# ICESAT/GLAS
# Science Computing Facility

# Introduction to GLAS Data

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## Section 1: Introduction

This document was written to give an introductory overview of the GLAS data product files and available resources to understand them so newcomers can better understand how the data are organized and how to access them.

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## Section 3: Product Descriptions

### Altimetry Products

GLA01: Level 1a, ¼ rev, Global altimeter telemetry reformatted and calibrated
GLA05: Level 1b, ¼ rev, Global altimeter waveform return parameterization
GLA06: Level 1b, ¼ rev, Global elevations, roughness, and geodetic corrections
GLA12: Level 2, 14 rev, Regional ice sheet elevations
GLA13: Level 2, 14 rev, Regional sea ice roughness and freeboard
GLA14: Level 2, 14 rev, Regional land elevations
GLA15: Level 2, 14 rev, Regional ocean elevations

### LIDAR Products

GLA02: Level 1a, 2 rev, LIDAR telemetry reformatted and calibrated
GLA07: Level 1b, 2 rev, Calibrated, attenuated backscatter profiles
GLA08: Level 2, 14 rev, Boundary layer and aerosol layer heights
GLA09: Level 2, 14 rev, Cloud layer heights
GLA10: Level 2, 14 rev, Cloud and aerosol backscatter and extinction cross section profiles
GLA11: Level 2, 14 rev, Optical depths

### Other Products

GLA03: Level 1a, 2 rev, Engineering data
GLA04: Level 1a, 2 rev, Position and attitude data

### Record Output

Products GLA01-7, 12-15: records are output at once per sec.
Products GLA08-11: records are output at once every 4 sec.

**Note**:
A file is sometimes called a “granule”.

## Section 4: Laser Campaigns

To measure icecap seasonal elevation variability while extending laser life, the GLAS laser is turned on to collect data for two to three “laser campaigns” per year. Each campaign is approximately one month long to correspond with the 33-day sub-cycle of the 91-day repeat orbit. Below is a table with basic statistics for each campaign:

| | Mode | Repeat | Start date | Start Pass ID | End Date | End Pass ID |
|---|---|---|---|---|---|---|
| L1a | sail/air | 8-day | 2003-02-20 | 1102_001_0072 | 2003-03-29 | 1102_006_0023 |
| L2a | sailboat | 8/91-day | 2003-09-25 | 1102_028_0088 | 2003-11-19 | 2103_002_0421 |
| L2b | sailboat | 91-day | 2004-02-17 | 2107_001_1284 | 2004-03-21 | 2107_002_0421 |
| L2c | airplane | 91-day | 2004-05-18 | 2107_002_1283 | 2004-06-21 | 2107_003_0434 |
| L3a | sailboat | 91-day | 2004-10-03 | 2109_001_1273 | 2004-11-08 | 2109_002_0452 |
| L3b | sailboat | 91-day | 2005-02-17 | 2111_001_1258 | 2005-03-24 | 2111_002_0426 |
| L3c | airplane | 91-day | 2005-05-20 | 2111_002_1275 | 2005-06-23 | 2111_003_0421 |
| L3d | sailboat | 91-day | 2005-10-21 | 2113_001_1282 | 2005-11-24 | 2113_002_0421 |
| L3e | sailboat | 91-day | 2006-02-22 | 2115_001_1283 | 2006-03-28 | 2115_002_0424 |
| L3f | airplane | 91-day | 2006-05-24 | 2115_002_1283 | 2006-06-26 | 2115_003_0421 |
| L3g | sailboat | 91-day | 2006-10-25 | 2117_001_1283 | 2006-11-27 | 2117_002_0423 |
| L3h | sailboat | 91-day | 2007-03-12 | 2119_001_1279 | 2007-04-14 | 2119_002_0426 |
| L3i | sailboat | 91-day | 2007-10-02 | 2121_001_1280 | 2007-11-05 | 2121_002_0421 |
| L3j | sailboat | 91-day | 2008-02-17 | 2123_001_1282 | 2008-03-21 | 2123_002_0422 |
| L3k | airplane | 91-day | 2008-10-04 | 2125_001_1283 | 2008-10-19 | 2125_002_0145 |
| L2d | sailboat | 91-day | 2008-11-25 | 2127_001_0096 | 2008-12-17 | 2127_001_0423 |
| L2e | sailboat | 91-day | 2009-03-09 | 2129_001_1286 | 2009-04-11 | 2129_002_0424 |
| L2f | airplane | 91-day | 2009-09-30 | 2131_001_1280 | 2009-10-11 | 2131_002_0084 |

- For more information, refer to the “Instrument Updates” table under “Instrument Updates” or to the “Borg Data Assimilation Tables” under “Data Tables” on the SCF website.

## Section 5: Data Directories

The GLAS data products can be accessed directly by those who have accounts on the system, glas-scf.gsfc.nasa.gov. The data reside in campaign-named subdirectories under two directory structures:

- /SCF/product_sets/mscf/current – contains the latest release of data
- /SCF/product_sets/mscf/previous – contains the next to last release of data

The subdirectories beneath these directory structures look like this:

L1A L2A L2B L2C L2D L2E L2F L3A L3B L3C L3D L3E L3F L3G L3H L3I L3J L3K

To see which release of data are in a subdirectory, you can either list the data directly or view the “SCF Release Table” under “Data Tables” on the SCF website.

## Section 6: MSCF File Naming Convention

This is how the GLAS data products are named by the I-SIPS and stored at the main SCF:

GLAxx_ymm_prkk_ccc_tttt_s_nn_ffff. Pnnnn

Where:

- xx - GLAS data product number (1-15)
- y - "Y" code that indicates calibration levels of POD and PAD. Refer to the "YXX Release Number Convention Document" under "Documentation" on the SCF website for details.
- mm - Release number for GSAS version that created the product.
- p - Repeat ground track phase
- r - Reference orbit number
- kk - Instance # incremented every time ICESat enters a different reference orbit
- ccc - Cycle (000-999)
- tttt - Track (0000-2600)
- s - Segment, (0=none, 1-4 correspond to 50° lat/lon breaks)
- nn - File version number starting at 01
- ffff - Multi-file granule number (GLA04 only)
- Pnnnn - Unique 14 rev product set ID number, PID

Notes:

- The product set ID (PID) is the same for each file within the same 14 revs. The product sets contain tracks 1-14, 15-28, etc.

- Products GLA01, 5, and 6 contain 1/4 rev of data in each file and therefore files are named with every track starting with track 1. They are also broken into ¼ rev segments.

For example:
GLA01_028_2119_002_0009_1_01_0001.P1465
GLA01_028_2119_002_0009_2_01_0001.P1465
GLA01_028_2119_002_0009_3_01_0001.P1465
GLA01_028_2119_002_0009_4_01_0001.P1465

- Products GLA03, 4, and 7 contain 2 revs of data in each file and therefore files are named with every 2 tracks starting with track 1. The segment number is 0.

For example:
GLA02_028_2119_002_0009_0_01_0001.P1465
GLA02_028_2119_002_0011_0_01_0001.P1465

- Products GLA08 - 15 contain 14 revs of data in each file and therefore files are named with every 14 tracks starting with track 1. The segment number is 0.

For example:
GLA08_028_2119_002_0001_0_01_0001.P1465
GLA08_028_2119_002_0015_0_01_0001.P1466

- Description of segments for ¼ rev files:

There are 4 segments in a track. The first one is from latitude 50 degrees towards the north to latitude 50 degrees moving south (N. Pole). The second one is descending from 50 degrees to –50 degrees. The third one is from –50 degrees to –50 degrees (S. Pole). The fourth one is ascending from –50 degrees to 50 degrees. Since a track begins at 0 degrees latitude, yet segment 4 spans from -50 to 50 degrees latitude, data from 0 to 50 degrees latitude will be the in the segment 4 file of the last track.

For example:
If GLA01 data for cycle 2, track 10, 60 to 70 degrees latitude reside in file:

GLA01_028_2119_002_0010_1_01_0001.P1465

Then GLA01 data for cycle 2, track 10, 20 to 30 degrees latitude reside in file:

GLA01_028_2119_002_0009_4_04_0001.P1465

- Refer to the “SCF File Naming Conventions Document” under “Documentation” on the SCF website for more information.

## Section 7: RSCF File Naming Convention

This is how the subsetted GLAS data products created on the main SCF are named before they are transferred to a remote SCF:

GLAxx_yymmddhh_tiiii_rww_lll.Pnnnn_pp_vv

- xx - GLAS data product number (1-15)
- yymmddhh -
  For subscription data: date of the first data received from I-SIPS in the 14 rev product set
  For special request data: date of the beginning of the first granule that is used to create the subset
- t - type of request; s for subscription, r for special request
- iiii - subscription number or special request number
- r - is the POD/PAD "Y" code of the first input file in the subsetted file. Refer to the "YXX Release Number Convention Document" under "Documentation" on the SCF website for details.
- ww is the GSAS release number of the first input file in the subsetted file.
- lll is the laser campaign; i.e. L1A, L2A, L2B, etc.
- Pnnnn - unique product set ID number, PID
- pp - part number of product file for multiple files < 2 GB
- vv - version of this file starting at 00

Notes:

- The product set ID here is different than the one used in the MSCF file naming convention. Here it is just a unique number not having anything to do with 14 rev product sets.

- If a data product file is calculated to exceed the 2 GB file size limit, it will be divided into separate product files with incrementing part numbers.

- Header records in each GLAS standard data product file will list the specific input parameters used to fill the request, and the I-SIPS input files used so the user can keep track of what I-SIPS versions went into each data set.

- Refer to the "SCF File Naming Conventions Document" under "Documentation" on the SCF website for more information.

## Section 8: Definition of Orbit Parameters

Data are often referred to by their pass ID: prkk_ccc_tttt (as in the mscf file naming convention).

Where

- p - repeat ground track phase refers to how many days the orbit takes to repeat itself
  = 1 for 8-day repeat orbit
  = 2 for 91-day repeat orbit

- r - reference orbit number starts at 1 and increments each time we receive a new reference orbit groundtrack file

- kk - instance number increments every time the satellite changes from one reference orbit to another one.

Prkk is often referred to as the reference ID.

- ccc - cycle number restarts at 1 every time the satellite moves into a new reference orbit. The cycle number then increments every time track 1 for that orbit is reached.

  - There are 119 tracks per cycle in an 8-day reference orbit.
  - There are 1354 tracks per cycle in a 91-day reference orbit.

  Note that most orbits will begin in an arbitrary track (not 1) because of how we are numbering the tracks.

- tttt – track number. Tracks are defined from a reference orbit. Each track begins and ends at the ascending equator crossing (0 degrees latitude). Tracks are numbered such that track number 1 is the closest track west of Greenwich and then contiguous in time after that.

Note: The words “pass”, “track”, and “rev” are often used interchangeably. Rev is slightly different from track in that the rev numbers are continuously incremented while the track numbers restart with each new cycle.

For example:

GLA01_028_2119_002_0010_1_01_0001.P1465

2119 is the reference ID (91-day repeat orbit, original one, 19$^{th}$ orbit transition)
2 is the cycle
10 is the track
22715 is the rev (obtained from the “Date Conversion Tool” on the SCF website)

## Section 9: Data Management Files

The following ancillary files are created at the main SCF to index into the product files for quick subsetting capabilities. They are each created one per product file for both the I-SIPS products files and the subsetted product files. They are utilized by some of the product readers and by the visualization software.

- Unique Index File (UR) - Correlates unique index records with physical records.
- Pass File (PS) - Correlates passes (tracks) with unique index records.
- Bin File (BNA, BNL) - Divides the geographic range into 1 deg x 1 deg bins and correlates unique index records with bins.
- Georeference File (GRA, GRL) - Indexes into bin file.

These files following the same naming convention as the data product files, except that the first 2 or 3 characters will differ. “A’ stands for altimetry, “L” stands for lidar.

For example:

For product file GLA01_028_2119_002_0010_1_01_0001.P1465

The ancillary files are: UR01_028_2119_002_0010_1_01_0001.P1465
PS01_028_2119_002_0010_1_01_0001.P1465
BNA01_028_2119_002_0010_1_01_0001.P1465
GRA01_028_2119_002_0010_1_01_0001.P1465

For product file GLA02_028_2119_002_0009_0_01_0001.P1465

The ancillary files are: UR02_028_2119_002_0009_0_01_0001.P1465
PS02_028_2119_002_0009_0_01_0001.P1465
BNL02_028_2119_002_0009_0_01_0001.P1465
GRL02_028_2119_002_0009_0_01_0001.P1465

- Refer to the “SCF DMS File Formats Document” under “Documentation” on the SCF website for file formats. Refer to the “SCF Product Tools Guide” for information on software that reads these files.

## Section 10: SCF Website

The SCF website (glas-scfweb.gsfc.nasa.gov) is a resource for obtaining pertinent information about the GLAS instrument, data, and data accessing software. It is password protected; contact the SCF manager if you need the username and password. Listed below are some key features important for new data users:

- Product Formats – Links to the Product Format Database at glas.wff.nasa.gov. The database contains detailed descriptions of each parameter on every GLAS data product.

- Documentation – Links to useful documentation including product release notes, SCF software release notes, user's guides, ATBD's, etc.

- Instrument Updates – Links to the Instrument Updates Table that lists start and end times for each laser campaign, plus other important instrument events.

- Data Tables – Links to the SCF Release Table that lists the current and previous releases of data available at the main SCF for each laser campaign.

- Date Conversion Tool – Converts among various date units used by GLAS.

## Section 11: Invoking Data Request and Visualization Software

If you are on a remote SCF and would like to request data, he's the short guide on how to do it:

- Login to your rSCF system.
- Type glas_data_request to invoke the data request GUI.
- Refer to the "SCF Data Request Software User's Guide" under "Documentation" on the SCF website to learn how to use the GUI.

If you are on a remote SCF and would like to visualize data, he's the short guide on how to do it:

- Login to your rSCF system.
- Type glas_visualizer to invoke the data visualization GUI.
- Refer to the "SCF Data Visualization Software User's Guide" under "Documentation" on the SCF website to learn how to use the GUI.
- Refer to the "Visualizer Tutorial" under "Documentation" on the SCF website for examples on using the Visualization software.

Various product readers, aside from the visualizer, are also available in Fortran 90 or IDL on the remote SCF's.

- Refer to the "SCF Product Tools Guide" under "Documentation" on the SCF website for more information.

## Appendix A: Abbreviations & Acronyms

| | |
|---|---|
| ATBD | Algorithm Theoretical Basis Documents |
| GLAS | Geoscience Laser Altimeter System |
| ICESat | Ice, Cloud, and land Elevation Satellite |
| I-SIPS | ICESat Science Investigator-led Processing System |
| LIDAR | LIght Detection And Ranging |
| mSCF | Main Science Computing Facility |
| rSCF | Remote Science Computing Facility |