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

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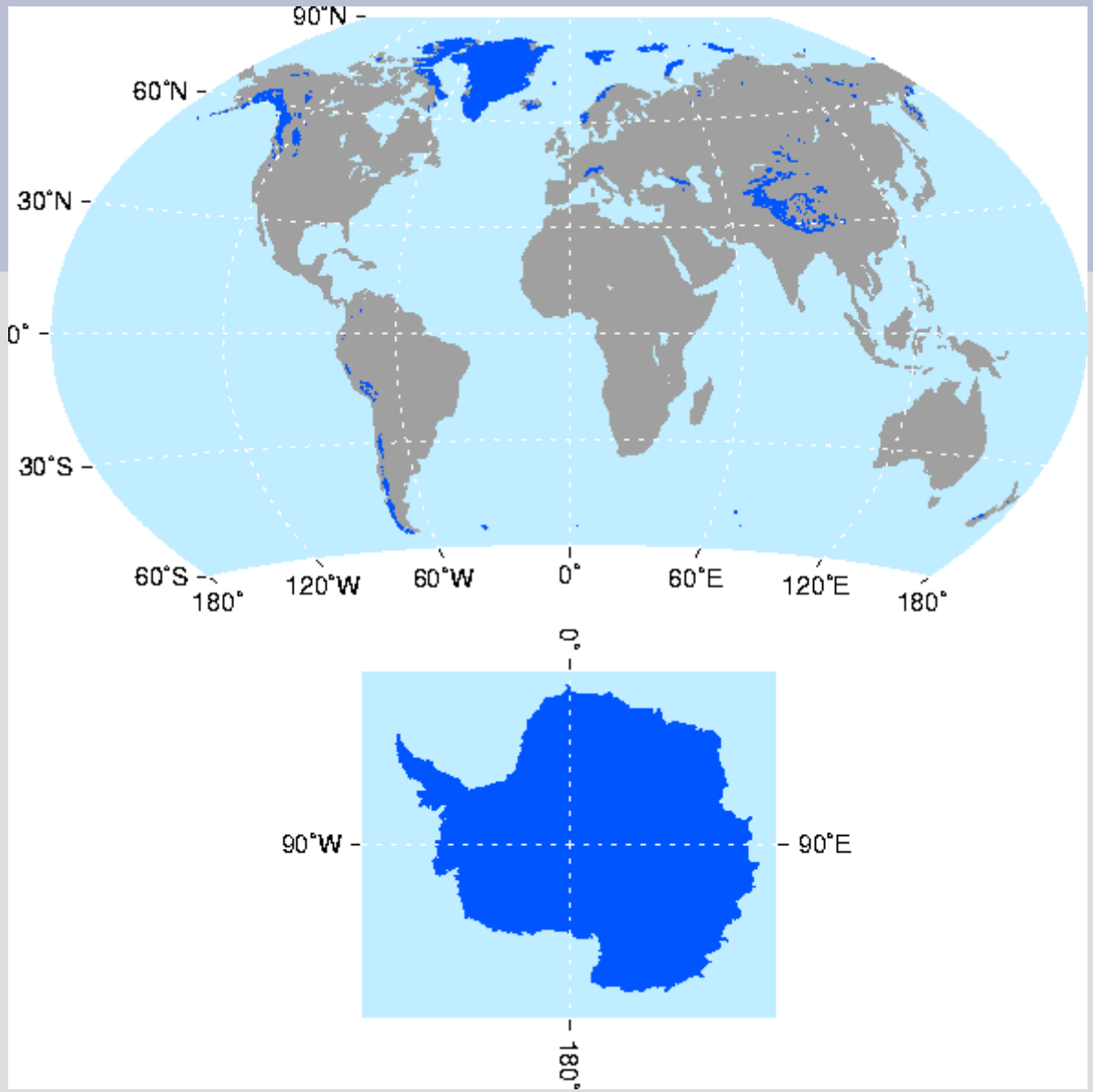
Richard Armstrong
National Snow and Ice Data Center
Boulder, Colorado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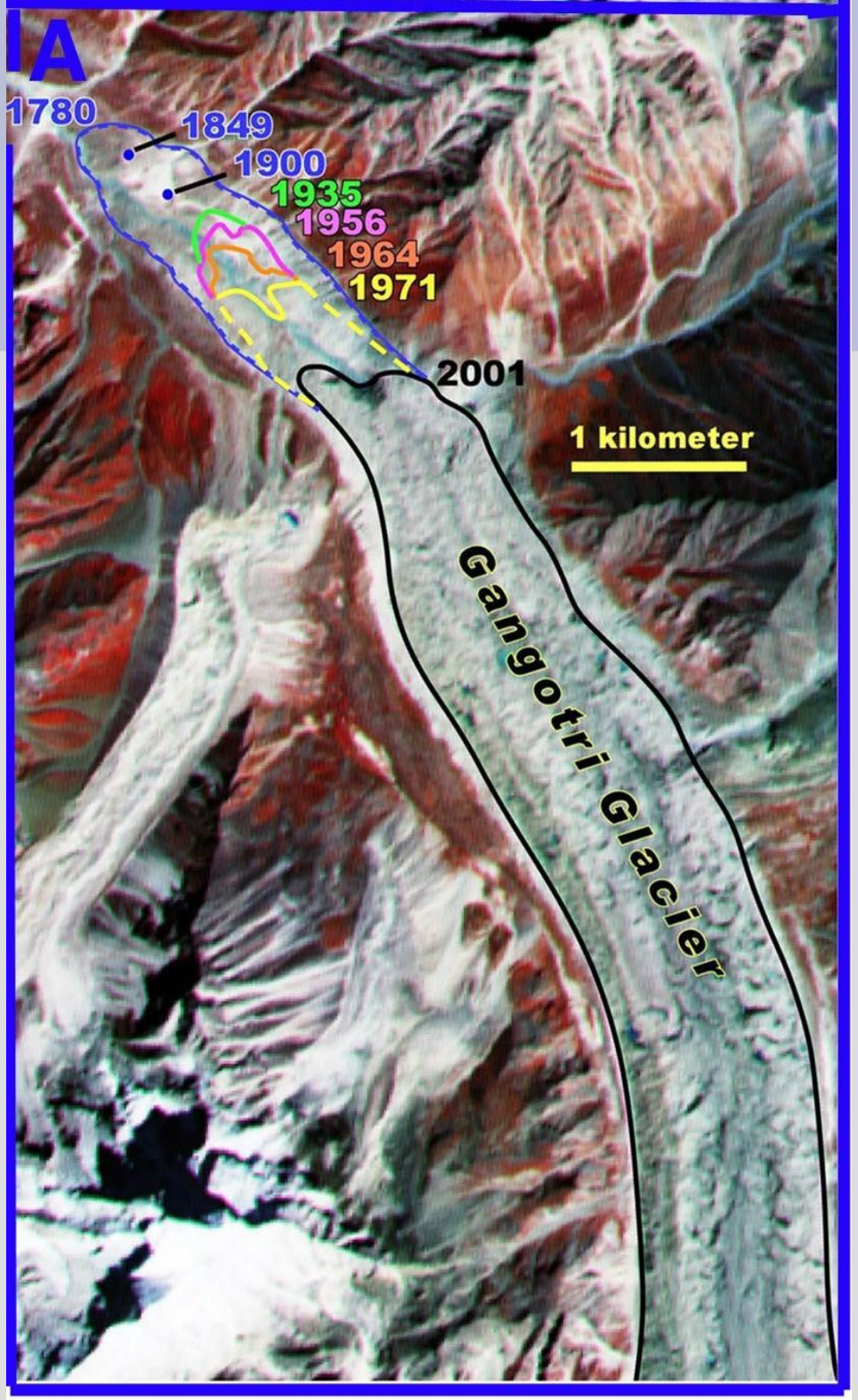


Map data registered to an ASTER image of Gangotri Glacier, India, showing long-term recession.

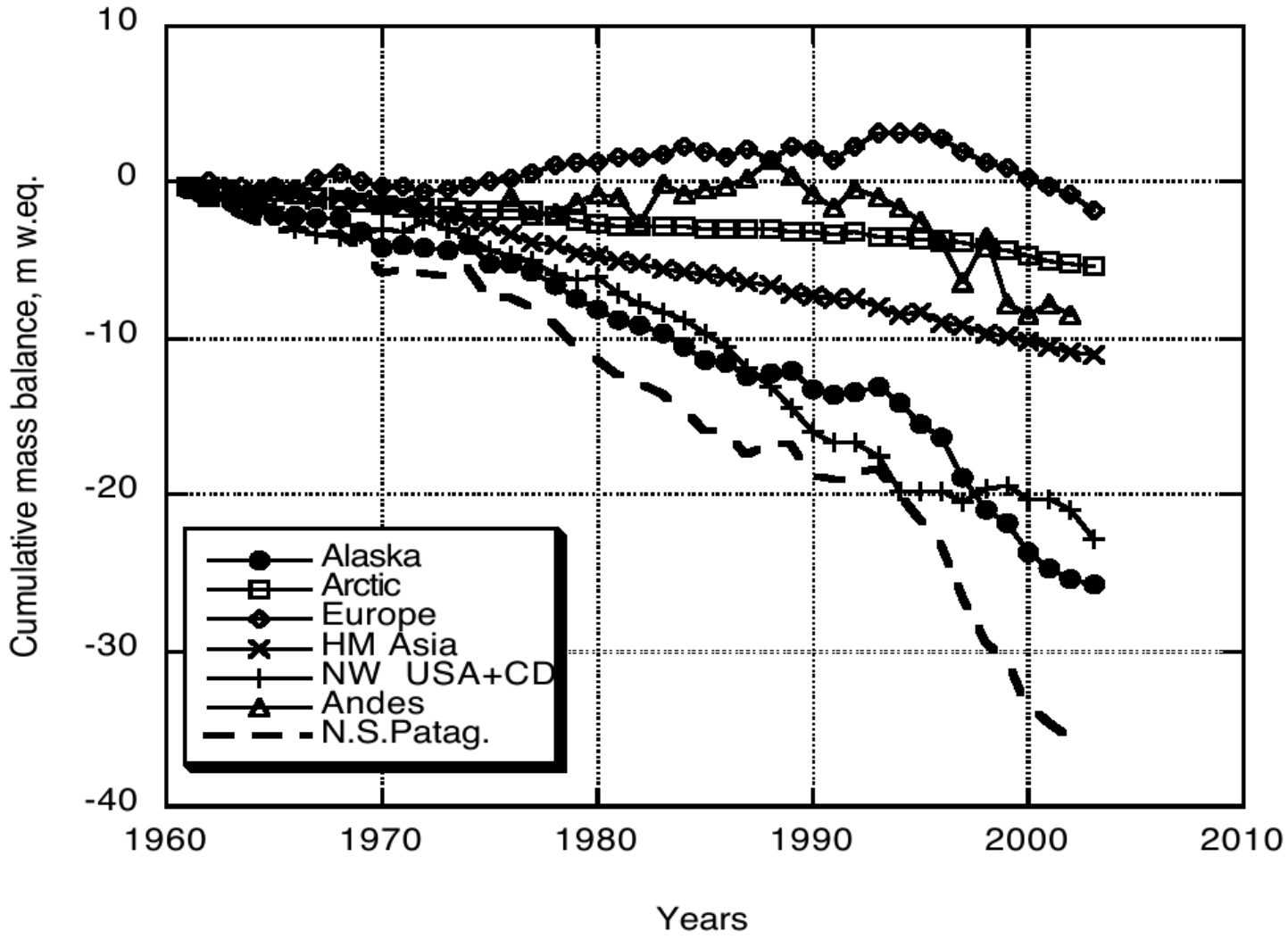


FIGURE 4. Cumulative mass balances calculated for large regions. For these calculations mass balance time series of all glaciers (more than 300 from time to time, and from 30 to 100 with multi-year records) were used (see http://www.nsidc.org). Annual mass balance data were weighted by the surface area 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

HELP Window View Legend

Database Layers:

- [ ] [ ] GLIMS Glaciers
- [ ] [ ] ASTER Footprints
- [x] [x] Regional Center Outlines
- [x] [x] GLIMS Participants
- [ ] Glaciers from DCW
- [ ] [ ] World Glacier Inventory
- [ ] STAR Outlines
- [x] [ ] Countries

Background Data:

- [ ] MODIS Blue Marble
- [ ] Source Images

Temporally Constrain Data

- [ ] GLIMS Glaciers
- [ ] ASTER Footprints

Start Date:1990-01-01

Year | Month | Day

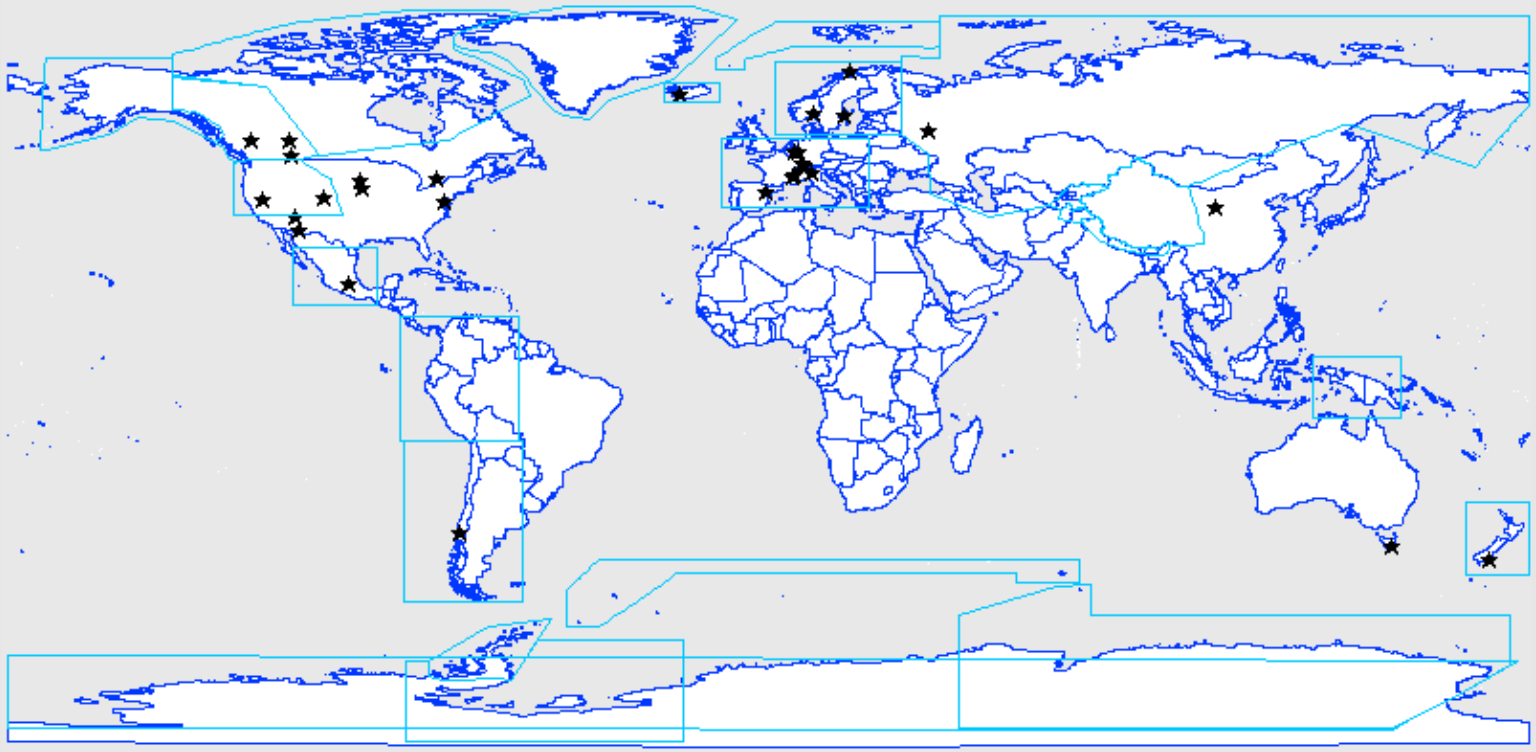
End Date:2005-12-31

Year | Month | Day

Refresh Map

GLIMS Glacier Database

Zoom to... | Map Size...



0 4600 9200 13800 18400 km

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HELP Window View Legend

Database Layers:

- [x] [x] GLIMS Glaciers
- [ ] [ ] ASTER Footprints
- [ ] [ ] Regional Center Outlines
- [ ] [ ] GLIMS Participants
- [ ] Glaciers from DCW
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- [x] [ ] Countries

Background Data:

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- [x] Source Images

Temporally Constrain Data

- [ ] GLIMS Glaciers
- [ ] ASTER Footprints

Start Date:1990-01-01

Year Month Day

End Date:2005-12-31

Year Month Day

Refresh Map

GLIMS Glacier Database

Zoom to... Map Size...

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HELP Window View Legend

GLIMS Glacier Database

Zoom to... Map Size...

Database Layers:

- [x] [x] GLIMS Glaciers
- [ ] [ ] ASTER Footprints
  - [x] Day Images Only
- [ ] [ ] Regional Center Outlines
- [ ] [ ] GLIMS Participants
- [ ] Glaciers from DCW
- [ ] [ ] World Glacier Inventory
- [ ] STAR Outlines
- [x] [ ] Countries

Background Data:

- [ ] MODIS Blue Marble
- [ ] Source Images

Temporally Constrain Data

- [ ] GLIMS Glaciers
- [ ] ASTER Footprints

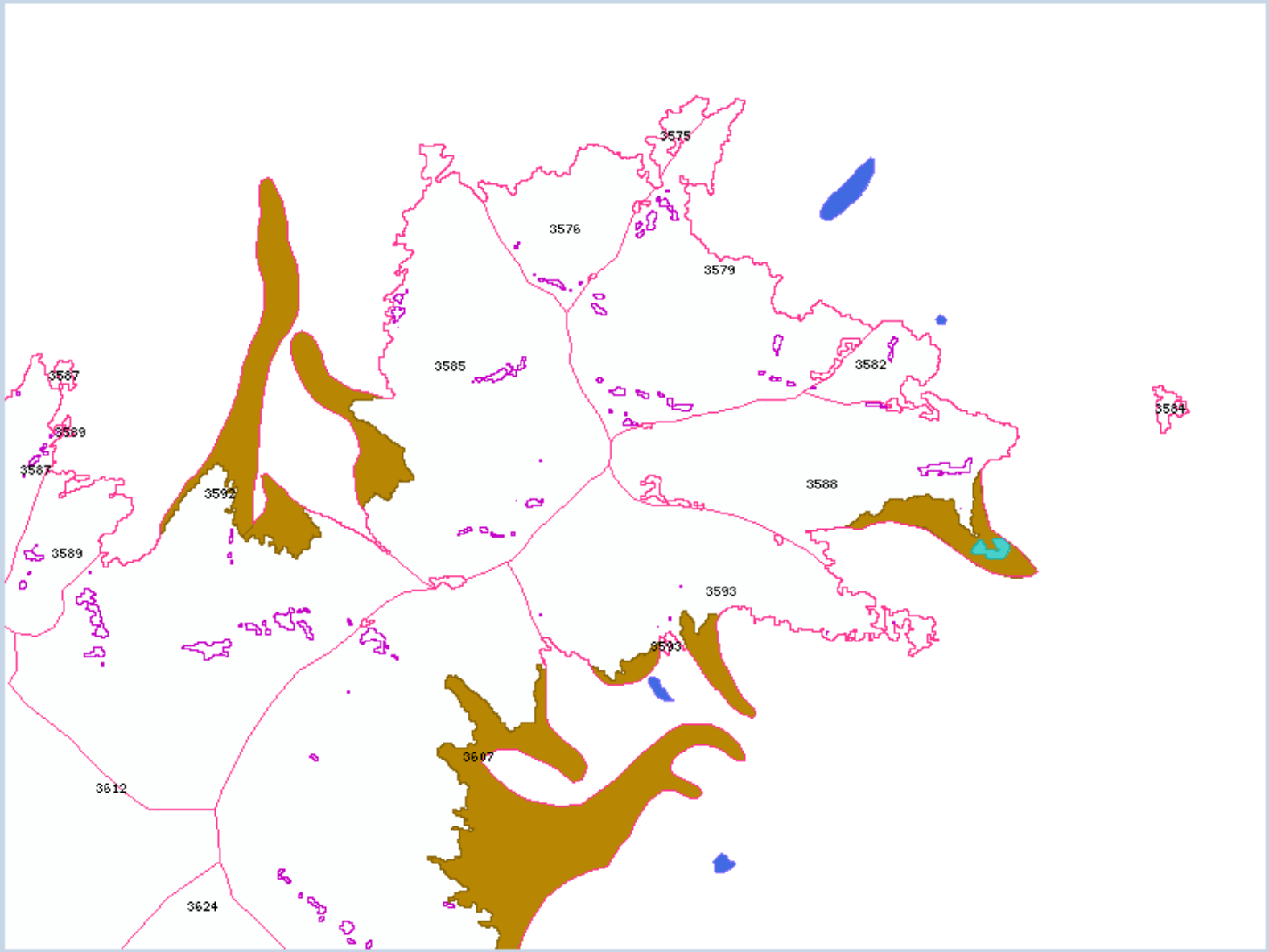
Start Date:1990-01-01

Year Month Day

End Date:2005-12-31

Year Month Day

Refresh Map



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HELP Window View Legend

Database Layers:

- [x] [x] GLIMS Glaciers
- [ ] [ ] ASTER Footprints
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- [ ] ASTER Footprints

Start Date:1990-01-01

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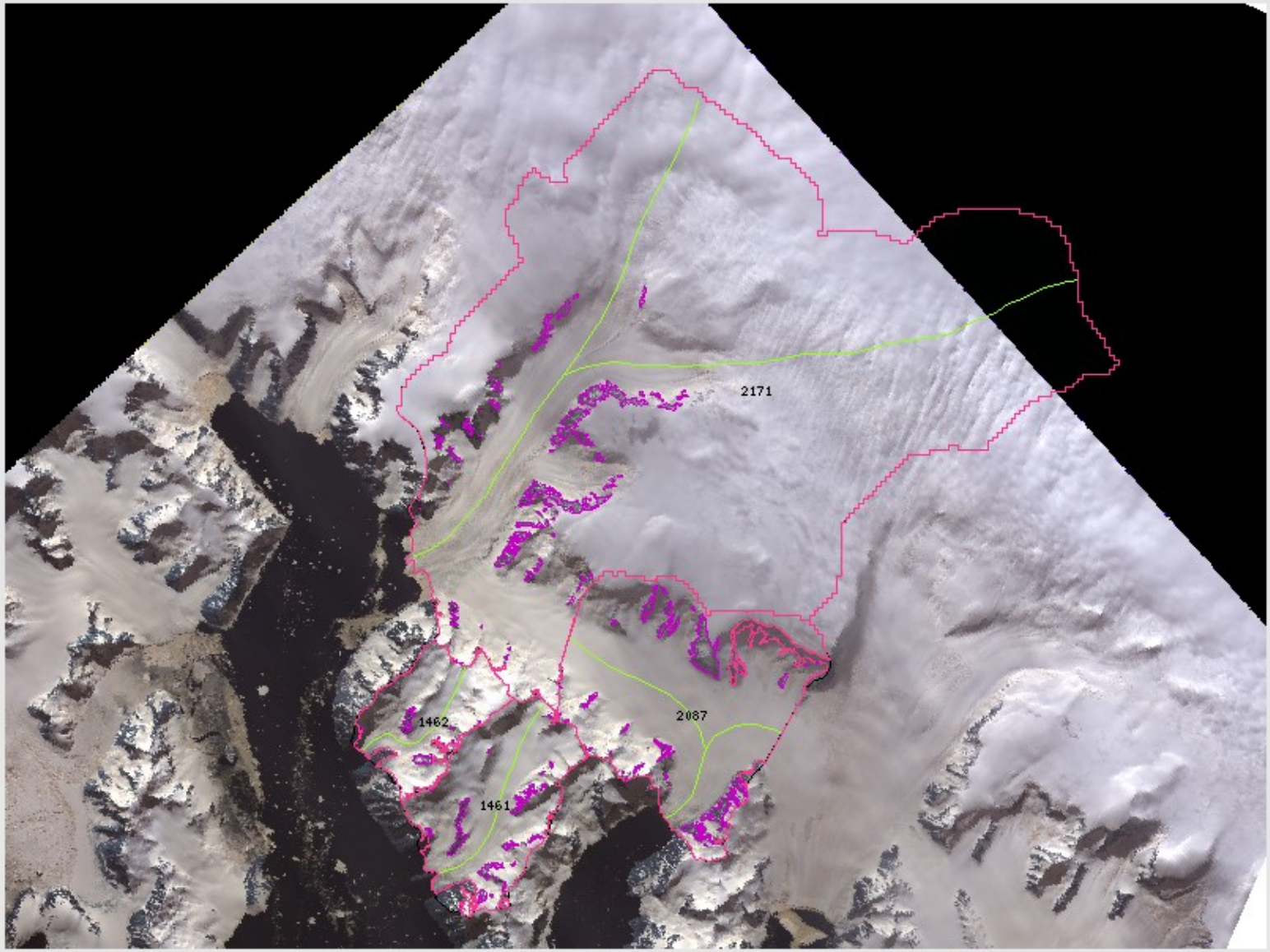
Year Month Day

Refresh Map

GLIMS Glacier Database

Zoom to... Map Size...



0 6 12 18 24 km

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Latitude: -68.375
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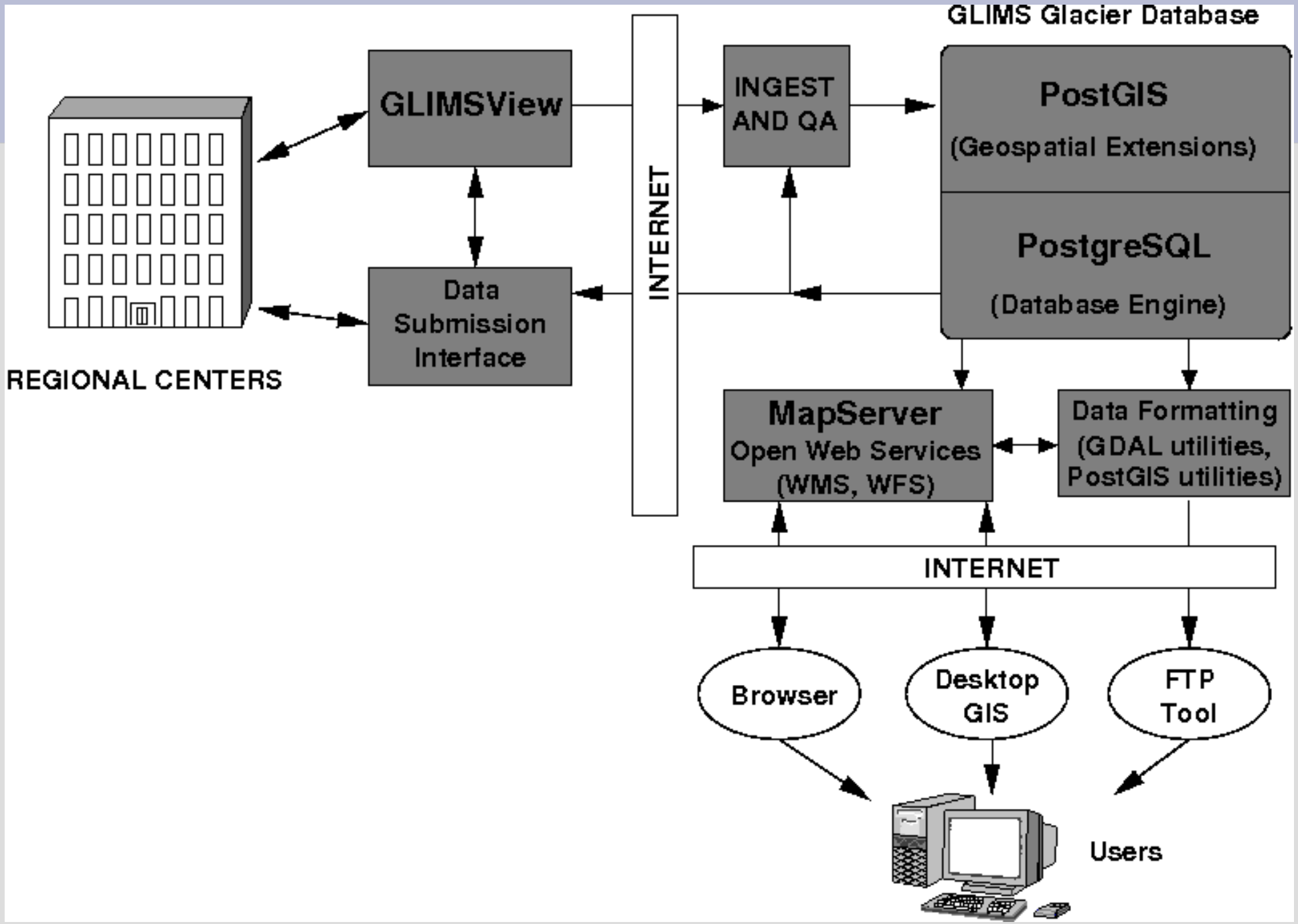
Download GLIMS Data

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



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.

HELP Window View Legend

Database Layers:

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- [x] Source Images

Temporally Constrain Data

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- [ ] ASTER Footprints

Start Date:1990-01-01

Year Month Day

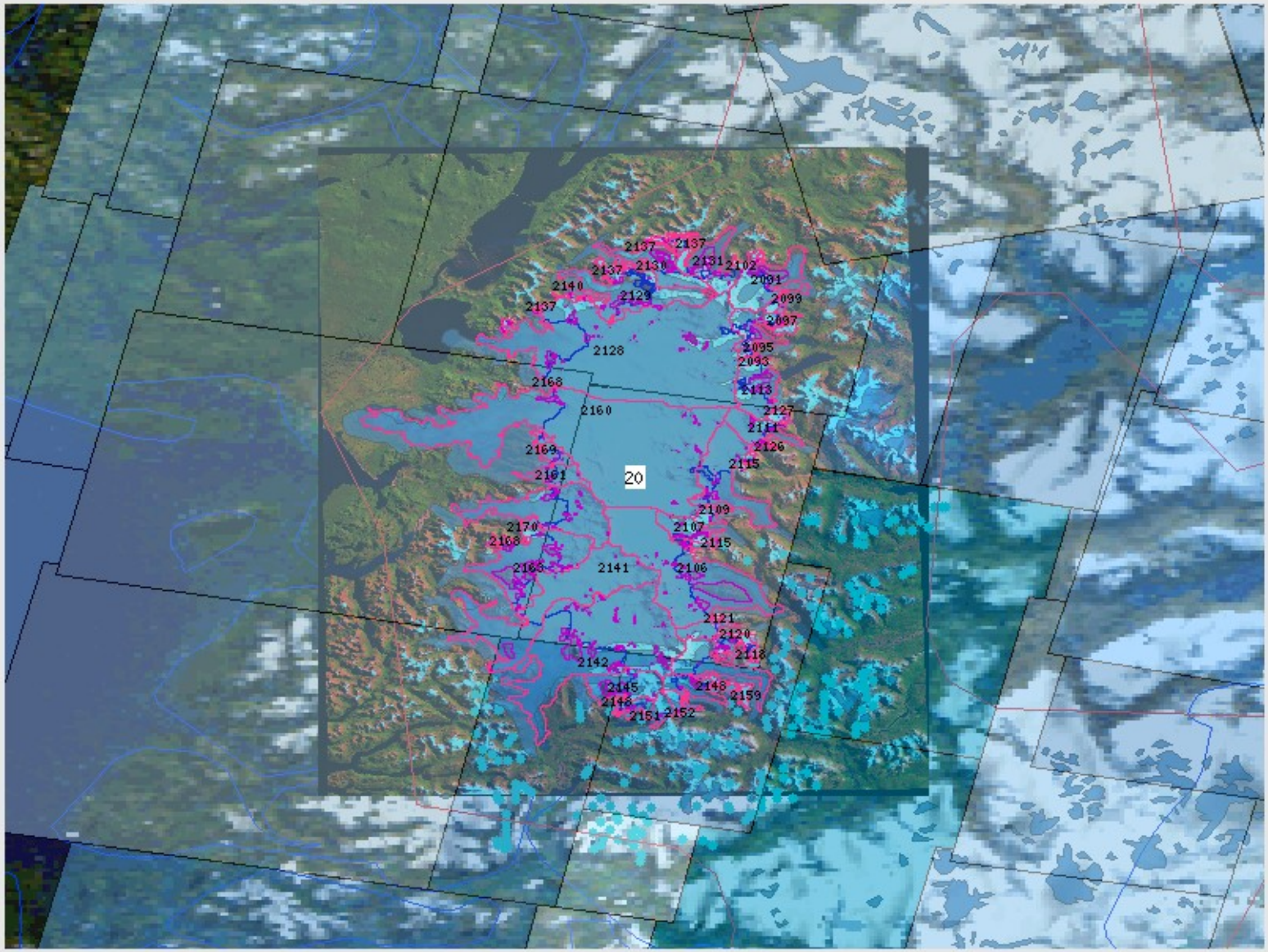
End Date:2005-12-31

Year Month Day

Refresh Map

GLIMS Glacier Database

Zoom to... Map Size...



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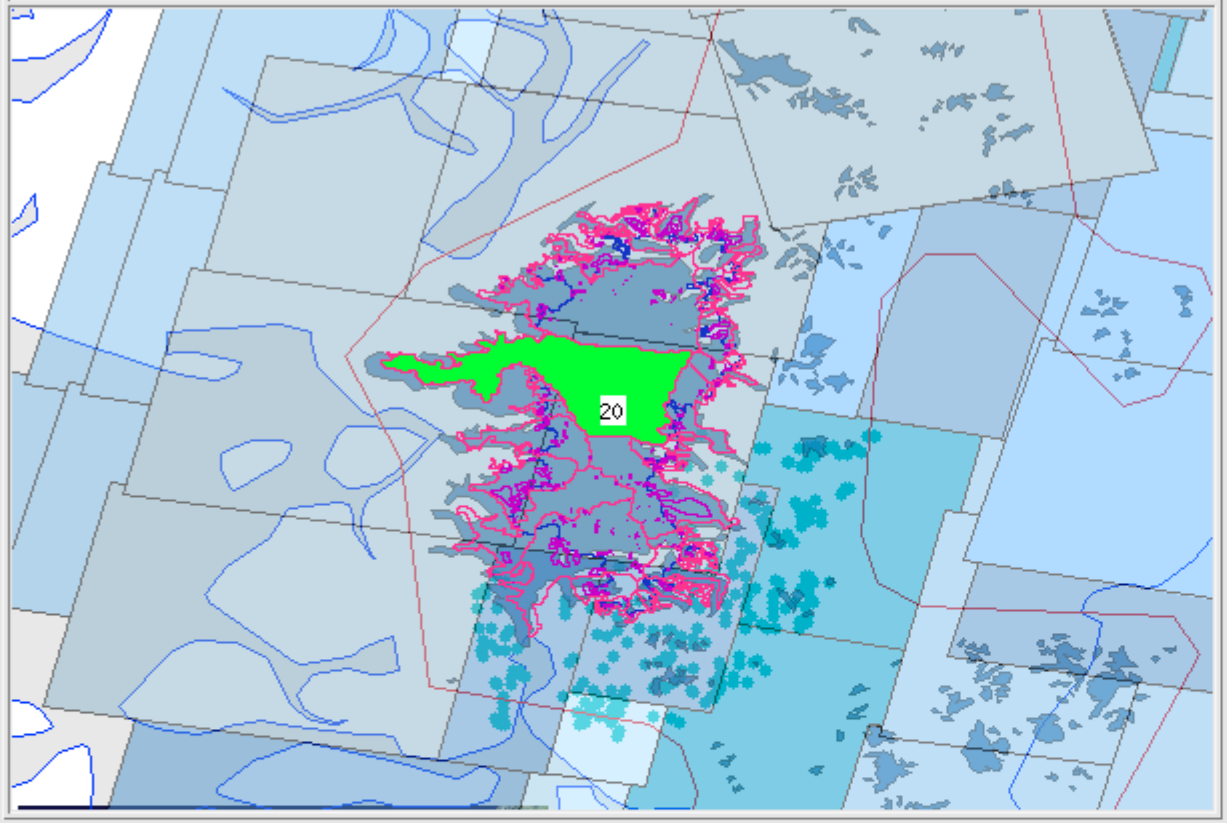
Selected Features



Glacier Outlines

Download Selected Glacier Outlines

Glacier Name	Glacier ID	Data Acquisition Date	WGMS ID	Contributor's Local Glacier ID	Analysis ID	Area, km^2	Analyst Name	Institution	URL	Date Available
San Quintin	G286485E46923S	2001-03-11 00:00:00		NPI-8	2160	789.8	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:43:58

HELP Window View Legend

Database Layers:

- [x] [x] GLIMS Glaciers
- [x] [x] ASTER Footprints
- [x] [ ] Regional Center Outlines
- [x] [ ] GLIMS Participants
- [x] Glaciers from DCW
- [x] [ ] World Glacier Inventory
- [x] STAR Outlines
- [x] [ ] Countries

Background Data:

- [x] MODIS Blue Marble
- [x] Source Images

Temporally Constrain Data

- [ ] GLIMS Glaciers
- [ ] ASTER Footprints

Start Date: 1990-01-01

Year Month Day

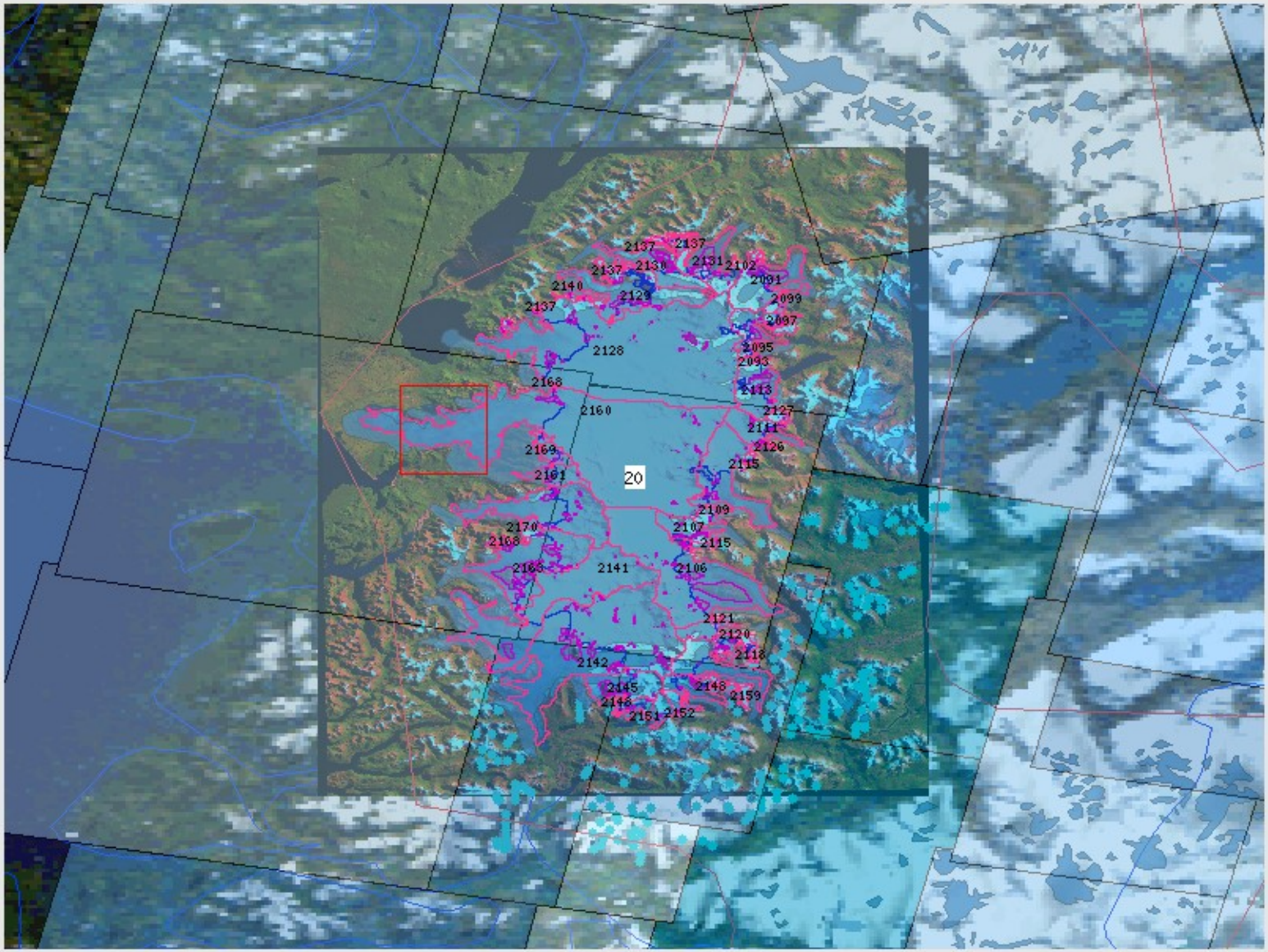
End Date: 2005-12-31

Year Month Day

Refresh Map

GLIMS Glacier Database

Zoom to... Map Size...



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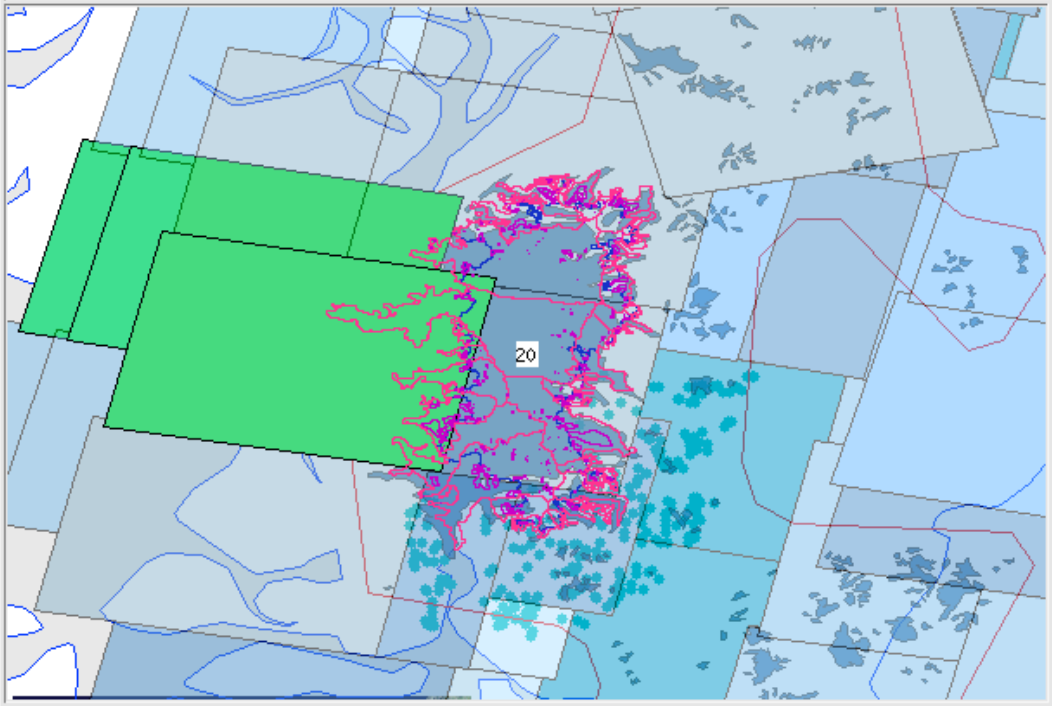
Download GLIMS Data

GLIMS Query Results

Selected Features



GLIMS ASTER Footprints

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SC:AST_L1B.003:2018584500	2018584500	AST_L1B	Day	2001-10-05	100	01 HGH, 02 HGH, 3N NOR, 3B NOR, 04 NOR, 05 NOR, 06 NOR, 07 NOR, 08 NOR, 09 NOR	View Image
SC:AST_L1B.003:2021774914	2021774914	AST_L1B	Day	2004-03-10	0	01 HGH, 02 HGH, 3N NOR, 3B NOR, 04 NOR, 05 NOR, 06 NOR, 07 NOR, 08 NOR, 09 NOR	View Image

Done

Go

http://gli...2004-03-10

-74.5636 -46.6301 -73.6055 -46.7614

-74.731 -47.1853 -73.7633 -47.3179

Image Date: 2004-03-10

Go Back

Done

HELP Window View Legend

Database Layers:

- [x] [x] GLIMS Glaciers
- [x] [x] ASTER Footprints
- [x] [ ] Regional Center Outlines
- [x] [ ] GLIMS Participants
- [x] Glaciers from DCW
- [x] [ ] World Glacier Inventory
- [x] STAR Outlines
- [x] [ ] Countries

Background Data:

- [x] MODIS Blue Marble
- [x] Source Images

Temporally Constrain Data

- [ ] GLIMS Glaciers
- [ ] ASTER Footprints

Start Date: 1990-01-01

Year Month Day

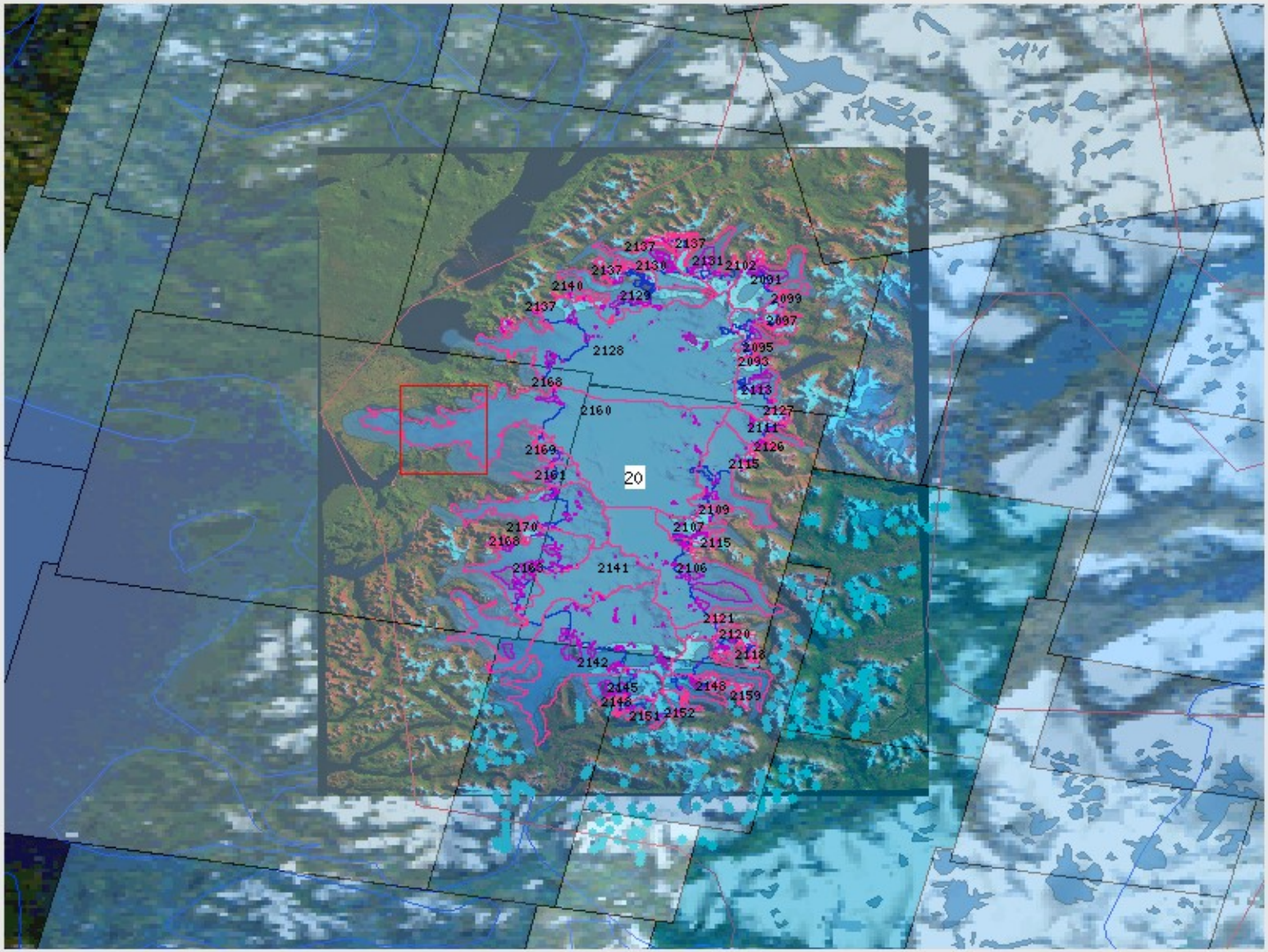
End Date: 2005-12-31

Year Month Day

Refresh Map

GLIMS Glacier Database

Zoom to... Map Size...



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Year Month Day

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Year Month Day

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GLIMS Glacier Database

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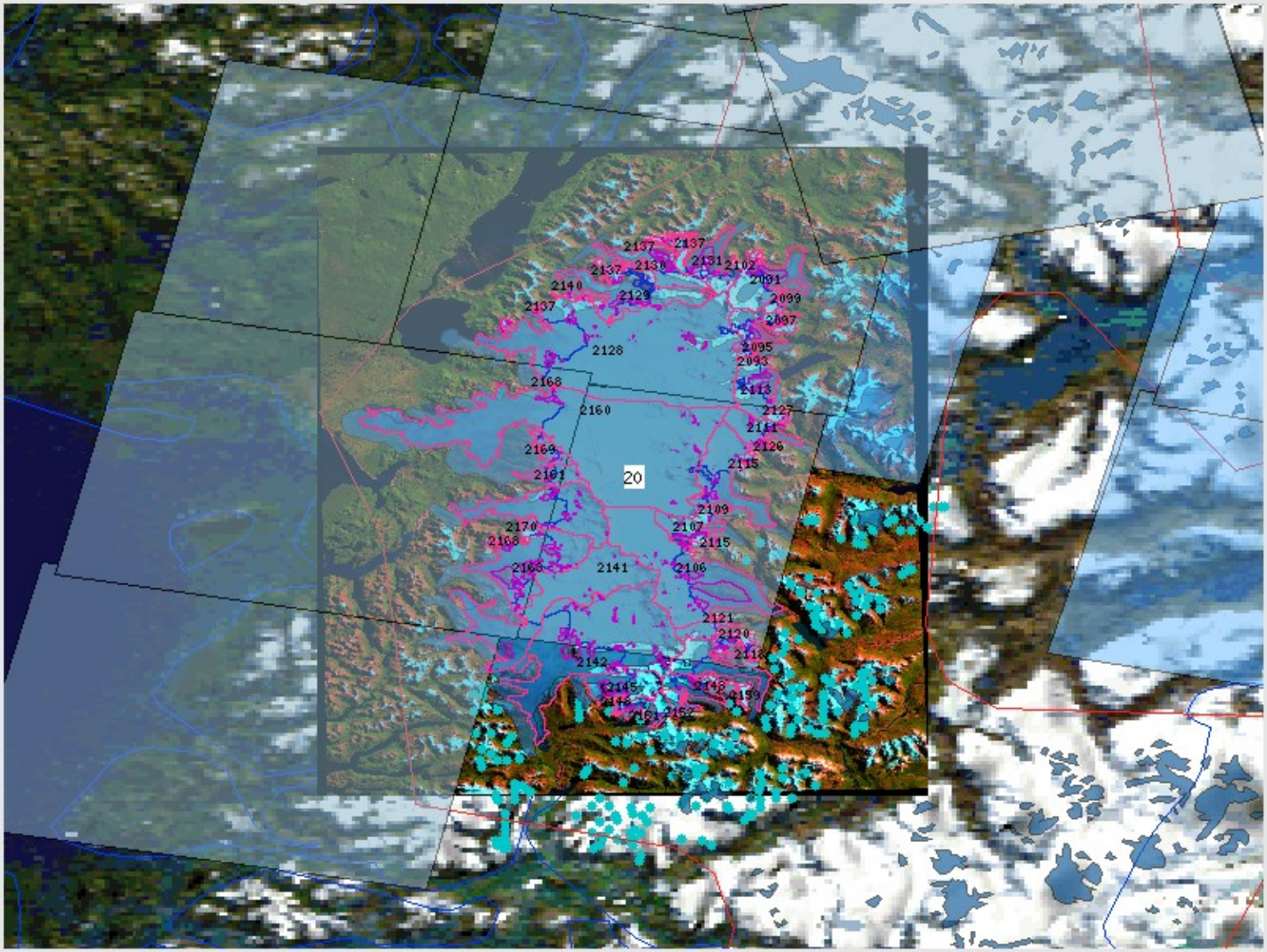

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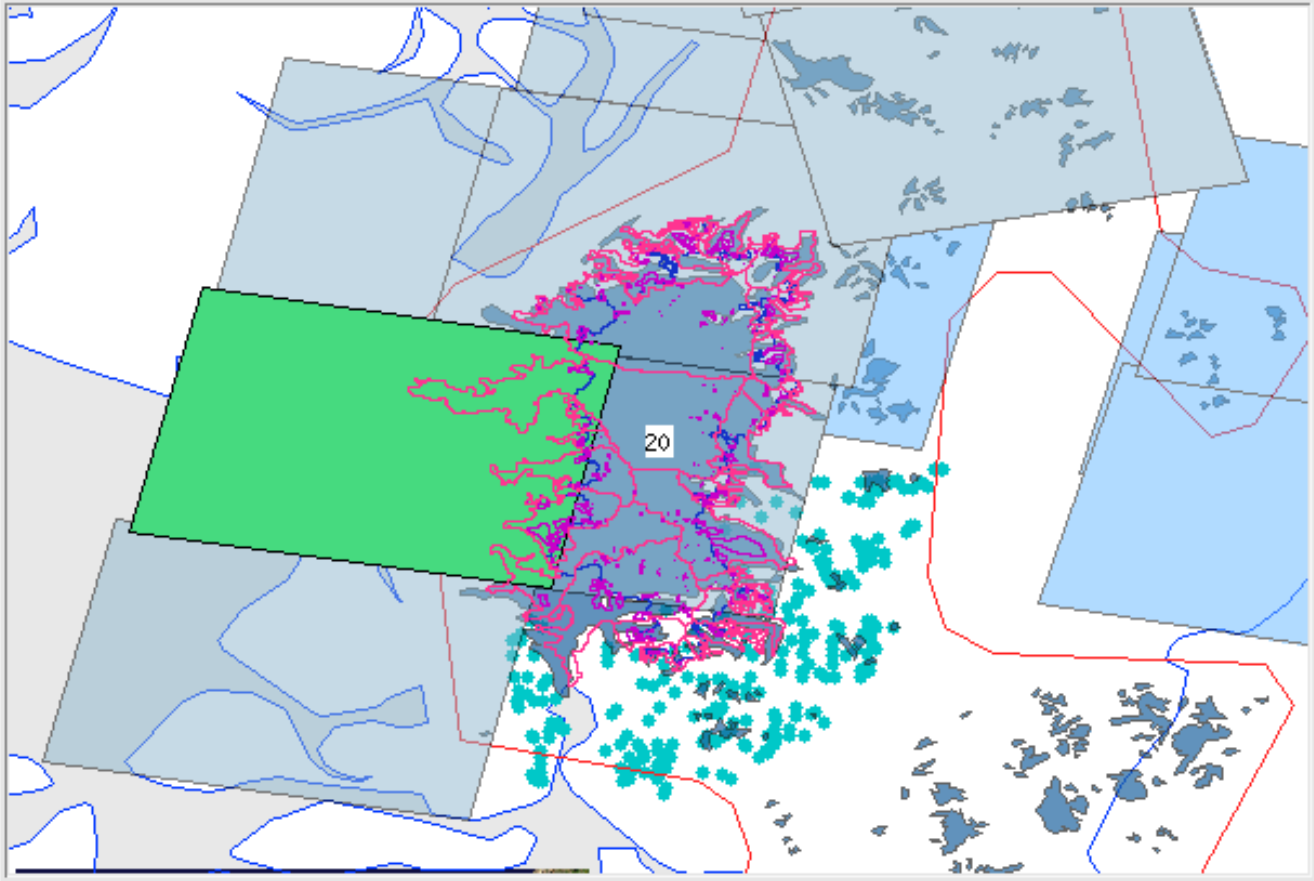
GLIMS Query Results

Selected Features



GLIMS ASTER Footprints

Granule ID	EDC ID	Short Name	Day or Night	Capture Date	Cloud Cover	Gain Settings	View Browse
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Done

HELP Window View Legend

Database Layers:

- [x] [x] GLIMS Glaciers
- [ ] [ ] ASTER Footprints
- [ ] [ ] Regional Center Outlines
- [ ] [ ] GLIMS Participants
- [ ] Glaciers from DCW
- [ ] [ ] World Glacier Inventory
- [ ] STAR Outlines
- [x] [ ] Countries

Background Data:

- [x] MODIS Blue Marble
- [x] Source Images

Temporally Constrain Data

- [ ] GLIMS Glaciers
- [ ] ASTER Footprints

Start Date:2004-01-01

Year | Month | Day

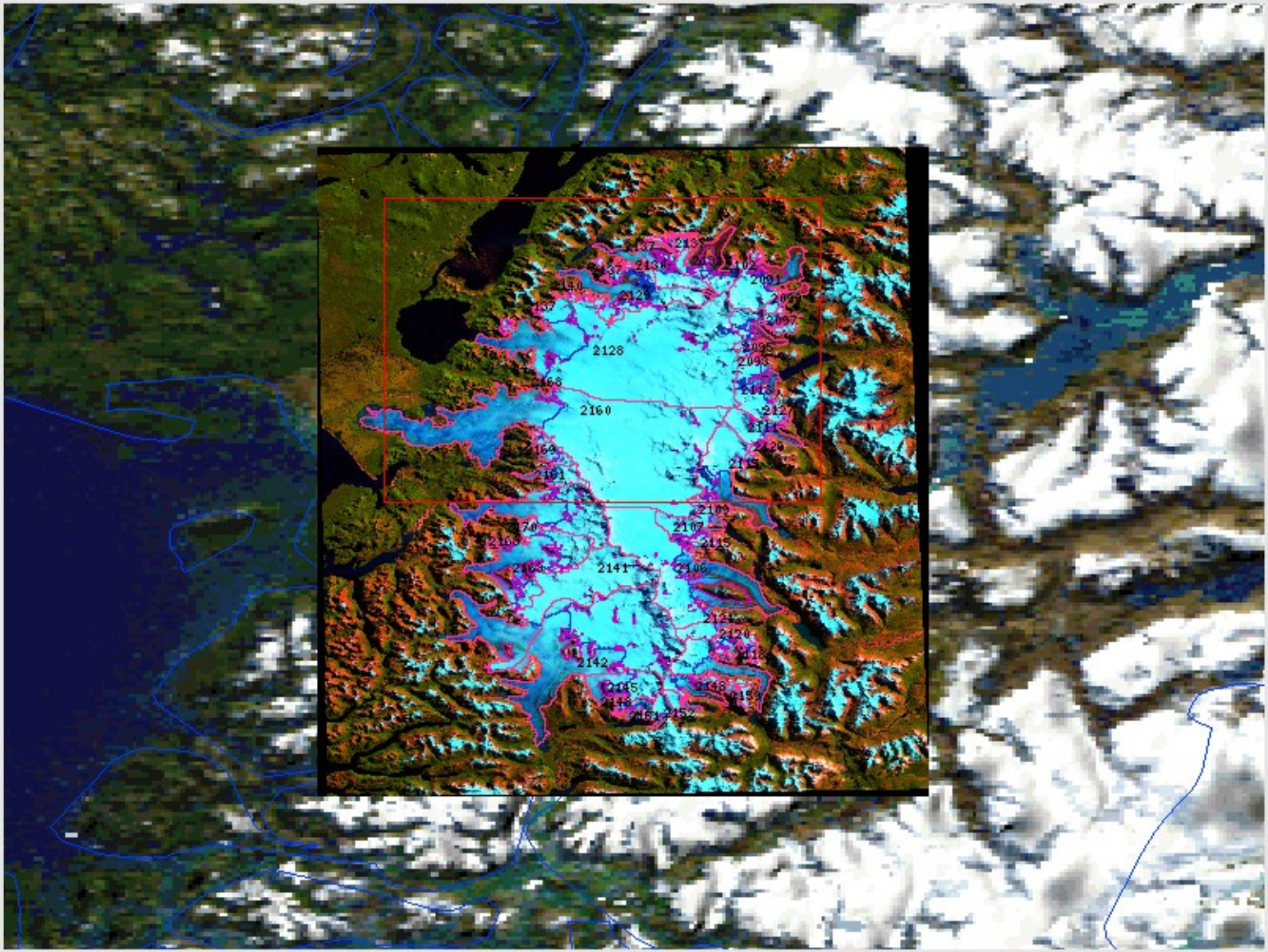
End Date:2005-12-31

Year | Month | Day

Refresh Map

GLIMS Glacier Database

Zoom to... | Map Size...

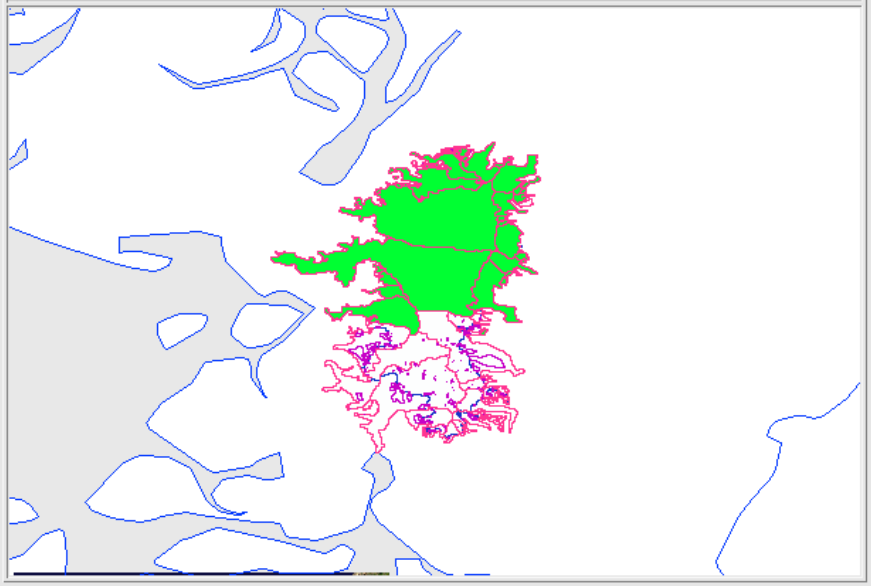


Segment:
Total Dist:

Latitude: -46.119
Longitude: -72.221

Download GLIMS Data

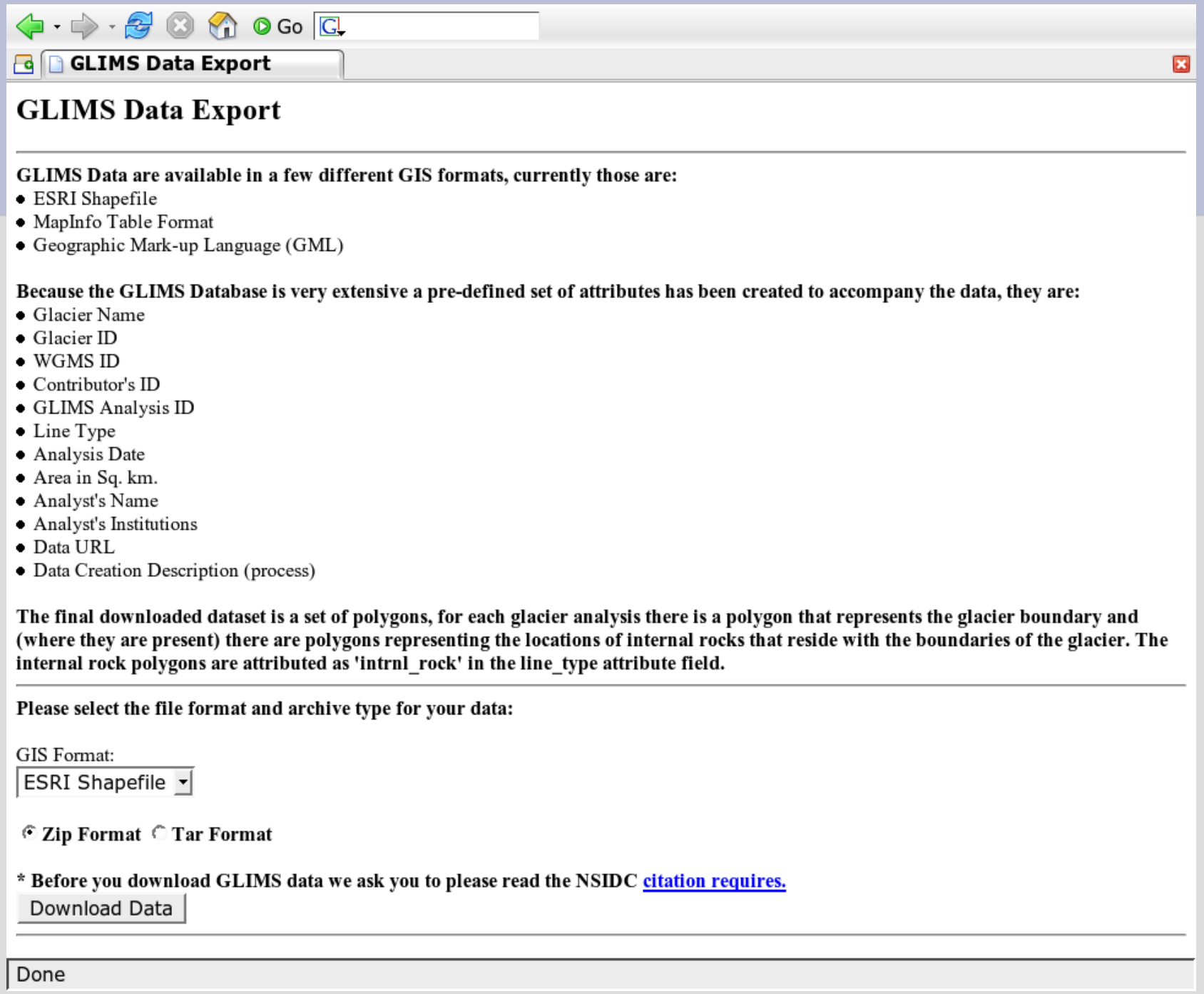
Selected Features



Glacier Outlines

Download Selected Glacier Outlines

Glacier Name	Glacier ID	Data Acquisition Date	WGMS ID	Contributor's Local Glacier ID	Analysis ID	Area, km^2	Analyst Name	Institution	URL	Date Available
Exploradores	G286716E46597S	2001-03-11 00:00:00		NPI-38	2091	85.75	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:46:04
Fiero	G286697E46659S	2001-03-11 00:00:00		NPI-35	2092	41.5	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:46:04
Cristal	G286714E46737S	2001-03-11 00:00:00		NPI-33	2093	5.36	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:46:04
Mocho	G286707E46722S	2001-03-11 00:00:00		NPI-34	2094	5.16	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:46:04
Group of small glaciers	G286735E46710S	2001-03-11 00:00:00		NPI-39	2095	34.6	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:46:04
Group of small	G286735E46710S	2001-03-11 00:00:00		NPI-39	2095	34.6	Francisca Bown	Centro de Estudios Cienticos (CECS)	http://www.cecs.cl	2005-12-20 19:46:04


Go
GLIMS Data Export
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/