GLIMS: Progress in Mapping the World's Glaciers

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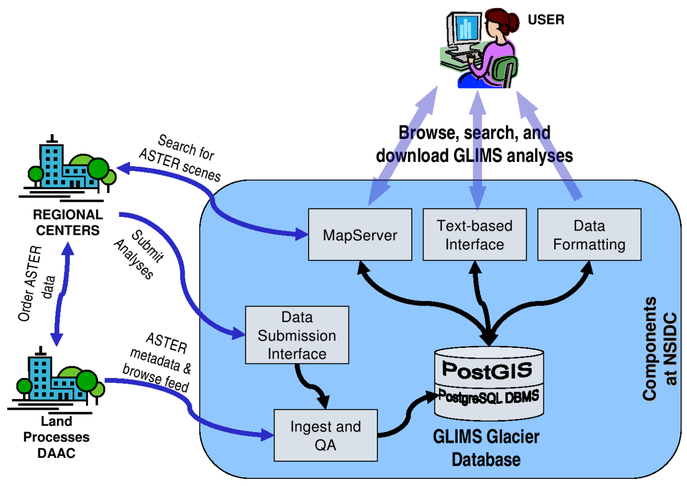
Introduction:

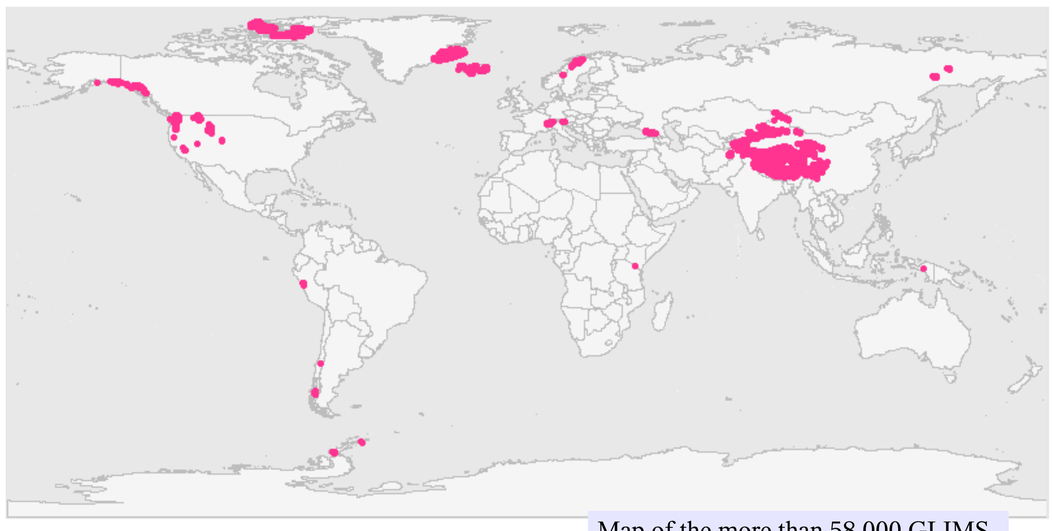
The Global Land Ice Measurement from Space (GLIMS) project is a cooperative effort of over sixty institutions world-wide with the goal of inventorying a majority of the world's estimated 160 000 glaciers. Each institution (called a Regional Center, or RC) oversees the analysis of data for a particular region of the globe containing glacier ice. Data received by the GLIMS team at the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado are inserted into a geospatial database and made available via a web site featuring an interactive map, a text-based interface, and a Web-Mapping Service. The GLIMS Glacier Database now contains outlines of over 58 000 glaciers.

As submissions to the database from all over the world increase, we find that we must accommodate a greater diversity in character and quality of the data submitted than was originally anticipated. Here we present an overview of the current glacier outline inventory, and examine issues related to data coverage, and data quality.

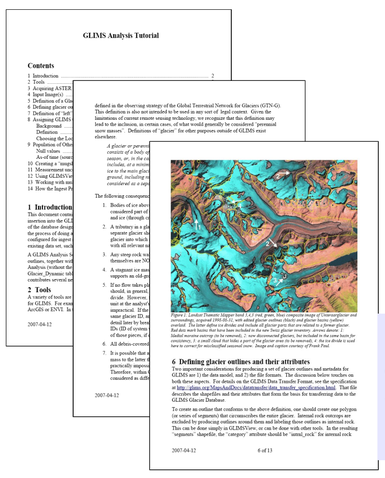
The GLIMS Glacier Database, Web interfaces to it, as well as the GLIMSView tool, provided to help in the production of GLIMS analyses, are all built from Open Source software.



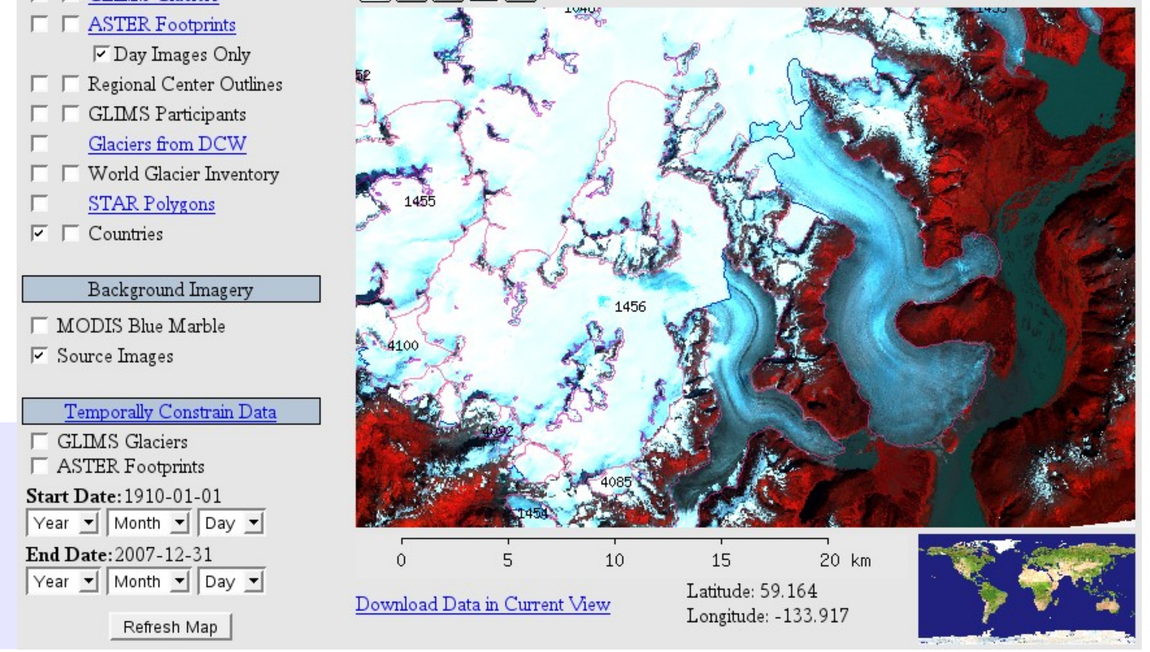
Flow of data and information within GLIMS. Regional centers view available ASTER scenes, order the desired scenes from the LPDAAC, digitize glacier outlines, attach GLIMS-specific metadata, and then package the data for import into the GLIMS database. Results are uploaded through the GLIMS data submission interface. Users view analyses through a web-based mapserver 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.



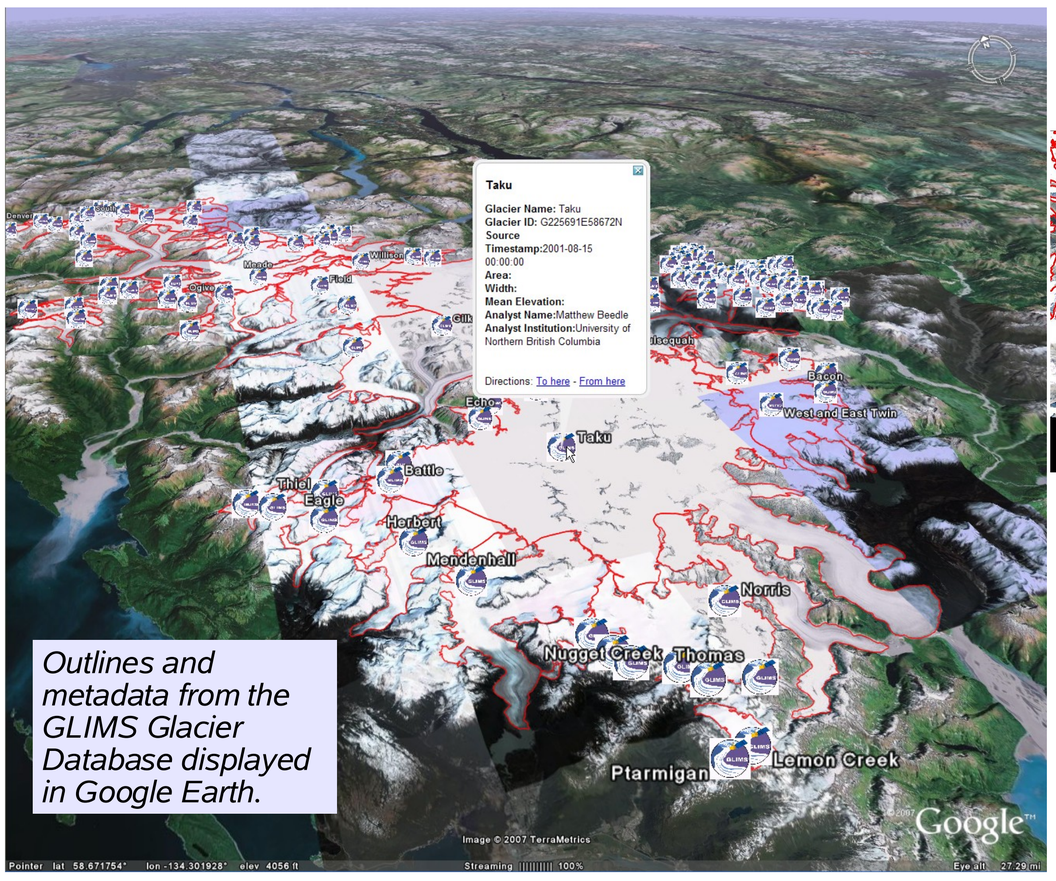
Map of the more than 58 000 GLIMS glacier outlines, which cover all glacierized continents.



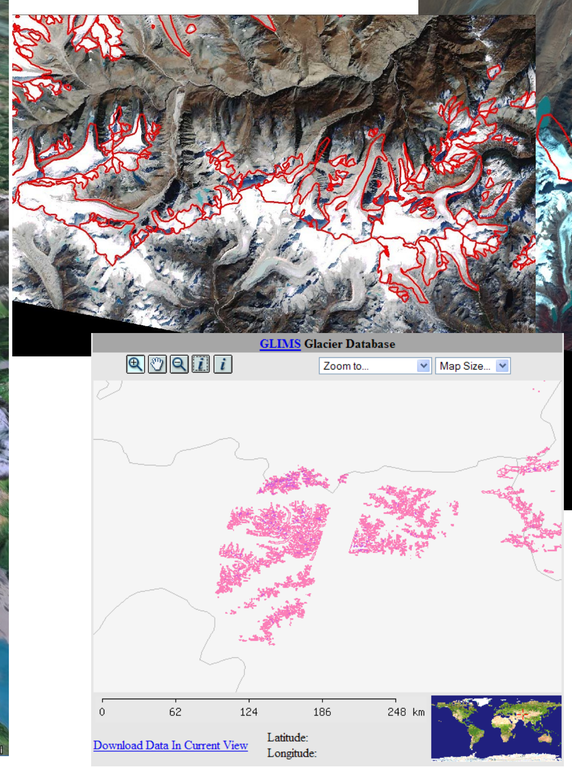
The GLIMS Analysis tutorial provides guidance on preparing a glacier outline data set for insertion into the GLIMS Glacier Database.

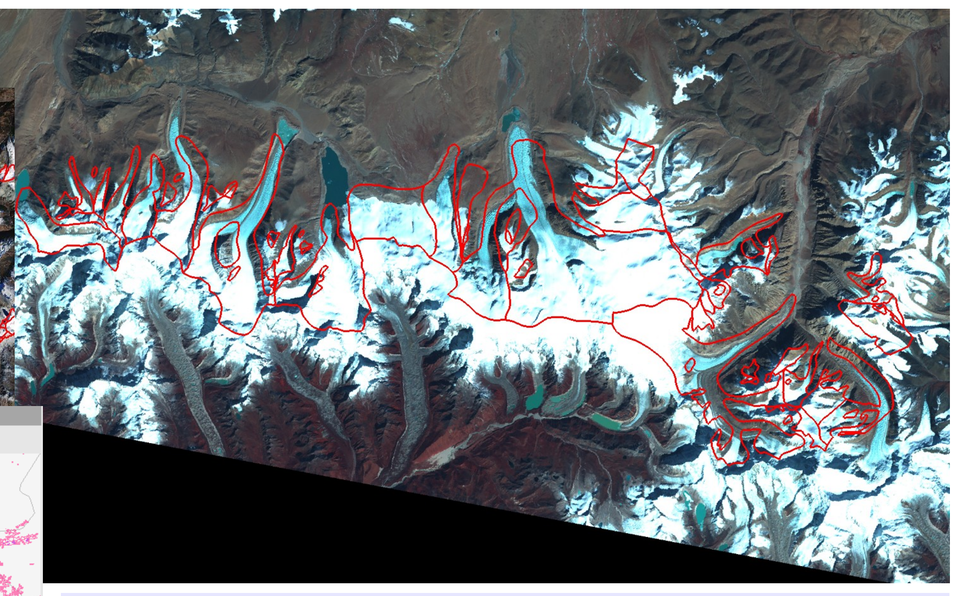


The MapServer-based GLIMS Glacier Database viewer, showing glacier boundaries, snow lines, internal rock boundaries, background imagery, and several other related data layers.



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





Examples of issues with analyses submitted to the GLIMS Database. Top right: arbitrary termination of glacier boundaries at political boundaries (outlines are from older map, imagery is recent); Upper left: subtle geolocation errors; Left: insufficient coverage by satellite imagery limits analysis to scene boundaries.

Summary:

The issues surrounding ingest of a glacier analysis data set submitted to NSIDC are of two types – those that will prevent ingest of the data and those that affect in some way the quality of the data after it has been ingested.

Problems of the first type include:

- Lack required metadata, or failure in some other way to fully conform to the GLIMS data transfer specification. The GLIMS project created GLIMSView, a tool for generating digital outlines of glaciers from imagery, to assist in this process. GLIMSView exports results of glacier analysis into a format that is suitable for direct ingest into the database.
- Incorrect georegistration. When georegistraiton errors are pronounced, quality control procedures prevent ingest.

Problems of the second type include:

- Varying interpretations of what constitutes a glacier. An illustrated manual and tutorial, produced by the GLIMS project, has been produced to help with this.
- Subtle georegistration errors. These are difficult to identify with automated procedures. Often, data having such errors are ingested and only later are these errors found. These errors typically arise from misregistration of the images or maps used in digitization, or from reprojection operations.

Other quality and coverage issues include:

- Arbitrary termination of glacier boundaries at political borders
- Multiple, inconsistent outlines of the same glaciers digitized by different analysts.
- Insufficient coverage by satellite imagery limiting analysis to scene boundaries.
- Assessing change by comparing outlines derived from maps with recent outlines derived from satellite imagery. Without access to the source from which map was made, e.g. aerial photography, sometimes difficult to distinguish real change from differences in interpretation.

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http://glims.org/

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