The GLIMS Glacier Database: a spatio-temporal database implemented using Open Source tools

Bruce Raup, Chris Helm, Siri Jodha Singh Khalsa, Richard Armstrong
National Snow and Ice Data Center
Boulder, Colorado
Map data registered to an ASTER image of Gangotri Glacier, India, showing long-term recession.
FIGURE 4. Cumulative mass balances calculated for large regions. For these calculations mass balance time series of all glaciers (more than 300 from time to time, and from 30 to 100 with multi-year records) were used (see http://www.nsidc.org). Annual mass balance data were weighted by the surface area of individual glaciers, then by the aggregate surface area of 49 primary glacier systems (20 of them are shown in Figure 3). Cumulative curves for large regions show a clear shift toward acceleration in mass loss by the end of the 1980s or in the 1990s. From Dyurgerov and Meier 2005.
Global Land Ice Measurements from Space (GLIMS)

Goal: to map and measure glacier parameters from space

GLIMS involves:

- 110 people
- 73 institutions
- 28 countries
System components

- PostgreSQL (relational database)
- PostGIS (geospatial extensions and functions)
- MapServer (OGC compliant WMS and WFS)
- Proj.4 (projection library and utilities)
- GDAL (Geospatial Data Abstraction Library)
- Perl, PHP, Shapelib, ...
Reasons for choosing Open Source

- Flexibility – easy to script and add new capabilities (temporal constraints).
- Ability to share the whole system with other Regional Centers (many of whom have small budgets).
- Capable, and fast!
- Runs on Linux, where we can take advantage of our stock of Linux-based tools.
### Glacier Outlines

<table>
<thead>
<tr>
<th>Glacier Name</th>
<th>Glacier ID</th>
<th>Data Acquisition Date</th>
<th>WGMS ID</th>
<th>Contributor's Local Glacier ID</th>
<th>Analysis ID</th>
<th>Area, km²</th>
<th>Analyst Name</th>
<th>Institution</th>
<th>URL</th>
<th>Date Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Quintin</td>
<td>G286485E46923S</td>
<td>2001-03-11 00:00:00</td>
<td>NPI-8</td>
<td></td>
<td>2160</td>
<td>789.8</td>
<td>Francisca Bown</td>
<td>Centro de Estudios Científicos (CECS)</td>
<td><a href="http://www.cecs.cl">http://www.cecs.cl</a></td>
<td>2005-12-20 19:43:58</td>
</tr>
</tbody>
</table>
## GLIMS ASTER Footprints

<table>
<thead>
<tr>
<th>Granule ID</th>
<th>EDC ID</th>
<th>Short Name</th>
<th>Day or Night</th>
<th>Capture Date</th>
<th>Cloud Cover</th>
<th>Gain Settings</th>
<th>View Browse</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC:AST_L1B.003:2017442091</td>
<td>2017442091</td>
<td>AST_L1B</td>
<td>Day</td>
<td>2001-01-22</td>
<td>100</td>
<td>01 HGH, 02 HGH, 3N NOR, 3B NOR, 04 NOR, 05 NOR, 06 NOR, 07 NOR, 08 NOR, 09 NOR</td>
<td>View Image</td>
</tr>
<tr>
<td>SC:AST_L1B.003:2018584500</td>
<td>2018584500</td>
<td>AST_L1B</td>
<td>Day</td>
<td>2001-10-05</td>
<td>100</td>
<td>01 HGH, 02 HGH, 3N NOR, 3B NOR, 04 NOR, 05 NOR, 06 NOR, 07 NOR, 08 NOR, 09 NOR</td>
<td>View Image</td>
</tr>
<tr>
<td>SC:AST_L1B.003:2021774914</td>
<td>2021774914</td>
<td>AST_L1B</td>
<td>Day</td>
<td>2004-03-10</td>
<td>0</td>
<td>01 HGH, 02 HGH, 3N NOR, 3B NOR, 04 NOR, 05 NOR, 06 NOR, 07 NOR, 08 NOR, 09 NOR</td>
<td>View Image</td>
</tr>
</tbody>
</table>
Segment:
Total Dist:
Latitude: -46.277
Longitude: -72.268

Download GLIMS Data
### Glacier Outlines

<table>
<thead>
<tr>
<th>Glacier Name</th>
<th>Glacier ID</th>
<th>Data Acquisition Date</th>
<th>WGMS ID</th>
<th>Product ID</th>
<th>Analyst ID</th>
<th>Area, km²</th>
<th>Analyst Name</th>
<th>Institution</th>
<th>URL</th>
<th>Date Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploradores</td>
<td>G28676E46597S</td>
<td>2001-03-11 00:00:00</td>
<td>NPI-38</td>
<td>2091</td>
<td></td>
<td>85.75</td>
<td>Francisca Bowna</td>
<td>Centro de Estudios Científicos (CECS)</td>
<td><a href="http://www.cecs.cl">http://www.cecs.cl</a></td>
<td>2005-12-20 19:46:04</td>
</tr>
<tr>
<td>Fiero</td>
<td>G28669E46659S</td>
<td>2001-03-11 00:00:00</td>
<td>NPI-35</td>
<td>2092</td>
<td></td>
<td>41.5</td>
<td>Francisca Bowna</td>
<td>Centro de Estudios Científicos (CECS)</td>
<td><a href="http://www.cecs.cl">http://www.cecs.cl</a></td>
<td>2005-12-20 19:46:04</td>
</tr>
<tr>
<td>Cristal</td>
<td>G28671E46737S</td>
<td>2001-03-11 00:00:00</td>
<td>NPI-33</td>
<td>2093</td>
<td></td>
<td>5.36</td>
<td>Francisca Bowna</td>
<td>Centro de Estudios Científicos (CECS)</td>
<td><a href="http://www.cecs.cl">http://www.cecs.cl</a></td>
<td>2005-12-20 19:46:04</td>
</tr>
<tr>
<td>Mocho</td>
<td>G28670E46722S</td>
<td>2001-03-11 00:00:00</td>
<td>NPI-34</td>
<td>2094</td>
<td></td>
<td>5.16</td>
<td>Francisca Bowna</td>
<td>Centro de Estudios Científicos (CECS)</td>
<td><a href="http://www.cecs.cl">http://www.cecs.cl</a></td>
<td>2005-12-20 19:46:04</td>
</tr>
<tr>
<td>Group of small</td>
<td>G28673E46710S</td>
<td>2001-03-11 00:00:00</td>
<td>NPI-39</td>
<td>2095</td>
<td></td>
<td>34.6</td>
<td>Francisca Bowna</td>
<td>Centro de Estudios Científicos (CECS)</td>
<td><a href="http://www.cecs.cl">http://www.cecs.cl</a></td>
<td>2005-12-20 19:46:04</td>
</tr>
<tr>
<td>glaciers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GLIMS Data Export

GLIMS Data are available in a few different GIS formats, currently those are:
- ESRI Shapefile
- MapInfo Table Format
- Geographic Mark-up Language (GML)

Because the GLIMS Database is very extensive a pre-defined set of attributes has been created to accompany the data, they are:
- Glacier Name
- Glacier ID
- WGMS ID
- Contributor's ID
- GLIMS Analysis ID
- Line Type
- Analysis Date
- Area in Sq. km.
- Analyst's Name
- Analyst's Institutions
- Data URL
- Data Creation Description (process)

The final downloaded dataset is a set 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 reside with the boundaries of the glacier. The internal rock polygons are attributed as 'intrnl_rock' in the line_type attribute field.

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

GIS Format:  
ESRI Shapefile

Zip Format  Tar Format

* Before you download GLIMS data we ask you to please read the NSIDC citation requires.

Download Data

Done
Future Work

- Ship FGDC metadata with downloaded data
- Forms-based query to enable searches by glacier name, glacier area, etc.
- Interface improvements
Summary

- GLIMS is a collaborative effort to map the world's glaciers and make the database accessible on the Web.
- PostgreSQL and PostGIS provide a tool for storing, manipulating, and analyzing complex geospatial objects.
- MapServer is a flexible and easy tool for serving data on the Web in a variety of formats and projections.
- http://glims.colorado.edu/glacierdata/