GLIMS: Progress in Mapping the World's Glaciers

Bruce H. Raup, Siri Jodha S. Khalsa, Richard Armstrong
National Snow and Ice Data Center, University of Colorado UCB 449, Boulder, CO 80309-0449

Abstract:

The Global Land Ice Measurements from Space (GLIMS) project has built a geospatial and temporal database (Figure 1) of glacier data, composed of glacier outlines and various attributes, e.g. glacier name, area, and data source details. These data are being derived primarily from satellite imagery, such as from ASTER and Landsat. Each "snapshot" of a glacier is from a specific time, and the database is designed to store multiple snapshots representative of different times. The database currently contains outlines for approximately 62 000 glaciers (Figure 2).

We have implemented two web-based interfaces to the database. One enables exploration of the data via interactive maps (web map server, Figure 3), while the other allows searches based on text-field constraints (Figure 4). The web map server is an Open Geospatial Consortium (OGC) compliant Web Map Server (WMS) and Web Feature Server (WFS). This means that other web sites can display glacier layers from our site over the Internet, or retrieve glacier features in vector format. All components of the system are implemented using Open Source software: Linux, PostgreSQL, PostGIS (geospatial extensions to the database), MapServer (WMS and WFS), and several supporting components such as Proj.4 (a geographic projection library) and PHP. These tools are robust and provide a flexible and powerful framework for web mapping applications.

As a service to the GLIMS community, the database contains metadata on all ASTER imagery acquired over glacierized terrain. Reduced-resolution images (browse imagery) can be viewed either as a layer in the MapServer application (a layer in Figure 3), or overlaid on the virtual globe within Google Earth (Figure 5). The interactive map application allows the user to constrain by time what data appear on the map. For example, ASTER or glacier outlines from 2002 only, or from Autumn in any year, can be displayed. The Google Earth interface has similar functionality via its timeline tool.

The system allows users to download their selected glacier data in a choice of formats. The results of a query based on spatial selection (using a mouse) or text-field constraints can be downloaded in any of these formats: ESRI shapefiles, KML (Google Earth, Figure 6), MapInfo, GML (Geography Markup Language) and GMT (Generic Mapping Tools). This "clip-and-ship" function allows users to download only the data they are interested in.

We have developed a free application called GLIMSView (Figure 7) that Regional Centers are using to digitize glacier outlines, or to prepare outlines produced with other tools for ingest into the GLIMS Glacier Database.

Our flexible web interfaces to the database, which includes various support layers, will facilitate enhanced analysis to be undertaken on glacier systems, their distribution, and their impacts on other Earth systems.

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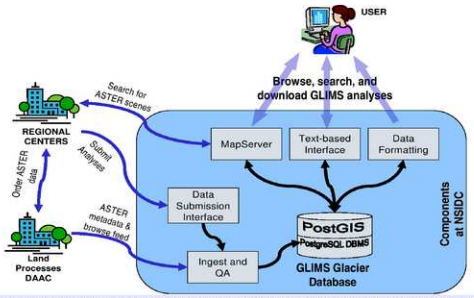

Figure 1: Flow of data and information within GLIMS. Regional Centers view available ASTER scenes, order the desired scenes from the LPDAAC, digitize glacier outlines, attach GLIMS-specific metadata, and then package the data for import into the GLIMS database. Results are uploaded through the GLIMS data submission interface. Users view analyses through a web-based map server and can perform queries using this interface or a text-base interface. User-selected results can be downloaded in a choice of formats, including Shapefiles, GMT, GML, and KML.

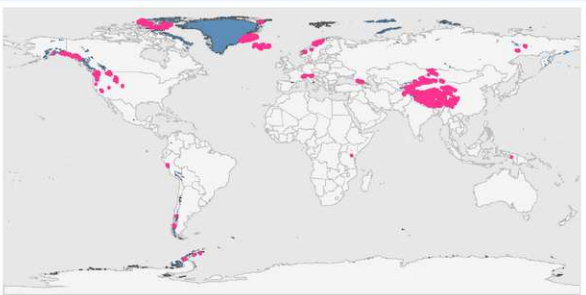

Figure 2: Map of the approximately 62 000 GLIMS glacier outlines, which cover all glacierized continents (red). Glacier layer from ESRI's Digital Chart of the World is also shown for reference (blue).

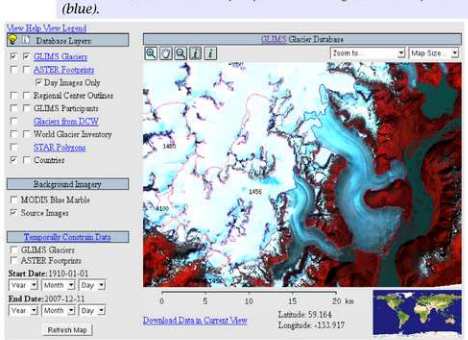

Figure 3: The MapServer-based GLIMS Glacier Database viewer, showing glacier boundaries, snow lines, internal rock boundaries, background imagery, and several other related data layers.

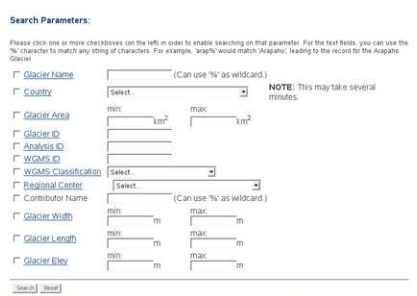

Figure 4: The text-based search interface, allowing the user to find glaciers by name, size, type, and other attributes.

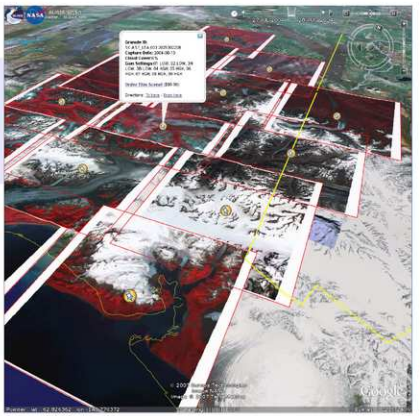

Figure 5: ASTER Browse images displayed in Google Earth as ground overlays. Google Earth displays the images draped over the terrain, and the timeline tool (upper right) can be used to control which images are displayed.

Figure 6: Outlines and metadata from the GLIMS Glacier Database displayed in Google Earth.

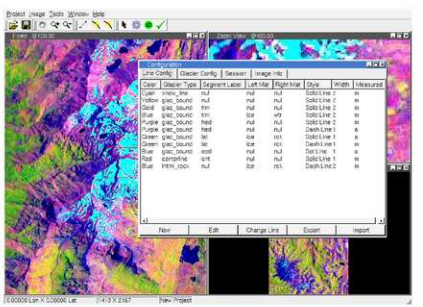

Figure 7: Example of GLIMSView session. Glacier outlines can be digitized and attributed, then exported for ingest into the GLIMS Glacier Database.

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http://glims.org/ http://nsidc.org/glims/