



LVIS L1A Geotagged Images, Version 1

USER GUIDE

How to Cite These Data

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

Blair, J. B. and M. Hofton. 2020. *LVIS L1A Geotagged Images, Version 1*. [Indicate subset used].

Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center.

<https://doi.org/10.5067/NE5KKKBAQG44>. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/OLVIS1A>



National Snow and Ice Data Center

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1 DATA DESCRIPTION

NASA's LVIS Facility collects airborne lidar and digital camera imagery from medium and high-altitude research aircraft. The digital camera images in this Level-1A data product were collected by two airborne cameras mounted alongside two LVIS Facility Instruments (LVIS-C and LVIS-F). The two cameras were operated during flights to support either the Global Ecosystem Dynamics Investigation (GEDI) mission or NASA's Terrestrial Ecology Program Arctic-Boreal Vulnerability Experiment (ABoVE) campaign.

Additional data are available from annual Engineering Check Flights of the LVIS instrument flown in the United States on 07 November 2018 and 31 January 2019 out of NASA's Langley Research Center in Hampton, VA. Check flights were conducted over sites in Maryland, Virginia, and North Carolina.

Related Level-1B data sets include *LVIS Classic L1B Geolocated Return Energy Waveforms* and *LVIS Facility L1B Geolocated Return Energy Waveforms*, which contain the geolocated laser waveform data for each laser footprint collected by the LVIS instrumentation; related Level-2 data sets include *LVIS Classic L2 Geolocated Surface Elevation and Canopy Height Product* and *LVIS Facility L2 Geolocated Surface Elevation and Canopy Height Product*, which contain canopy top elevations, ground elevations, and relative heights derived from the Level-1B data.

1.1 Parameters

The data files include images of various terrains, such as tundra, forests, permafrost, lakes, and volcanoes.

1.2 File Information

1.2.1 Format

The data files are provided in JPEG (.JPG) format. Some images are also captured in the native CR2 (Canon Raw Version 2) format. Each data file is paired with an associated XML file (.xml), which contains additional metadata.

1.2.2 File Contents

Figure 1 shows an example image from the file OLVIS1A_CAM1_ABoVE2019_0807_R2006_089242.JPG.



Figure 1. Sample image of coastline.

1.2.3 Naming Convention

Example file names:

OLVIS1A_CAM1_ABoVE2019_0801_R2009_075772.JPG
 OLVIS1A_CAM1_ABoVE2019_0801_R2009_075772.JPG.xml

OLVIS1A_CAM2_GEDI2019_0524_R2005_069442.JPG
 OLVIS1A_CAM2_GEDI2019_0524_R2005_069442.JPG.xml

OLVIS1A_CAM1_US2018_1107_R2011_055445.JPG
 OLVIS1A_CAM1_US2018_1107_R2011_055445.JPG.xml

The files are named according to the following convention, which is described in more detail in Table 1.

OLVIS1A_CAMERA_CAMPAIGNYYYY_MMDD_RYYMM_nnnnnn.ext

Table 1. File Naming Convention

Variable	Description
OLVIS1A	Data set ID
CAMERA	Indicates which camera was used: CAM1 or CAM2

Variable	Description
CAMPAIGNYYYY	Campaign identifier: ABoVE = Arctic-Boreal Vulnerability Experiment; GEDI = Global Ecosystem Dynamics Investigation; US = Engineering Check Flights; YYYY= four-digit year of campaign
MMDD	Two-digit month and two-digit day of start of data collection
RYYMM	Date (two-digit year, two-digit month) of data production
nnnnnn	Number of seconds since GPS midnight of the day on which data collection started
ext	File type: <ul style="list-style-type: none"> • .JPG (JPG data file) or .CR2 (Canon Raw Version 2 data file) • .JPG.xml (XML metadata file)

1.3 Spatial Information

1.3.1 Coverage

The data set covers various regions in the United States, Western Canada, and Central America, as outlined by the spatial extents below:

Northernmost latitude: 72° N
Southernmost latitude: 9° N
Westernmost longitude: 168° W
Easternmost longitude: 75° W

1.3.2 Resolution

Spatial resolution varies with aircraft altitude. At a nominal flight altitude of 41,000 ft, the nominal spatial resolution is 4.2 km by 2.8 km (0.5 m/pixel) for Camera 1 and 3.3 km by 4.9 km (0.6 m/pixel) for Camera 2.

1.3.3 Geolocation

International Terrestrial Reference Frame 2008 (ITRF08), WGS-84 ellipsoid

1.4 Temporal Information

1.4.1 Coverage

7 November 2018 to 08 August 2019

1.4.2 Resolution

For full lists of the flight dates and general locations of the 2019 ABoVE and GEDI data flights, visit the [ABoVE 2019 LVIS](#) and the [GEDI 2019 LVIS](#) web pages at NASA Goddard Space Flight Center.

2 DATA ACQUISITION AND PROCESSING

2.1 Instrumentation

The images provided in this data set were taken with two downward-facing (nadir) Canon EOS 5DS R cameras. Camera 1 was mounted next to the LVIS-Facility instrumentation, with a Carl Zeiss Makro-Planar T*100mm f/2 ZE lens, an image resolution of 8688px by 5792px, and a nominal frame overlap of 80%. Camera 2 was mounted next to the LVIS-Classic instrumentation, with a Carl Zeiss Planar T* 85mm f/1.4 ZE lens, an image resolution of 5792px by 8688px, and a nominal frame overlap of 80%.

2.2 Acquisition and Processing

Imagery is stored via Ethernet on a supporting computer running the Canon EOS camera utility software to monitor and control image exposure. Frame capture is controlled using an external intervalometer. The intervalometer provides a Transistor-Transistor-Logic (TTL) pulse to the navigation system, which enables precise timing, positioning, and attitude for each image capture.

Images are acquired at 4- or 5-second intervals, depending on the ground speed of the aircraft. The image name contains the acquisition time in number of seconds since GPS midnight of the day on which data collection started. The Exif data of each image are edited to provide the precise time of acquisition, as well as position and orientation of the camera at time of acquisition; this includes GPSTimeStamp, GPSLatitude, GPSLongitude, GPSAltitude, GPSRoll, GPSPitch, and GPSImgDirection.

2.3 Quality, Errors, and Limitations

For all LVIS Camera images, the last six numbers in the file name refer to the time at which the picture was taken, indicating the number of seconds past GPS midnight on the day the data collection started. This information can also be found in the Exif data for each file under the "GPS Date/Time" field. Due to a formatting error, a 1-second offset may exist in the image collection time contained in the Exif "GPS Date/Time" field. The affected flights are listed below. For images from these flights, the collection time contained in the file name should be used, or one second should be added to the time contained in the Exif "GPS Date/Time" field.

GEDI 2019-05-21 Camera 2
GEDI 2019-05-23 Camera 1
GEDI 2019-05-24 Camera 1 and Camera 2
GEDI 2019-05-29 Camera 1 and Camera 2
ABoVE 2019-07-12 Camera 1 and Camera 2
ABoVE 2019-07-22 Camera 1 and Camera 2
ABoVE 2019-07-23 Camera 1
ABoVE 2019-07-25 Camera 1 and Camera 2
ABoVE 2019-07-27 Camera 1 and Camera 2
ABoVE 2019-07-28 Camera 1 and Camera 2
ABoVE 2019-07-31 Camera 1 and Camera 2

3 SOFTWARE AND TOOLS

The data files can be viewed using any software that recognizes the JPG format. Frame ID markers in KMZ format are available for both cameras at the [ABoVE 2019 LVIS](#) and the [GEDI 2019 LVIS](#) web pages at NASA Goddard Space Flight Center (requires Google Earth to view KMZ files).

4 RELATED DATA SETS

[LVIS Classic L1B Geolocated Return Energy Waveforms](#)
[LVIS Classic L2 Geolocated Surface Elevation and Canopy Height Product](#)
[LVIS Facility L1B Geolocated Return Energy Waveforms](#)
[LVIS Facility L2 Geolocated Surface Elevation and Canopy Height Product](#)

5 RELATED WEBSITES

[LVIS data product website at NSIDC](#)
[LVIS web page at NASA Goddard Space Flight Center](#)
[ABoVE 2019 LVIS web page at NASA Goddard Space Flight Center](#)
[GEDI 2019 LVIS web page at NASA Goddard Space Flight Center](#)
[ABoVE web page at NASA](#)
[GEDI website](#)

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7 ACKNOWLEDGMENTS

This work was supported through funding from Hank Margolis (NASA - SMD - ESD Terrestrial Ecology).

8 DOCUMENT INFORMATION

8.1 Publication Date

November 2020

8.2 Date Last Updated

February 2021