



# IceBridge CAMBOT L1B Geolocated Images, 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:

Studinger, M. 2010, updated 2017. *IceBridge CAMBOT L1B Geolocated Images, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/FC93UWYQA1D8>. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT [NSIDC@NSIDC.ORG](mailto:NSIDC@NSIDC.ORG)

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/IOCAM1B>



National Snow and Ice Data Center

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# 1 DETAILED DATA DESCRIPTION

This data set contains images taken with the Continuous Airborne Mapping By Optical Translator (CAMBOT) over Antarctica and Greenland.

Files include JPG images (.JPG), browse images (.png), XML files (.xml), and ASCII text files (.txt).

Each image file is paired with an associated ASCII text file and an XML file. Text files include related georeferencing information, including timestamp, lat/long degrees, altitude, and aircraft attitude. The XML files contain location, platform, and instrument metadata.

## 1.1 Format

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IceBridge CAMBOT Level-1B Geolocated Images data set files are in JPEG (.jpg), PNG (.png), XML (.xml), and ASCII (.txt) fixed-field format.

## 1.2 File Naming Convention

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Example file name:

IOCAM1B\_2013\_GR\_NASA\_20130426\_IMG\_00001.JPG

Files are named according to the following convention, which is described in more detail in Table 1:

IOCAM1B\_YYYY\_LO\_NASA\_yyyymmdd\_IMG\_nnnnn.xxx

Table 1. File Naming Convention

Variable	Description
IOCAM1B	File name prefix indicating CAMBOT Level-1B data
YYYY_LO_NASA	NASA campaign year and name. LO = location, where AN = Antarctica, and GR = Greenland Example: 2013_AN_NASA
yyyyymmdd	Year, month, and day of image capture
IMG	Image
nnnnn	Sequence number of image captured
xxx	File type: .JPG, .png, .txt, or .xml

## 1.3 Spatial Coverage

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Spatial coverage for the IceBridge CAMBOT campaigns includes Greenland and Antarctica. In effect, this represents the coverage noted below.

Greenland:

Southernmost Latitude: 60° N

Northernmost Latitude: 90° N

Westernmost Longitude: 180° W

Easternmost Longitude: 180° E

Antarctica:

Southernmost Latitude: 90° S

Northernmost Latitude: 53° S

Westernmost Longitude: 180° W

Easternmost Longitude: 180° E

### 1.3.1 Spatial Resolution

The image files are 3888 pixels width by 2592 pixels height for 2010 and 2011 campaigns, and 2816 pixels width by 1880 pixels height for 2009 campaigns. At 450 m above the ground, each pixel represents 13 cm by 13 cm on the ground. The image footprint at 450 m instrument altitude is 500 m along track by 300 m across track.

### 1.3.2 Projection and Grid Description

No projection. Data are georeferenced as a series of camera locations: latitude, longitude, elevation and altitude above ground (WGS 84 Datum) and aircraft orientation roll, pitch, and heading.

## 1.4 Temporal Coverage

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These data were collected as part of Operation IceBridge funded campaigns from 31 March 2009 to 26 April 2013.

On 09 April 2011 and 04 May 2011 the aircraft flew calibration flights. No ATM LIDAR science data are provided for these two days in the [IceBridge ATM L1B Qfit Elevation and Return Strength](#) data set, but CAMBOT images were captured for both days and are included in this data set.

During the IceBridge 2011 Greenland campaign, the CAMBOT instrument had a shutter failure on 10 May 2011, so there are no CAMBOT data files for the remaining four flights after that date.

### 1.4.1 Temporal Resolution

IceBridge campaigns are conducted on an annual repeating basis. Arctic and Greenland campaigns are conducted during March, April, and May, and Antarctic campaigns are conducted during October and November.

## 1.5 Parameter or Variable

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The image below is an excerpt from the 14 April 2010 Greenland image file

IOCAM1B\_2010\_GR\_NASA\_20100414\_IMG\_03539.JPG.

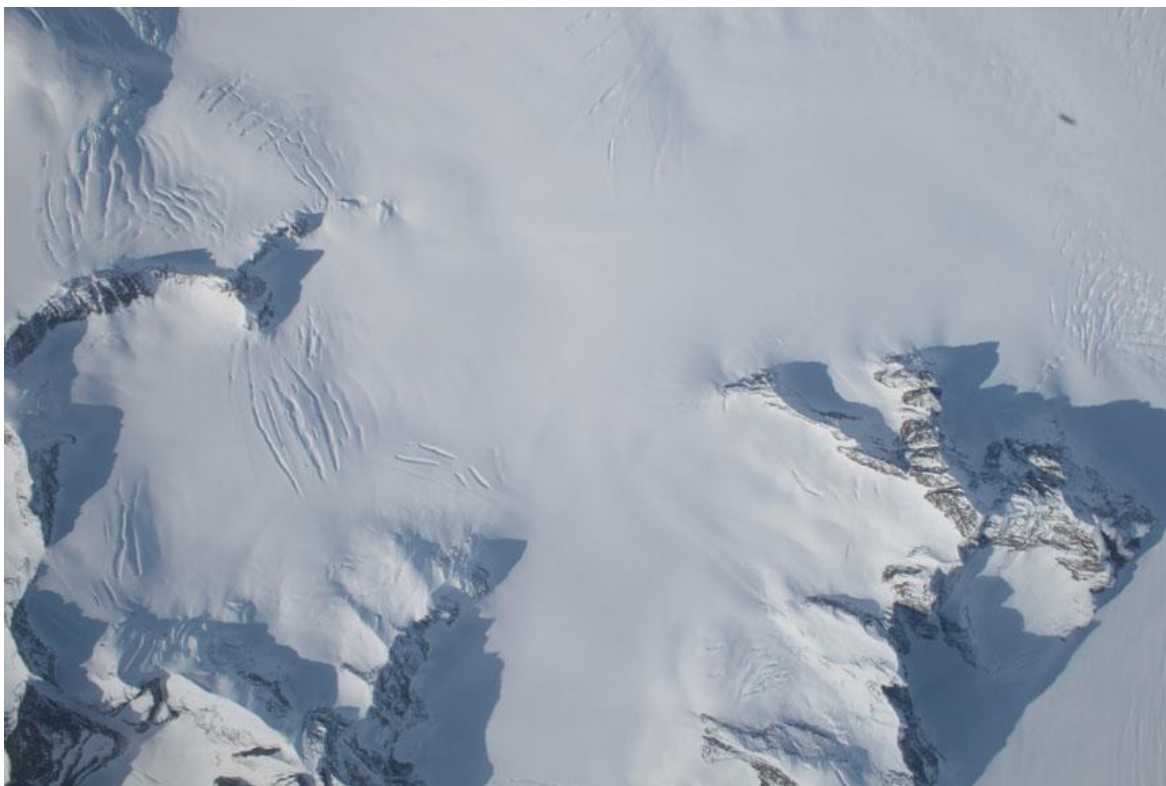


Figure 1. Excerpt image from file IOCAM1B\_2010\_GR\_NASA\_20100414\_IMG\_03539.JPG

## 2 SOFTWARE AND TOOLS

The image files may be opened by any image display program capable of reading JPEG and PNG files. The ASCII fixed-field files may be opened by any text editor or word processing program that reads ASCII text files.

## 3 DATA ACQUISITION AND PROCESSING

### 3.1 Theory of Measurements

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CAMBOT is a digital image acquisition system that supports analysis of laser altimeter data from the Airborne Topographic Mapper (ATM). The image provides a qualitative high-resolution assessment of the surface structure and lower atmosphere conditions sensed by the ATM. As a passive instrument, using sunlight is the source of illumination, CAMBOT has some limitation, such as shadows, daytime-only operation, and reduced data value under high-cloud or low mist conditions. However, the images are a very high-resolution record of ice structures, nunataks, snow, crevasses, sastrugi, leads and sea ice type.

### 3.2 Data Acquisition Methods

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The CAMBOT system takes down-looking images from an aircraft, which are logged directly to a Mac mini data computer. When the acquisition software is started on the data computer, it verifies that an appropriate camera is powered up and connected via USB. Then, the acquisition software sends a set of default camera settings to the camera for initialization. At this point, the system operates in standby mode until the operator clicks on the Start button to begin acquisition. When the Start button is pressed, a directory is made for the current day (of the form YYYYMMDD) in the home directory. Next, a subdirectory is created for this specific CAMBOT recording session (of the form YYYYMMDD\_HHNN). Finally, the software sends a trigger to the camera to capture an image. Once captured, the image is immediately transferred back to the data computer and stored in the session subdirectory. The acquisition software sends the image capture signal every four seconds by default, which can be modified in the software settings. During the acquisition, a log file is generated which records a local timestamp based on computer time for the following events:

- Timestamp when capture signal is sent to camera
- Timestamp when image transfer to computer begins
- Timestamp when image transfer to computer ends

### 3.3 Derivation Techniques and Algorithms

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The CAMBOT files are created during processing of the ATM laser data and are useful for interpreting the nadir-viewing LIDAR. There is little to no image processing or image data manipulation applied outside of what the Canon Rebel XTi camera does during acquisition of an image and conversion to the JPEG and PNG distribution formats.

### 3.3.1 Processing Steps

The following processing steps are performed by the data provider for each flight.

1. Assemble the Applanix trajectory and .cam files for the flight into the corresponding CAMBOT data directory. Prepare the .cam files by concatenating all the .cam files into a single file and filtering the resulting files to remove outliers.
2. Create a picture.txt file to assign each raw CAMBOT JPG with a relative timestamp determined by the data computer which recorded the images, which is extracted from the cambot.log file created during acquisition.
3. Correct the relative UTC timestamps to corrected timestamps in the GPS time standard. This is accomplished by applying a single offset to all of the image timestamps in a single flight. This offset is nominally the offset between UTC and GPS time, but can drift day-to-day if the local data computer time is not synchronized to UTC each day.
4. Interpolate the attitude pitch, roll, and heading information from the Applanix trajectory to match the timestamps of the CAMBOT images. Interpolate the positional information (latitude, longitude, altitude, altitude-above-ground) from the filtered .cam file. Create a gps.txt file which contains the image filename, GPS timestamp, aircraft positional information including latitude, longitude, ellipsoid altitude, altitude-above-ground, and attitude information including roll, pitch, heading.
5. Calculate the rotation of the image relative to true north using the heading information of the aircraft, rotate the image, and save a reduced-resolution copy of the resulting image as a transparent PNG.
6. Create a Google Earth KML file to overlay the rotated reduced-resolution images with the proper location and size onto the Google Earth model.

### 3.3.2 Error Sources

During the IceBridge 2011 Greenland campaign, the CAMBOT instrument had a shutter failure on 10 May 2011, so there are no CAMBOT data files for the remaining four flights after that date.

During the 2012 Greenland campaign, the CAMBOT camera failed shortly before Barrow on 14 March 2012. There was no spare on board due to weight constraints. The backup CAMBOT system was installed prior to the 21 March 2012 flight. Thus, no image data are available for 15 through 19 March 2012.

### 3.3.3 Sensor or Instrument Description

The CAMBOT system is comprised of a Canon Rebel XTi (or alternatively the XSi model) camera and a Mac mini running custom data acquisition software. The camera is powered with an AC power adapter and connected to the Mac mini via USB. The camera is outfitted with a Canon Zoom EF-S 18-55 mm lens. The CAMBOT system was generally operated to acquire one image every four seconds.

## 4 REFERENCES AND RELATED PUBLICATIONS

### 4.1 Related Data Collections

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[IceBridge ATM L1B Qfit Elevation and Return Strength](#)

[IceBridge DMS L1B Geolocated and Orthorectified Images](#)

[IceBridge DMS L0 Raw Imagery](#)

### 4.2 Related Websites

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[IceBridge data website at NSIDC](#)

[IceBridge website at NASA](#)

[ICESat/GLAS website at NASA Wallops Flight Facility](#)

[ICESat/GLAS website at NSIDC](#)

## 5 CONTACTS AND ACKNOWLEDGEMENTS

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## 6 DOCUMENT INFORMATION

### 6.1 Publication Date

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January 2012

### 6.2 Date Last Updated

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