Global Land Ice Measurements from Space (GLIMS) Glacier Database, Version 1

USER GUIDE

How to Cite These Data

To cite the global GLIMS data set, please use:


To cite a subset of the GLIMS database, please reference the analysis IDs and associated submitter and analyst(s), as indicated in the following example. Analysis IDs and attributing authors are listed in the CITATIONS.txt file that is provided with your GLIMS download. See Section 7 for more examples and details on citing these data.

Example: GLIMS Consortium. 2005. GLIMS Glacier Database, Version 1. [Analysis IDs 706804-710644, Paul, Frank (submitter); Azzoni, R.S.; Fugazza, D.; Le Bris, Raymond; Nemec, J.; Paul, Frank; Rabatel, Antoine; Ramusovic, M.; Rastner, Philipp; Schaub, Yvonne; Schweizer (nee Bippus), Gabriele (analyst(s))]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.7265/N5V98602. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0272
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1 DATA DESCRIPTION

The Global Land Ice Measurements from Space (GLIMS) is an international initiative with the goal of repeatedly surveying the world's estimated 200,000 glaciers. GLIMS uses data collected by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument aboard the Terra satellite and the LANDSAT series of satellites, along with historical observations. The GLIMS initiative has created a unique glacier inventory, storing information about the extent and rates of change of all the world's mountain glaciers and ice caps.

Note: A GLIMS Glacier Viewer was developed to provide the public with easy access to the GLIMS Glacier Database. A detailed description on how to use this web application and the text-based search option is given in Section 3 Software and Tools.

1.1 Parameters

The following table gives a list of important GLIMS parameters. A more comprehensive list of parameters can be found on the GLIMS Description of fields web page.

Table 1. List of GLIMS Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| line_type | Type of entity:  
  glac_bound = glacier boundary (polygon)  
  snowline = end-of-season snow line  
  centerline = center line along middle of glacier  
  debris_cov = debris cover (polygon)  
  pro_lake = proglacial lake (polygon)  
  supra_lake = supraglacial lake (polygon) |
| anlys_id | unique ID for this outline |
| glac_id | GLIMS glacier ID (e.g. G254228E40365N). Format is GxxxxxxEyyyyyH where:  
  G is a literal (stands for "glacier")  
  xxxxxx is the east longitude of the chosen representative point of the glacier  
  E is a literal (denotes east longitude)  
  yyyyy is the latitude of the chosen representative point of the glacier  
  H can be “N” or “S”, denoting northern or southern hemisphere, respectively |
<p>| area | glacier area given by provider, km² |
| db_area | glacier area calculated by NSIDC at ingest, km² |
| min_elev | Minimum elevation, in meters above sea level |
| mean_elev | Mean elevation, in meters above sea level |
| max_elev | Maximum elevation, in meters above sea level |
| src_date | Effective date for the glacier outlines |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>glac_name</td>
<td>Name of glacier, if available</td>
</tr>
<tr>
<td>wgms_id</td>
<td>ID from the World Glacier Monitoring Service</td>
</tr>
<tr>
<td>glac_stat</td>
<td>Glacier status: &quot;exists&quot; or &quot;gone&quot;</td>
</tr>
<tr>
<td>subm_id</td>
<td>Submission ID (can be used to tie together outlines from the same provider)</td>
</tr>
<tr>
<td>proc_desc</td>
<td>Processing description</td>
</tr>
<tr>
<td>rc_id</td>
<td>Regional Center ID</td>
</tr>
<tr>
<td>geog_area</td>
<td>General geographic area</td>
</tr>
<tr>
<td>chief_affl</td>
<td>Institution of Regional Center chief</td>
</tr>
<tr>
<td>loc_unc_x</td>
<td>Positional uncertainty of each vertex of polygons in x, m</td>
</tr>
<tr>
<td>loc_unc_y</td>
<td>Positional uncertainty of each vertex of polygons in y, m</td>
</tr>
<tr>
<td>glob_unc_x</td>
<td>Positional uncertainty of polygon itself in x, m</td>
</tr>
<tr>
<td>glob_unc_y</td>
<td>Positional uncertainty of polygon itself in y, m</td>
</tr>
<tr>
<td>submitters</td>
<td>List of people who submitted the data</td>
</tr>
<tr>
<td>analysts</td>
<td>List of people who created the data</td>
</tr>
</tbody>
</table>

1.2 File Information

1.2.1 Format

GLIMS Data are available in several file formats:

- ESRI Shapefile
- MapInfo Table Format
- GML (Geography Markup Language)
- KML (Keyhole Markup Language for viewing in Google Earth)
- GMT (Generic Mapping Tools)

Where and how to select the data format and model selection is described in detail in Section 3.4 Tour of GLIMS Data Download. Details of what files will be present depending on the data format choice is given in Table 2.
Table 2. Download Package Content Depending on Selected Download Option

<table>
<thead>
<tr>
<th>Download option</th>
<th>Download package content</th>
</tr>
</thead>
</table>
| ESRI Shapefile  | • glims_* .dbf: Attribute data and object IDs for the features  
|                 | • glims_* .prj: Definition of the map projection  
|                 | • glims_* .shp: Geometry information for the features  
|                 | • glims_* .shx: Geometry index to speed searching  |
| Mapinfo Table   | • glims_* directory, containing:  
|                 |   o layer.dat: Attribute data for the features  
|                 |   o layer.id: Info linking graphic data to the database  
|                 |   o layer.map: Graphic and geographic information for each feature  
|                 |   o layer.tab: ASCII file linking other files, holds information about the type of data set file  |
| GML             | • glims_* .gml: The main data file containing information on the features  
|                 | • glims_* .xsd: A schema file to describe the GML format.  |
| KML             | • glims_* .kml: The main data file containing information on the features  |
| GMT             | • glims_* .gmt: The geometry, attribute, geographic extent, and projection data in a simple ASCII format defined by the GMT group  |

Note: glims_* refers to all file options available such as "glims_images", "glims_lines", "glims_points" and "glims_polygons". They are described in more detail in Table 3.

1.2.2 Naming Convention

Each GLIMS download package can be ordered as a .zip or .tar option and all downloaded compressed folders will have the following file naming convention:

```
glims_download_XXXXX.<ext>  
```

where XXXX is a 5-digit random order number and the extension is dependent on the zip or tar selection of the download order. An example file name is glims_download_08054.zip.

1.2.3 ZIP/TAR File Contents

All compressed files contain a README.txt and a CITATIONS.txt file as well as a number of different data files depending on the selected data format (See Table 2). All potential file contents are described in Table 3.
Table 3. File Content Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>File Content Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>README.txt</td>
<td>General Information on content of the downloaded compressed folder.</td>
</tr>
<tr>
<td>CITATIONS.txt</td>
<td>Information on sources for the data, as well as how to cite the data in your own works.</td>
</tr>
<tr>
<td>glims_hypsometry_*.csv</td>
<td>Hypsometry (area-elevation histogram) data for the various glaciers/analyses in the search. The data are provided in histogram form, with a different file for each bin size present in the database. The CSV file has columns for the glacier ID and analysis ID, as well as a column for each elevation bin. The column header for each bin shows the center elevation of that bin. The bins represent meters of elevation, and the data represent the glacier area (in square kilometers) in that elevation bin. If there are no files present, there are no hypsometry data for any of the glaciers selected.</td>
</tr>
<tr>
<td>glims_images.*</td>
<td>The files contain information on the images that are linked to the glaciers selected. Attributes include the glacier ID, analysis ID, instrument short name, original ID, acquisition time, and a flag called &quot;est_loc&quot;. If this flag is 0, it means the coordinates listed are what are stored in the database. If the flag is 1, it means no coordinates were given, so the coordinates listed were estimated as an average of the other image coordinates in the package. If this file is not present, there were no images corresponding to the glaciers selected.</td>
</tr>
<tr>
<td>glims_lines.*</td>
<td>The data represent line features associated with the glaciers selected. These line features will either be &quot;snow lines&quot; or &quot;center lines&quot; for the glacier. If this file is not present, there are no line data for the glaciers selected.</td>
</tr>
<tr>
<td>glims_points.*</td>
<td>The data are representative points for the glaciers selected.</td>
</tr>
<tr>
<td>glims_polygons.*</td>
<td>The data represent polygon features, typically glacier outlines, but also including regions of glacial lakes, debris cover, rocks within the glacier (nunataks), and other polygonal features.</td>
</tr>
</tbody>
</table>

*Note: * refers to the different file extension options depending on what file format was selected. See Table 2 for more details.
1.3 Spatial Information

1.3.1 Coverage

GLIMS data is global but spatial coverage for individual download orders can be customized, for example, by zooming into a certain region in the map interface (See Section 3.1 Guide to using the GLIMS Glacier Viewer (map interface)).

1.3.2 Resolution

Polygons are created from satellite imagery with resolution (pixel size) in the 5-30 m range. The polygons are vector data and the positional uncertainty and their vertices are given in loc_unc_x, loc_unc_y, glob_unc_x and glob_unc_y. For more details on these parameters see Table 1.

1.3.3 Geolocation

All data are in the latitude/longitude coordinate system on the WGS-84 datum. The following table information for geolocating this data set.

<table>
<thead>
<tr>
<th>Geographic coordinate system</th>
<th>EPSG code</th>
<th>PROJ4 string</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGS 84</td>
<td>4326</td>
<td>+proj=longlat +datum=WGS84 +no_defs</td>
<td><a href="https://epsg.io/4326">https://epsg.io/4326</a></td>
</tr>
</tbody>
</table>

1.4 Temporal Information

1.4.1 Coverage

Most data come from satellite imagery and are therefore post-1980, but some data come from mapping moraines. The general temporal coverage is currently 1850 – 2018.

1.4.2 Resolution

Time coverage is irregular and data entry dependent.
2 DATA ACQUISITION AND PROCESSING

2.1 Background

GLIMS is an international initiative with the goal of repeatedly surveying the world’s estimated 200,000 glaciers. GLIMS uses data collected by the ASTER instrument aboard the Terra satellite and the LANDSAT series of satellites, along with historical observations.

The GLIMS initiative has created a unique glacier inventory, storing information about the extent and rates of change of all the world’s mountain glaciers and ice caps. The GLIMS project at NSIDC has implemented a database of glacier outlines from around the world and other information about glaciers that also includes metadata on how those outlines were derived. The GLIMS Glacier Database was created from data contributions from many glaciological institutions, which are managed by Regional Coordinators, who coordinate the production of glacier mapping results for their particular region. The GLIMS Glacier Database provides students, educators, scientists, and the public with reliable glacier data from these analyses. New glacier data are continually being added to the database.

Closely related to GLIMS, and in the future converging with GLIMS, is the Randolph Glacier Inventory (RGI 6.0), a global inventory of glacier outlines. While GLIMS is a multi-temporal database with an extensive set of attributes, the RGI is intended to be a snapshot of the world’s glaciers as they were near the beginning of the 21st century. The content of the RGI has mostly been integrated into the GLIMS database with the exception of a couple of regions. However, work remains to be done to make the RGI a downloadable subset of GLIMS, offering complete one-time coverage, version control and a standard set of attributes. Production of the RGI was motivated by the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5). Future updates will be made to the RGI and the GLIMS Glacier Database in parallel during a transition period. As all these data are incorporated into the GLIMS Glacier Database and as download tools are developed to obtain GLIMS data in the RGI data format, the RGI will evolve into a downloadable subset of GLIMS, offering complete one-time coverage, version control, and a standard set of attributes.

2.2 Acquisition

Most data are retrieved from satellite optical imagery. Some data come from old geographical maps and some from mapping moraines with satellite imagery.
2.3 Processing

The processing is variable. Most processing involves image classification with the band ratio method and polygons are typically edited to correct small errors and to include debris cover when the satellite imagery is converted from raster to vector. Some data are the result of manual digitization.

2.4 Quality, Errors, and Limitations

For details on Quality, Errors, and Limitations refer to “Chapter 7 | Quality in the GLIMS Glacier Database” in Kargel et al. (2014). The uncertainty parameters in the data are loc_unc_x, loc_unc_y, glob_unc_x and glob_unc_y. For more details on these parameters see Table 1.

2.5 Instrumentation

Data are retrieved from TERRA/ASTER and LANDSAT-7 satellites as well as from ground-based observations.

3 SOFTWARE AND TOOLS

This section describes:

- How to explore the GLIMS database using the GLIMS data viewer, a map interface. (see Section 3.1)
- How to explore the GLIMS database using a text-based interface searching for glaciers based on name, classification, area, etc. (see Section 3.2)
- A tour of the xml based quick look on the data (see Section 3.3)
- What data download options are available for GLIMS (see Section 3.4)

3.1 Guide to using the GLIMS Glacier Viewer (map interface)

The GLIMS Glacier Viewer was developed to provide the public with easy access to the GLIMS Glacier Database. This Web application allows users to view and query several thematic layers, including glacier outlines, Regional Coordinator institution locations, the World Glacier Inventory, and more. GLIMS data can be downloaded into a number of GIS-compatible formats, including ESRI Shapefiles, MapInfo tables, GML, and KML suitable for viewing in Google Earth.

The GLIMS Glacier Viewer can be accessed here: http://glims.colorado.edu/glacierdata/ by clicking “GLIMS Glacier Viewer”. Figure 1 shows the Access Page for the GLIMS Glacier Viewer.
The GLIMS Glacier Viewer

The GLIMS Glacier Viewer is an interactive map which gives a view of data in the GLIMS Glacier Database. A number of different layers in this interface can be viewed and spatially queried including: GLIMS Glacier Outlines, other glacier databases such as the World Glacier Inventory, Regional Coordinator Locations, and others. The GLIMS Glacier Outlines layer contains the results of glacier mapping within the GLIMS initiative. Each polygon in this layer represents the extent of a particular glacier at a specific time, as well as other possible features of the glacier such as the extent of debris cover or the location of supraglacial and proglacial lakes. The GLIMS Glacier outlines can be downloaded as ESRI Shapefiles, MapInfo tables, Geographic Markup Language (GML) files, Keyhole Markup Language (KML), Google Earth, and the Generic Mapping Tools (GMT) multi-segment format.

Drag to pan the map. Use the mouse wheel, zoom-controls, or pinch gestures (on a tablet or phone) to zoom. Hold shift and drag a box to zoom to a region. Single-click to query visible layers.

Figure 1. Access Page for GLIMS Glacier Viewer

Figure 2. Screenshot of the Interactive GLIMS Glacier Viewer Map

This will open a map view; an example is shown in Figure 2. The following features are available in this interactive map:

- Use the mouse wheel, zoom-controls in the upper left, or pinch gestures (on a tablet or phone) to zoom
- Hold SHIFT and the left mouse button to draw a box to zoom into the map.
- Click on the ‘E’ in the upper left corner to show the entire world map
- Drag by holding the left mouse button to pan the map
- Hovering over the layer symbol on the upper right displays the map legend (See Figure 3), allows to show or hide different glacier databases and to choose the underlying base map.
- The search bar on the center top allows users to search glaciers by name.
- Right under the search bar are buttons to “download all GLIMS Data in Current View” or to “download all GLIMS data”.
- To customize the area of interest both, zoom and reshaping the browser window can be used to select a region (e.g., tall and skinny versus short and wide)
- A single click on an element displays a window with the available data for the selected item including Glacier Name, Glacier ID, Analysis ID, Area, AS-of Date, Source and an option to select more info. (see Figure 4)
3.2 Guide to using the GLIMS Text-search function

A different option to search the GLIMS database is via the text-search based function. It can be accessed on the same webpage (http://glims.colorado.edu/glacierdata/) by clicking “Use the GLIMS Text Search”, see Figure 5.

![GLIMS Text Search Interface](image)

This opens a parameter-based search interface shown in Figure 6. This allows for the search of glaciers by name, ID, country or other text-based information as well as to filter the database by glacier area, elevation, length, width, WGMS classification, etc. Another option is to search for data provided by a specific data center, data submitter, or data analyst. The search button will search the database by the given parameters and the reset button will reset the search form.
An example result list of glaciers is shown in Figure 7. This is the output when entering Adamello (a glacier in Italy) in the glacier name field. The results list displays glacier ID, glacier name, analyst ID, NSIDC-calculated area, source date, date available, analyst’s last name, and analyst’s institution. At this point, the user has the option to click the “download all” button or click on the “information icon” or “download icon” to the right of each listed data set.
3.3 Tour of GLIMS Data Info

Section 3.1 and 3.2 described how to filter GLIMS data via the map interface or the text search option, respectively. Both searches result in a list of results that have a “more info” option. Via the map, you click on the “more…” link on the right side of the results list (Figure 4); and for the text search, you click on the info icon under the “Options” column. Both results in display of the information with various tabs such as “Glacier Info”, “Submission Info”, “Analyst Info”, “Image Info”, “Map Info”, “Glacier Map”, “Hypsometry” and “Download”. An example display is shown in Figure 8. Each tab can be explored for more information on a particular GLIMS record. The “Download” tab with its options is explained in more detail in the next section.

![Glacier Information Table]

Figure 8. Example Information for Analysis ID 709429

3.4 Tour of GLIMS Data Download

There are several options to get to a download interface and GLIMS records can be downloaded individually or as aggregates. The following are some of the ways to download GLIMS data:

- After selecting an individual GLIMS record on the list provided by the text search (Figure 7) and clicking the “Info” icon, the download option will be on the top right tab (Figure 8) and link to the download interface.
- After selecting an individual GLIMS record on the list provided by the text search (Figure 7), the “Download” icon on the right side of the record will lead directly to a download interface.
- The “Download all” button at the right lower corner of the list provided by the text search (Figure 7) will lead to the download interface.
• A single click in the map interface results in a pop-up window, clicking on "More..." will show one record like in Figure 8 and the download tab will again lead to the download interface.

• A single click in the map interface results in a pop-up window, and clicking on "Download these GLIMS Glacier Outlines" on the top left will lead to the download interface.

• In the map interface, there are also the options ‘Download GLIMS Data in Current View’ and ‘Download All GLIMS Data’ on the center top (Figure 2) that both lead to the download interface.

An example view of the download interface is shown in Figure 9:

---

**GLIMS Data Export**

GLIMS Data are available in these file formats:

- ESRI Shapefile
- MapInfo Table Format
- GML (Geography Markup Language)
- KML (for viewing in Google Earth)
- GMT (Generic Mapping Tools)

Because the GLIMS Database is very extensive, a pre-defined set of attributes has been created to accompany the data. Not all fields are populated for all glaciers.

The downloaded data set consists primarily of polygons. For each glacier analysis there is a polygon that represents the glacier boundary and (where they are present) there are polygons representing the locations of internal rocks that are contained within the boundaries of the glacier. The internal rock polygons are attributed as 'inmd_rock' in the line_type attribute field.

**Citing GLIMS Data:**

- Citation guidance is included in the README text file that will accompany your downloaded dataset. This information includes data-specific citations grouped by the downloaded data's analysis_id.
- Before you download GLIMS data, please read the NSIDC citation requirements.

Please select the file format and archive type for your data:

- **File format:**
  - ESRI Shapefile

Please select the data model for your data:

- **GLIMS (multi-temporal) data**
  - Internal rock representation.
  - 3D data (Vertex data) for separate polygons (GLIMS-3D)

  OR

- **Snapshot (RGB) data set for data (Warning: experimental):**
  - YYYY-mm-dd

---

Figure 9. GLIMS Download Interface

The first section in the GLIMS Download Interface describes the available file formats as well as citation guidelines. Click on “citation requirements” in the center of the screen for more information on NSIDC’s data citation policies or find the information directly on NSIDC’s Use and Copyright web page. Each data download will include a CITATIONS.txt file with citation guidelines. See more detailed information on how to cite these data in Section 7 Citing GLIMS Data.
3.4.1 Data Format Selection

GLIMS Data are available in several file formats:

- ESRI Shapefile
- MapInfo Table Format
- GML
- KML (for viewing in Google Earth)
- GMT

For each download order, you can select one of the above file formats. An archive file format (Zip or Tar) also has to be selected. Zip is the default selection.

3.4.2 Data Model Selection

For the GLIMS multi-temporal data, there are two different options for internal rock representation. The "Holes" option represents internal rock outcrops (nunataks) as holes in the glacier boundary polygon similar to the RGI data. The “Separate polygons” option represents nunataks with separate polygons. Figure 10 details the two model options. A third option is available for snapshots in time where a date in yyyy-mm-dd format has to be entered.

![Geometry Data Models](image)

Figure 10. Geometry Data Model Options for GLIMS multi-temporal data

4 VERSION HISTORY

GLIMS data is updated continuously within Version 1.

5 RELATED DATA SETS

Randolph Glacier Inventory 6.0
6 RELATED WEBSITES

GLIMS | Overview
GLIMS | Data Access
GLIMS at NSIDC

7 CITING GLIMS DATA

When referring to the complete set of GLIMS glacier data (e.g. for a global study of glaciers), please cite:


When referring to a subset of the GLIMS data, please cite data how it is provided in the CITATIONS.txt file. Below you can find some examples:

Example 1: GLIMS Consortium. 2005. *GLIMS Glacier Database, Version 1*. [Analysis IDs 328449-335984, Paul, Frank (submitter); Paul, Frank (analyst(s))]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.7265/N5V98602. [Date Accessed].

Example 2: GLIMS Consortium. 2005. *GLIMS Glacier Database, Version 1*. [Analysis IDs 362642-363545, Smiraglia, Claudio (submitter); Smiraglia, Claudio (analyst(s))]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.7265/N5V98602. [Date Accessed].

Example 3: GLIMS Consortium. 2005. *GLIMS Glacier Database, Version 1*. [Analysis IDs 706804-710644, Paul, Frank (submitter); Azzoni, R.S.; Fugazza, D.; Le Bris, Raymond; Nemec, J.; Paul, Frank; Rabatel, Antoine; Ramusovic, M.; Rastner, Philipp; Schaub, Yvonne; Schwaizer (nee Bippus), Gabriele (analyst(s))]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.7265/N5V98602. [Date Accessed].

When referring to the GLIMS Initiative in general, please cite:

8 CONTACTS AND ACKNOWLEDGMENTS

A large consortium of scientists is collaborating in this project. The overall effort is guided by the GLIMS Core Team.

9 REFERENCES


A list of GLIMS publications sorted by year can be found here: https://www.glims.org/Publications/.

10 DOCUMENT INFORMATION

10.1 Publication Date

15 December 2020

10.2 Date Last Updated

20 July 2021