Global Land Ice Measurements from Space (GLIMS): status and Asian activity

Asia CliC Meeting 2006, Yokohama
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Boulder, Colorado
Glaciers are a widely distributed, highly detailed target.
Global Land Ice Measurements from Space (GLIMS)

Goal: to map and measure glacier parameters from space

GLIMS involves:

- 112 people
- 70 institutions
- 28 countries
GLIMS Regions and Institutions

As of 2006-04-15
GLIMS Glacier Database

Segment: 
Latitude: -9.38
Total Dist: 
Longitude: -77.49

Download GLIMS Data
Segment:  
Total Dist:  
Latitude: -45.95  
Longitude: -72.251

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>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>2160</td>
<td>789.8</td>
<td>Francisco 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>
<td></td>
</tr>
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</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>
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<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>
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<td>2018584500</td>
<td>AST_L1B</td>
<td>Day</td>
<td>2001-10-05</td>
<td>100</td>
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<td>View Image</td>
</tr>
<tr>
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<td>AST_L1B</td>
<td>Day</td>
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<td>View Image</td>
</tr>
</tbody>
</table>
## GLIMS Query Results

### Selected Features

![Map of selected features](image)

<table>
<thead>
<tr>
<th>Glacier Outlines</th>
<th>Download Selected Glacier Outlines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glacier Name</strong></td>
<td><strong>Glacier ID</strong></td>
</tr>
<tr>
<td>Exploradores</td>
<td>G286716E46597S</td>
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<tr>
<td>Fiero</td>
<td>G286697E466659S</td>
</tr>
<tr>
<td>Cristal</td>
<td>G286714E46737S</td>
</tr>
<tr>
<td>Mocho</td>
<td>G286707E46722S</td>
</tr>
<tr>
<td>Group of small glaciers</td>
<td>G286735E46710S</td>
</tr>
<tr>
<td>Group of small glaciers</td>
<td>G286735E46710S</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](https://example.com).

Download Data
Search the Global Land Ice Measurements from Space Database

This interface is designed to provide a text based method for interacting with the GLIMS Glacier Database. The entire database can be accessed by searching on different criteria (see below). Each glacier outline returned in a result set can be viewed and downloaded in different GIS formats (except those under a specified embargo period).

You must check a search box (on the left) in order to enable searching on that parameter. Checking a box and not entering any search criteria will result in the entire database being returned. Likewise, not checking a box will result in an empty return set.

Please Enter your search parameters to search GLIMS Database.

Main Search Fields

- **Glacier Name**
- **Country**
  - Select...
  - **NOTE:** This may take several minutes.
- **Glacier Area**
  - min: __________ km²
  - max: __________ km²

Advanced Search Fields

- **Glacier ID**
- **WGMS ID**
- **WGMS Classification**
  - Select...
- **Regional Center**
  - Select...
- **Glacier Width(m)**
  - min: __________
  - max: __________
- **Glacier Length(m)**
  - min: __________
  - max: __________
- **Glacier Elev(m)**
  - min: __________
  - max: __________

[Search] [Reset]
<table>
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<th>RC ID</th>
<th>RC Name</th>
<th>Geographic Area</th>
<th>Contact</th>
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<tbody>
<tr>
<td>8</td>
<td>Chinese Academy of Sciences</td>
<td>Chinese Himalaya</td>
<td>Guodong Cheng</td>
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<tr>
<td>16</td>
<td>Geographical Institute</td>
<td>Russian Glaciers (exact boundaries of RC to be defined)</td>
<td>Vladimir Kotlyakov</td>
</tr>
<tr>
<td>12</td>
<td>Jawaharlal Nehru University</td>
<td>Himalaya (India, Nepal, Bhutan)</td>
<td>Syed I. Hasnain</td>
</tr>
<tr>
<td>17</td>
<td>Russian Academy of Sciences</td>
<td>Russian and former Soviet Union glaciers</td>
<td>Vladimir Konovalov</td>
</tr>
<tr>
<td>10</td>
<td>University of Nebraska at Omaha</td>
<td>Southwestern Asia (Pakistan + Afghanistan)</td>
<td>Michael P. Bishop</td>
</tr>
</tbody>
</table>
GLACE Experiments: Purpose

- Quantify inter-Regional Center variability in glacier classification and change detection due to both human and algorithmic differences
- Identify pitfalls in analysis methods and protocols
- In GLACE 2: Quantify variability in change detection
## GLACE 2 Summary statistics

<table>
<thead>
<tr>
<th>Analysis No.</th>
<th>Gl area AST</th>
<th>Gl area TM</th>
<th>Rock area AST</th>
<th>Rock area TM</th>
<th>Area ch, km²</th>
<th>Area ch, %</th>
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<tbody>
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<td>408.6</td>
<td>77.91</td>
<td>85.4</td>
<td>0.9</td>
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<td>2</td>
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<td>55.2</td>
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<td>-1.15</td>
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<tr>
<td>3</td>
<td>677.7</td>
<td></td>
<td>145.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>454.4</td>
<td>453.4</td>
<td>38.6</td>
<td>44.2</td>
<td>1</td>
<td>0.22</td>
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<tr>
<td>5</td>
<td>450.7</td>
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<td>44.3</td>
<td>65.6</td>
<td>9.4</td>
<td>2.13</td>
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<tr>
<td>6</td>
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<td>90.3</td>
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<td>-2.8</td>
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<tr>
<td>8</td>
<td>459.8</td>
<td>503.9</td>
<td>6</td>
<td>5.5</td>
<td>-44.1</td>
<td>-8.75</td>
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<tr>
<td>Min</td>
<td>304.7</td>
<td>316.8</td>
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<td>0</td>
<td>-44.1</td>
<td>-8.75</td>
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<tr>
<td>Max</td>
<td>677.7</td>
<td>503.9</td>
<td>145.8</td>
<td>90.3</td>
<td>9.4</td>
<td>2.13</td>
</tr>
<tr>
<td>Mean</td>
<td>454.16</td>
<td>431.09</td>
<td>59.18</td>
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<td>-1.99</td>
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<tr>
<td>Std Dev</td>
<td>105.2</td>
<td>60.77</td>
<td>48.79</td>
<td>35.73</td>
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<tr>
<td>Median</td>
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<td>441.3</td>
<td>51.55</td>
<td>55.2</td>
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<td>-1.15</td>
</tr>
</tbody>
</table>
GLACE Conclusions

✗ Results for GLACE 2 better than for GLACE 1
✗ Main differences are in accumulation areas
✗ This points to the need for:
  ✔ increased used of topographic information
  ✔ protocols for how to define a “glacier”
✗ The reality is better than this appears: QC steps at data ingest time would have disqualified several of the GLACE analyses.
GLIMS Glacier Database stores geospatial data and many scalar attributes of ~52000 glaciers.

Database is accessible via the Web at http://glims.colorado.edu/glacierdata/ and http://glims.colorado.edu/textsearch/

Chinese Glacier Inventory makes up most of the current data volume.

GLACE Experiments are improving the quality of GLIMS data processing and protocols.
Thank you!
Got questions?

Interactive maps:
http://glims.colorado.edu/glacierdata/

Text field search:
http://glims.colorado.edu/textsearch/

Main GLIMS Website:
http://www.glims.org/
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, ...
GLIMS Glacier Database System Architecture

Map browse, plus clip-and-ship
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.
Future Work

✗ Ship FGDC metadata with downloaded data
✗ Interface improvements and fixes
✔ handle projections better
✔ implement Google Maps-like no-refresh style interface (probably using open-source ka-Map)
✔ better presentation of multi-temporal data
✔ Offer more choices for attribute sets