algorithms

Raw instrument outputs are recorded with timestamps. Externally provided position and attitude data was prepended to each data packet. No further processing was performed on these data.

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

No processing was done on the instrument output.

2.3.3 Errors and Limitations

Data quality is degraded by aircraft maneuvers beyond straight and level flight. Data in actual aircraft turns is unusable.

This data set contains instances where the Spring Tension (entry 12 in the data packet) was incorrectly recorded by the instrument, leading to significant biases, but no higher frequency errors, in the calculated instrument acceleration unless corrected in post processing. These instances are randomly distributed in the data.

2.4 Sensor or Instrument Description

The instrument used was the ZLS Dynamic Gravimeter serial number S-83 with the UltraSys control system. This is based on the LaCoste and Romberg Air/Sea Gravity Meter with a control system upgrade. The system was loaned to the ICECAP project by the British Antarctic Survey (BAS) as a backup to the primary BGM-3 gravity meter for the 2011 field season. As adequate gravity data was obtained from the BGM-3 (see IGBGM1B and IGBGM2), no Level-2 ZLS gravity data has been generated from the IGZLS1B data set. Gravity data from this sensor has been released for BAS field seasons and are available from the Polar Airborne Geophysics Data Portal.

3 VERSION HISTORY

On 1 May 2013, V01 2011 Antarctica data were replaced by V1.1. In V1.1, additional fields were added containing real-time position and orientation data. V1.1 does not include data for 15 December 2011 and 20 December 2011.

4 REFERENCES

UltraSys User's Guide, ZLS Corporation, Rev: 3.09.1 2011/03/18

Vallient, H. D. 1992, The LaCoste & Romberg Air/Sea Gravity Meter: An Overview, in CRC Handbook of Geophysical Exploration at Sea: Hydrocarbons, edited by R. A. Geyer, 2nd ed., chap. 7:141-176.

4.1 Related Data Collections

- IceBridge BGM-3 Gravimeter L0 Raw Accelerations
- IceBridge BGM-3 Gravimeter L1B Time-Tagged Accelerations
- IceBridge BGM-3 Gravimeter L2 Geolocated Free Air Anomalies
- IceBridge CMG 1A Dynamic Gravity Meter Time-Tagged L1B Vertical Accelerations
- IceBridge CMG GT-1A Gravimeter L2 Geolocated Free Air Gravity Disturbances

5 ACKNOWLEDGMENTS

NASA ICEBRIDGE (NNX11AD33G); AAD Project 3103; ICEGRAV. Funding: NASA's Operation Ice Bridge (grant NNX11AD33G) to the University of Texas at Austin. The ZLS gravity meter was provided on loan by the British Antarctic Survey.

6 DOCUMENT INFORMATION

6.1 Publication Date

February 2015

6.2 Date Last Updated

March 2025