

Insights into & findings from global datasets on glacier distribution & changes

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Global Land Ice Measurements from Space initiative, International Association of Cryospheric Sciences



Global Terrestrial Network for Glaciers

Randolph
Glacier
Inventory

Fluctuations
of Glaciers

Glacier
Regions

GLIMS Glacier
Inventory

Global Glacier
Browser

Glacier
Photograph
Collection

World Glacier
Inventory

Glacier
Thickness
Database

Glacier Map
Collection

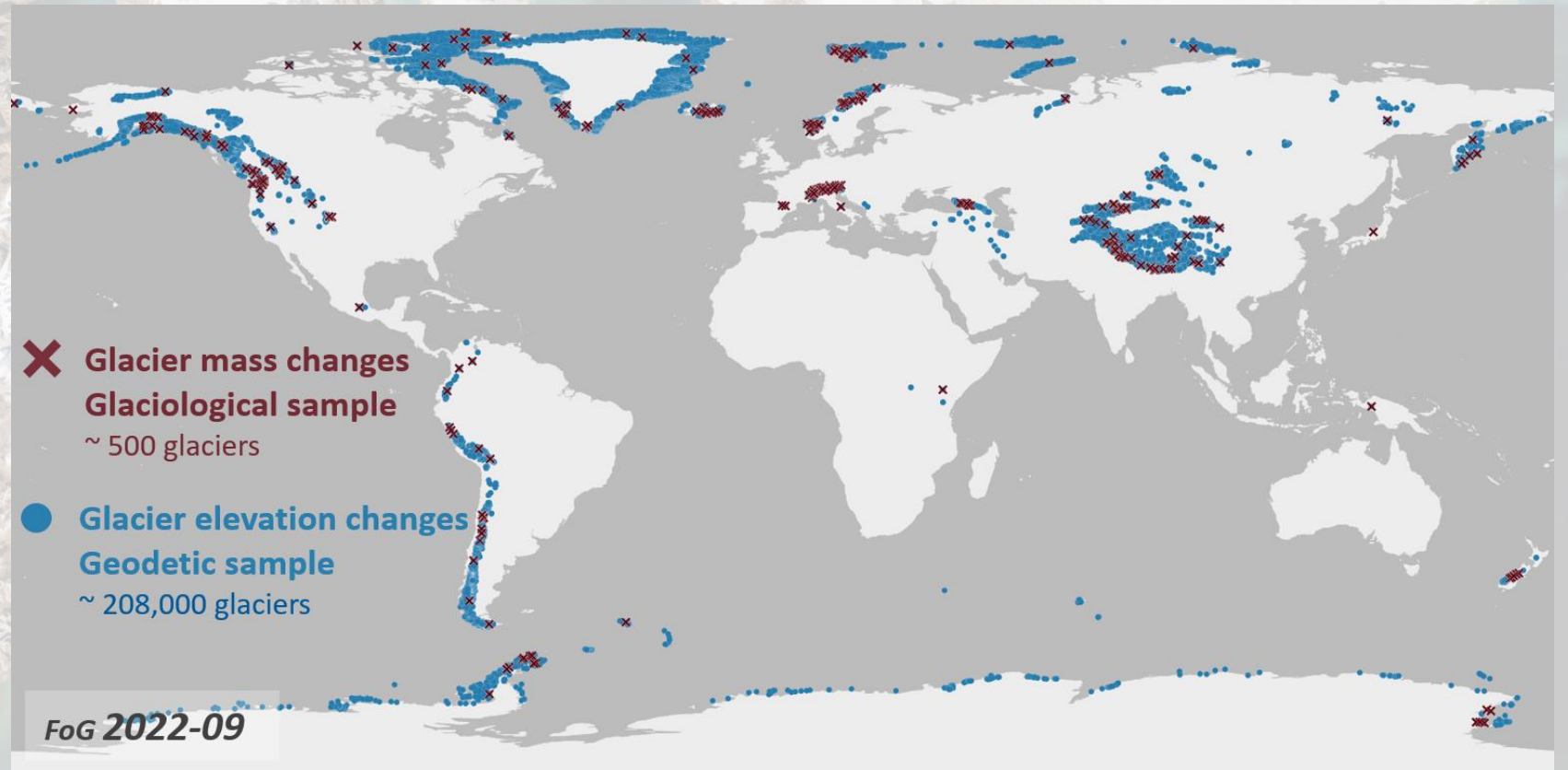
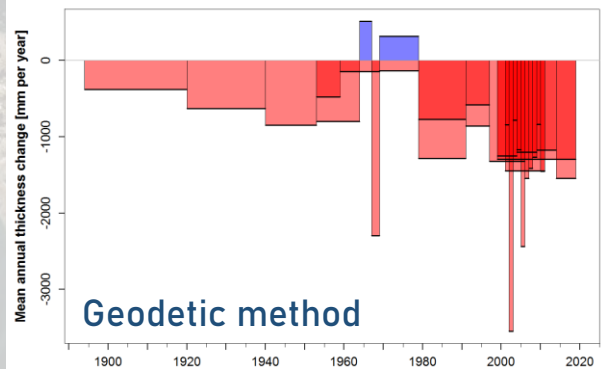
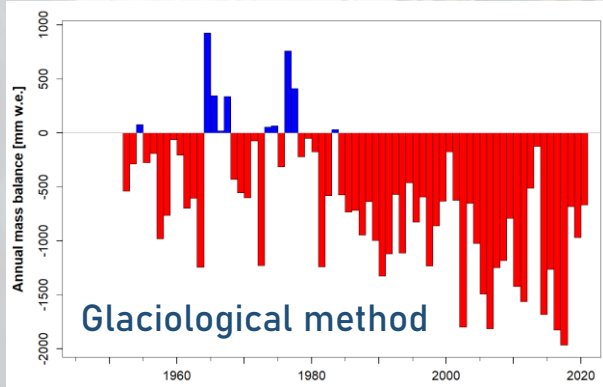
Data curated and made available by the World Glacier Monitoring Service, the US National Snow and Ice Data Center, the Global Land Ice Measurements from Space initiative, and working groups of the International Association of Cryospheric Sciences



Fluctuations of Glaciers

Glaciological and geodetic mass balances

Hintereisferner, Austria



Observations from Prinz et al., Klug et al., and other glacier observers.

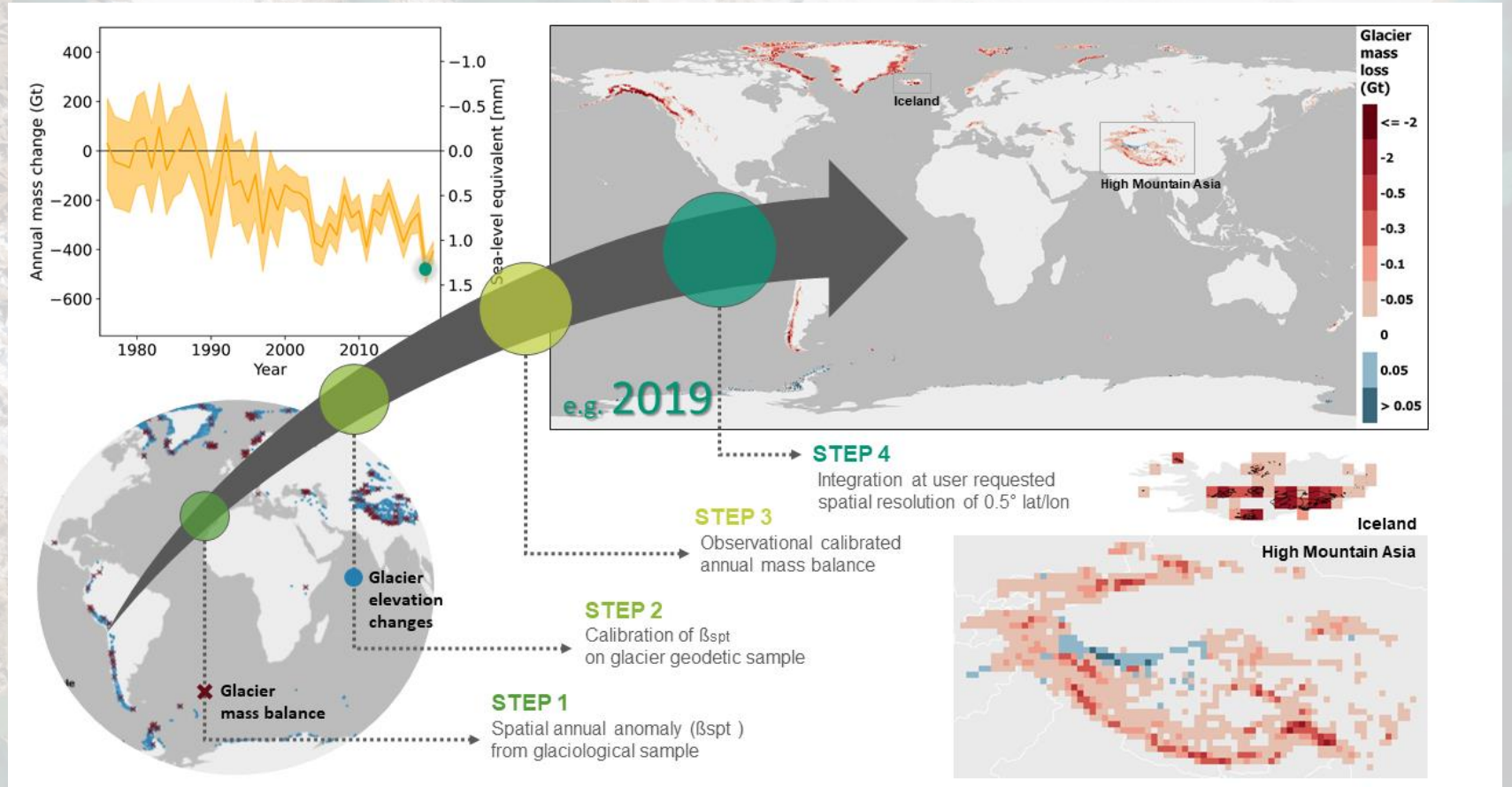
WGMS, (2022)



Fluctuations of Glaciers

Application: global gridded glacier mass changes

This product combines the temporal variability from glaciological with the long-term trends from geodetic observations. Results are glacier mass-change time series for each glacier and aggregated gridded mass changes worldwide.

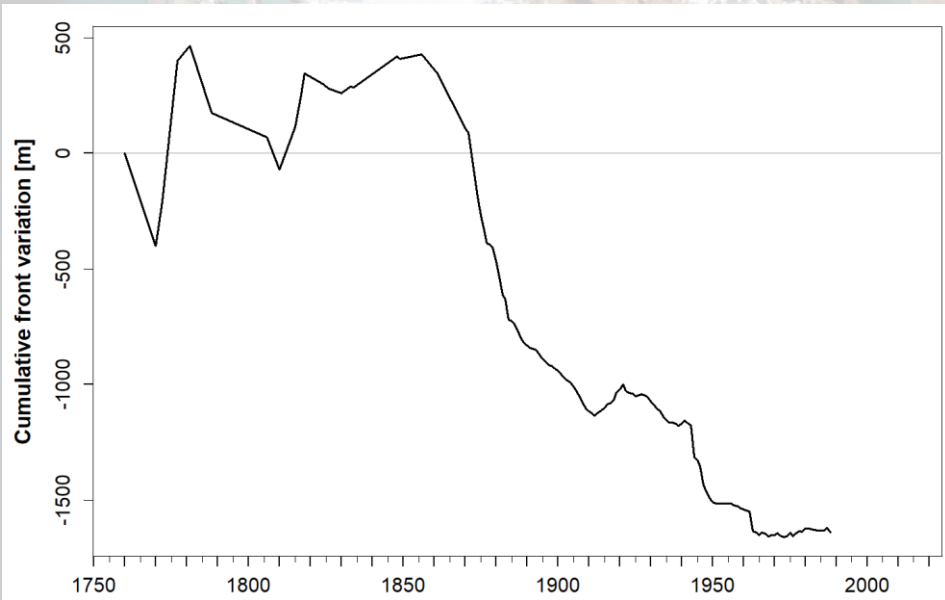


Dussailant et al. (2022), <https://climate.copernicus.eu>

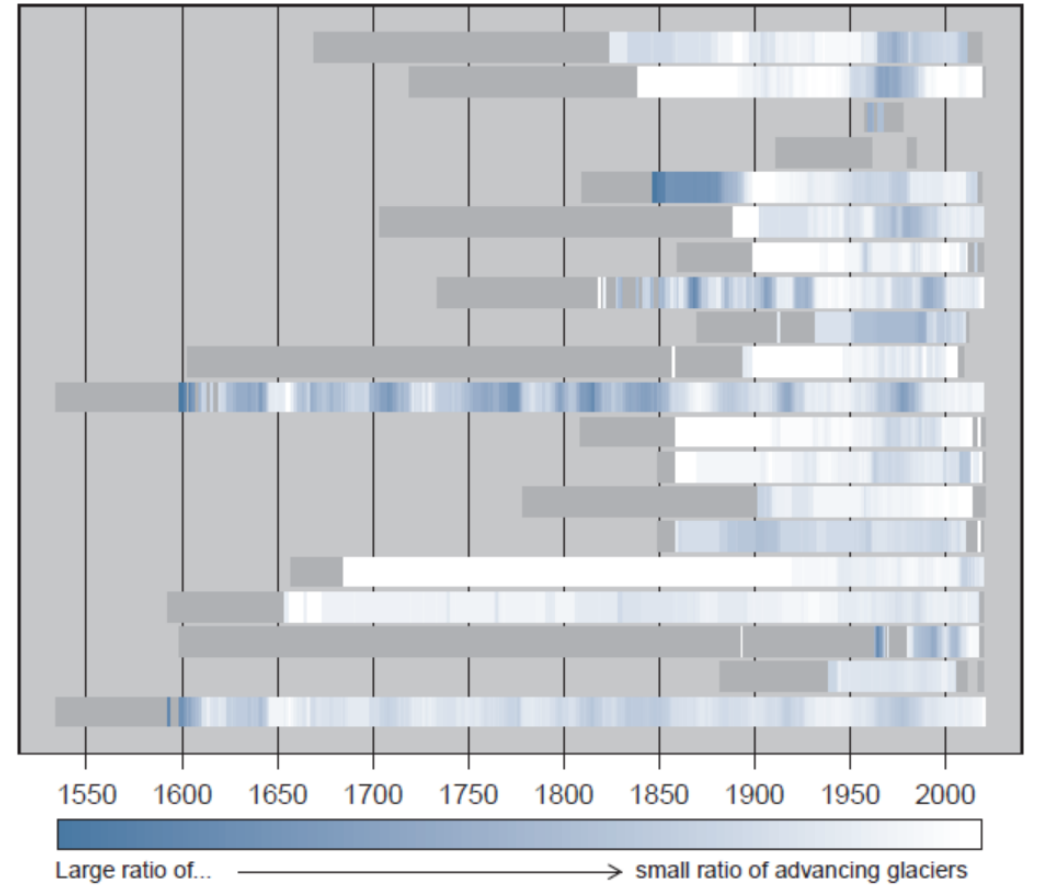
Fluctuations of Glaciers

Length changes from observations and reconstructions

Rhonegletscher, Switzerland



- Alaska (ALA)
- Western North America (WNA)
- Arctic Canada North (ACN)
- Arctic Canada South (ACS)
- Greenland (GRL)
- Iceland (ISL)
- Svalbard and Jan Mayen (SJM)
- Scandinavia (SCA)
- Russian Arctic (RUA)
- Asia North (ASN)
- Central Europe (CEU)
- Caucasus and Middle East (CAU)
- Asia Central (ASC)
- Asia South East (ASE)
- Asia South West (ASW)
- Low Latitudes (TRP)
- Southern Andes (SAN)
- New Zealand (NZL)
- Antarctic and Sub Ant. Isl. (ANT)
- Global Average



Svalbard, Copernicus Sentinel-2 by ESA

Reconstruction by Zumbühl & Holzhauser (1988, SAC)

WGMS, (2021)



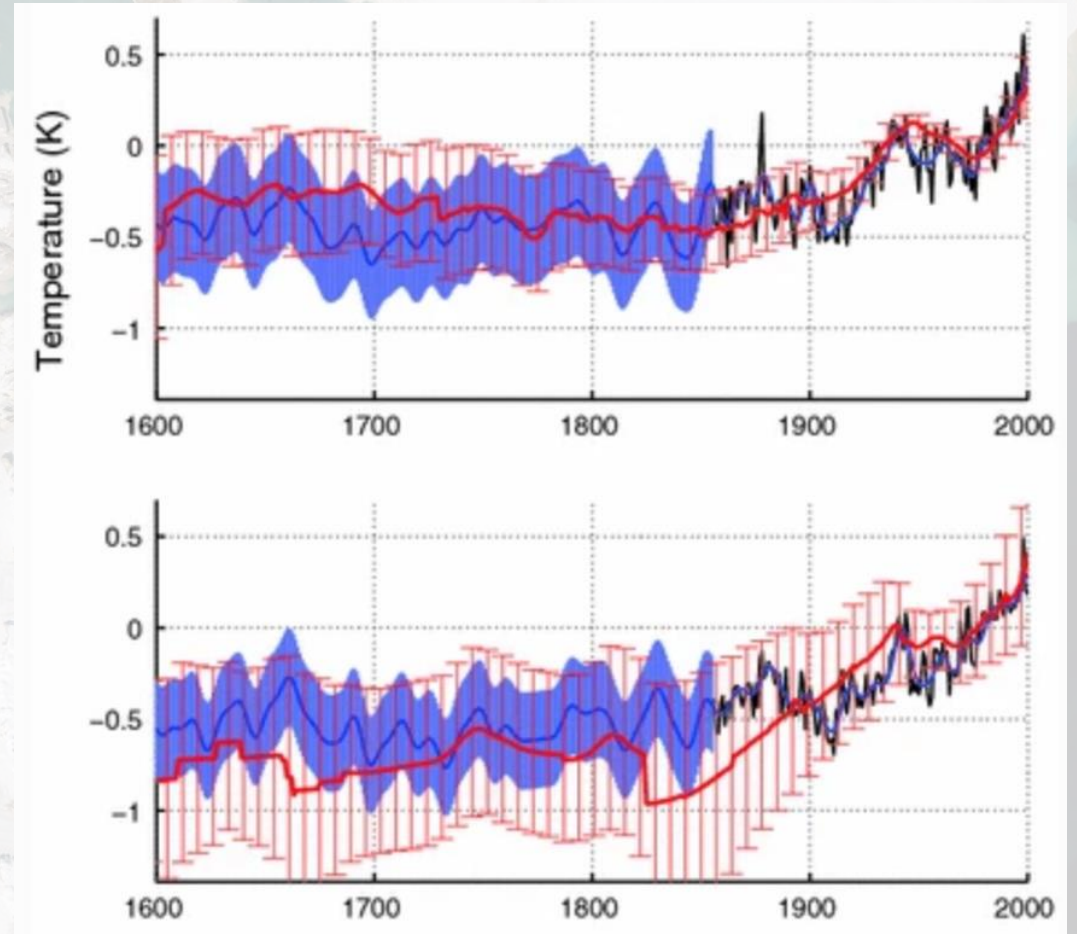
<https://www.gtn-g.org>



Fluctuations of Glaciers

Application: temperature reconstructions

Northern Hemisphere (top) and Southern Hemisphere (bottom) temperature anomaly w.r.t. 1961–1990 mean from: HADCRUT3 instrumental record (black); Mann et al. (2008) multi-proxy with land and ocean records, shaded uncertainty (blue); glacier reconstruction by Leclercq & Oerlemans (2012) with 95% confidence interval bars (red).



Leclercq & Oerlemans (2012, Climate Dynamics)

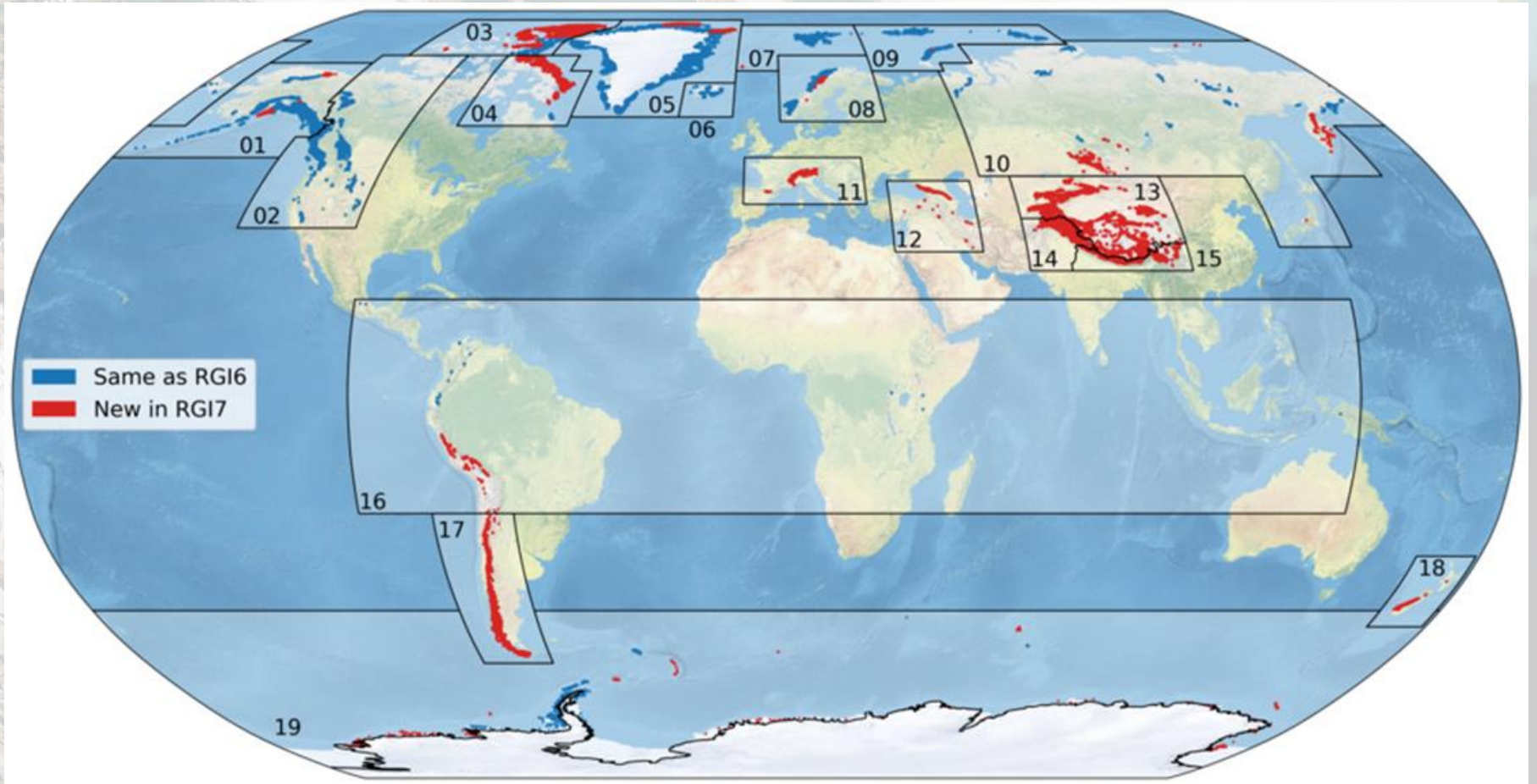
Randolph Glacier Inventory

Global glacier distribution around 2000

The RGI provides one digital outline around the year 2000 for each glacier in the world. These outlines come with glacier hypsometry and other attributes (e.g., surge, tidewater).

RGI 6 is the latest official version.

RGI 7 is coming soon.



RGI Consortium, (2017, updated)

Application: the largest glaciers in the world

**Antarctic Peninsula
ice complex**

Antarctica

80,852 km²

(partly considered as part of Antarctic Ice Sheet)

**Alexander Island
glacier complex**

Antarctica

47,486 km²

**Malaspina-Seward
glacier complex**

Alaska

30,195 km²

**Northern Ellesmere
Icefield**

Arctic Canada North

19,521 km²

**Severny Island
Northern Ice Cap**

Russian Arctic

20,667 km²

The largest glaciers, distinct from the two ice sheets, are glacier complexes located in the Polar Regions and in the Southern Andes.

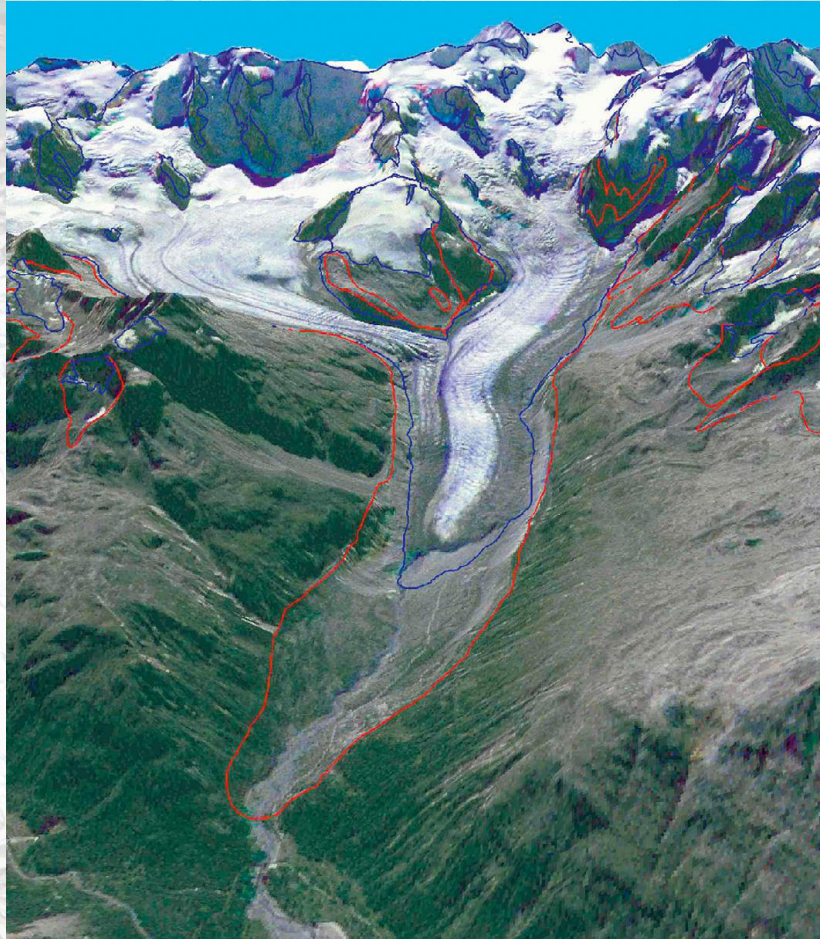
Windnagel et al. (2022, JoG)

GLIMS Glacier Inventory

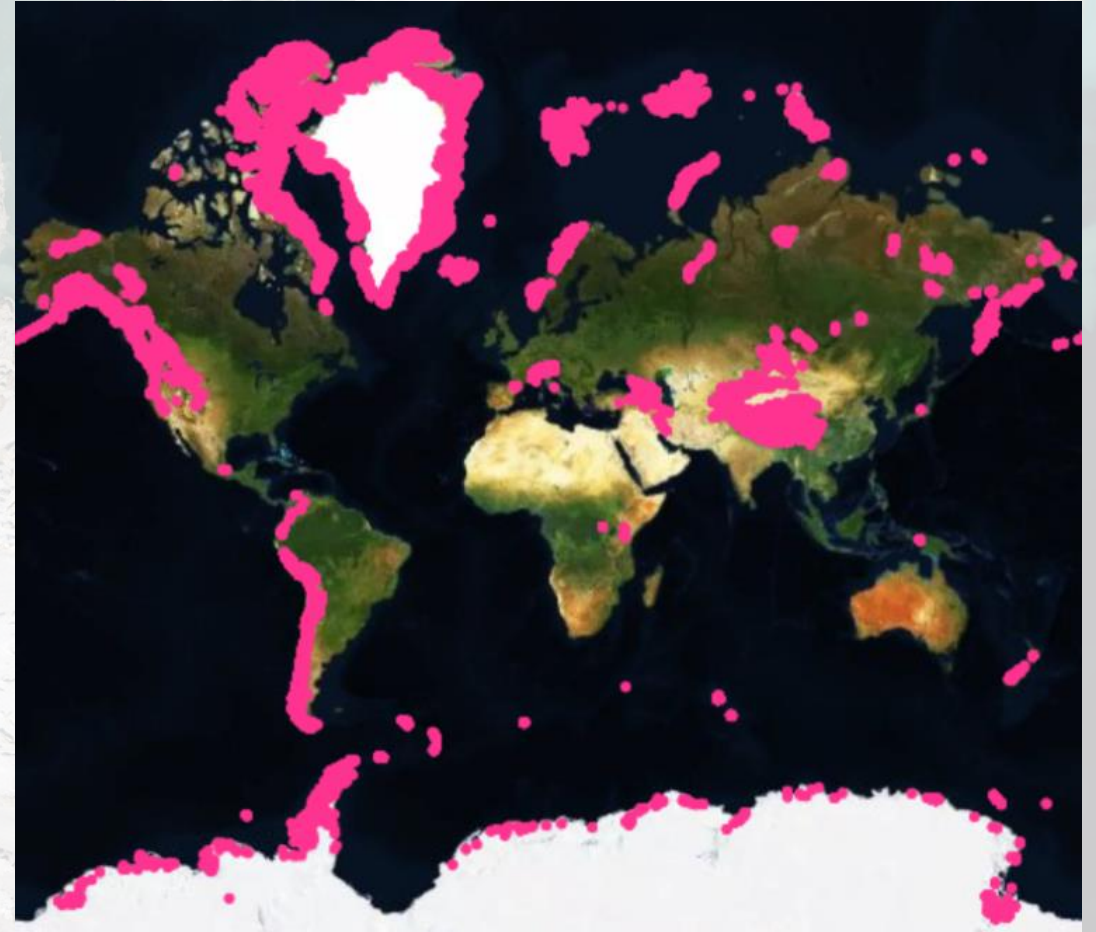
Multi-temporal inventory of glacier outlines

The GLIMS database provides multi-temporal glacier outlines. As such, it serves as source database for the Randolph Glacier Inventory for the year 2000.

Mortieratsch Glacier
Switzerland
1998, satellite
1973, airborne
1850, field survey

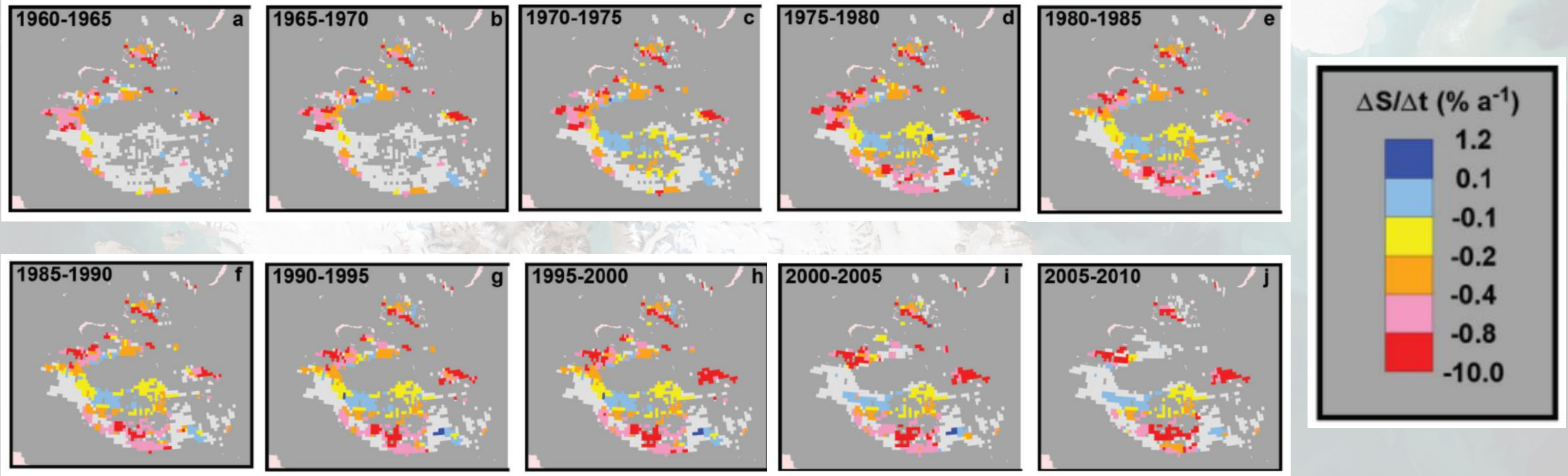


Haeberli et al. (2020, Elsevier)



GLIMS database, (2023), <https://glims.org>

Application: glacier area change rates



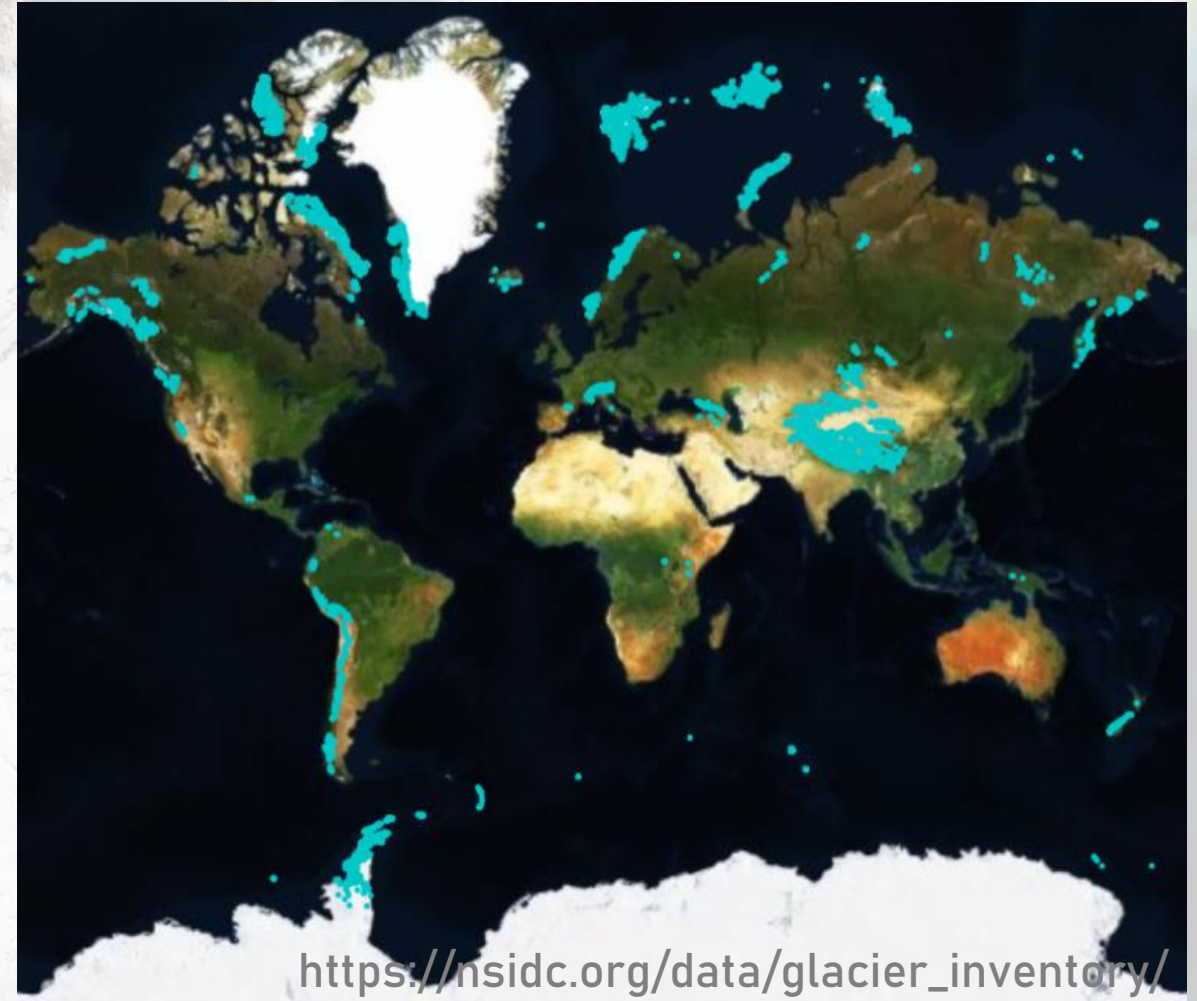
Area change rates for High Mountain Asia from multi-temporal glacier inventories. Cogley (2016, Ann. Glaciology)

World Glacier Inventory

Aerial glacier inventory of mid-20th century

The World Glacier Inventory is the result of a first attempt to internationally collect standardized dataset on glacier distribution (WGI 1989), mainly based on aerial photographs and maps of the mid-20th century. Data are organized as tabular information linked to geographical coordinates of a glacier label point.

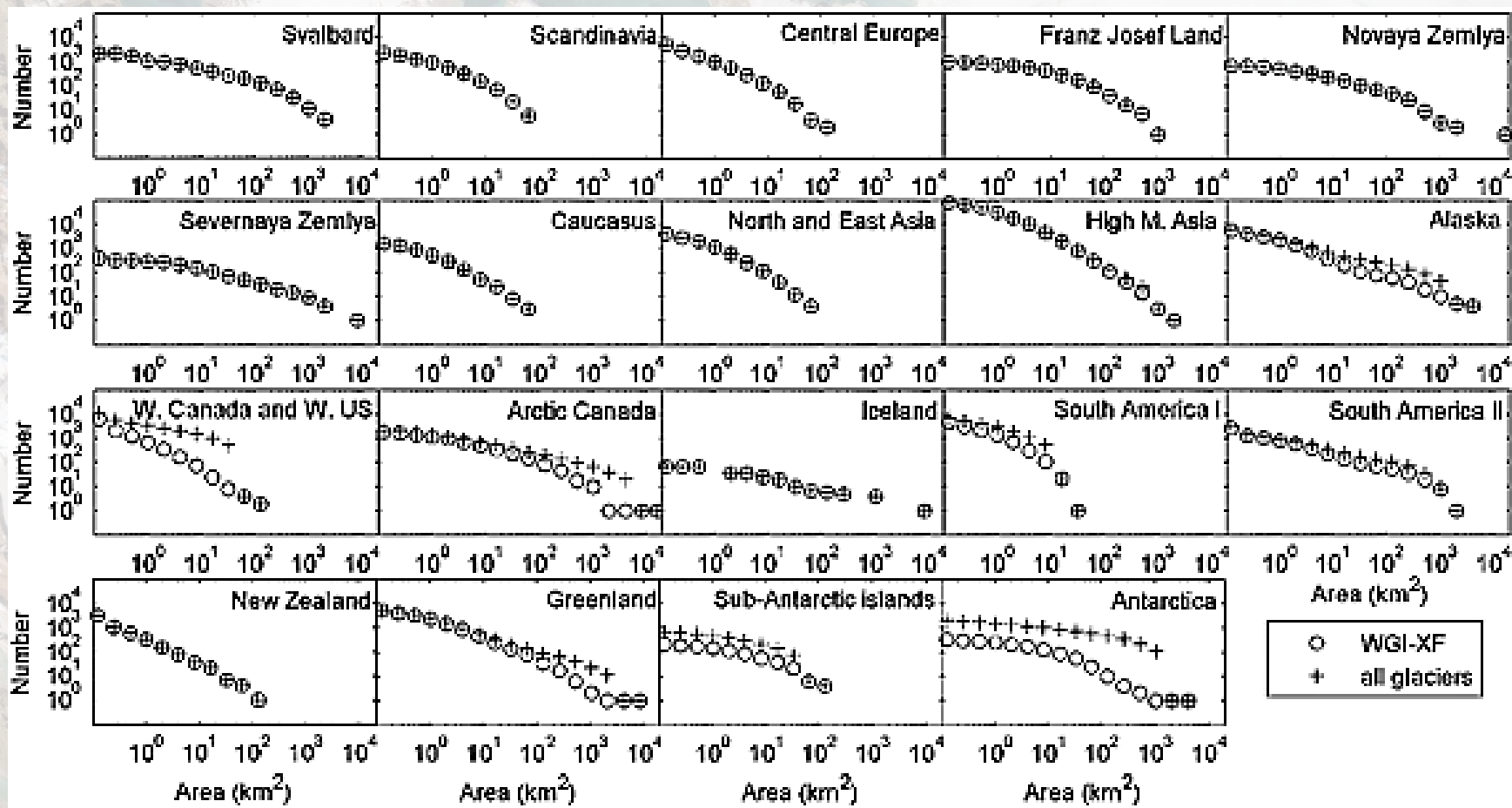
Nowadays, glacier inventories providing digital glacier outlines are compiled in the GLIMS Glacier Inventory.



World Glacier Inventory

Scaling regional glacier area to global coverage

Cumulative number of glaciers with areas larger than a given area for the WGI glaciers (circles) and all glaciers as computed by upscaling. Regions with overlapping circles and crosses have complete glacier inventory.



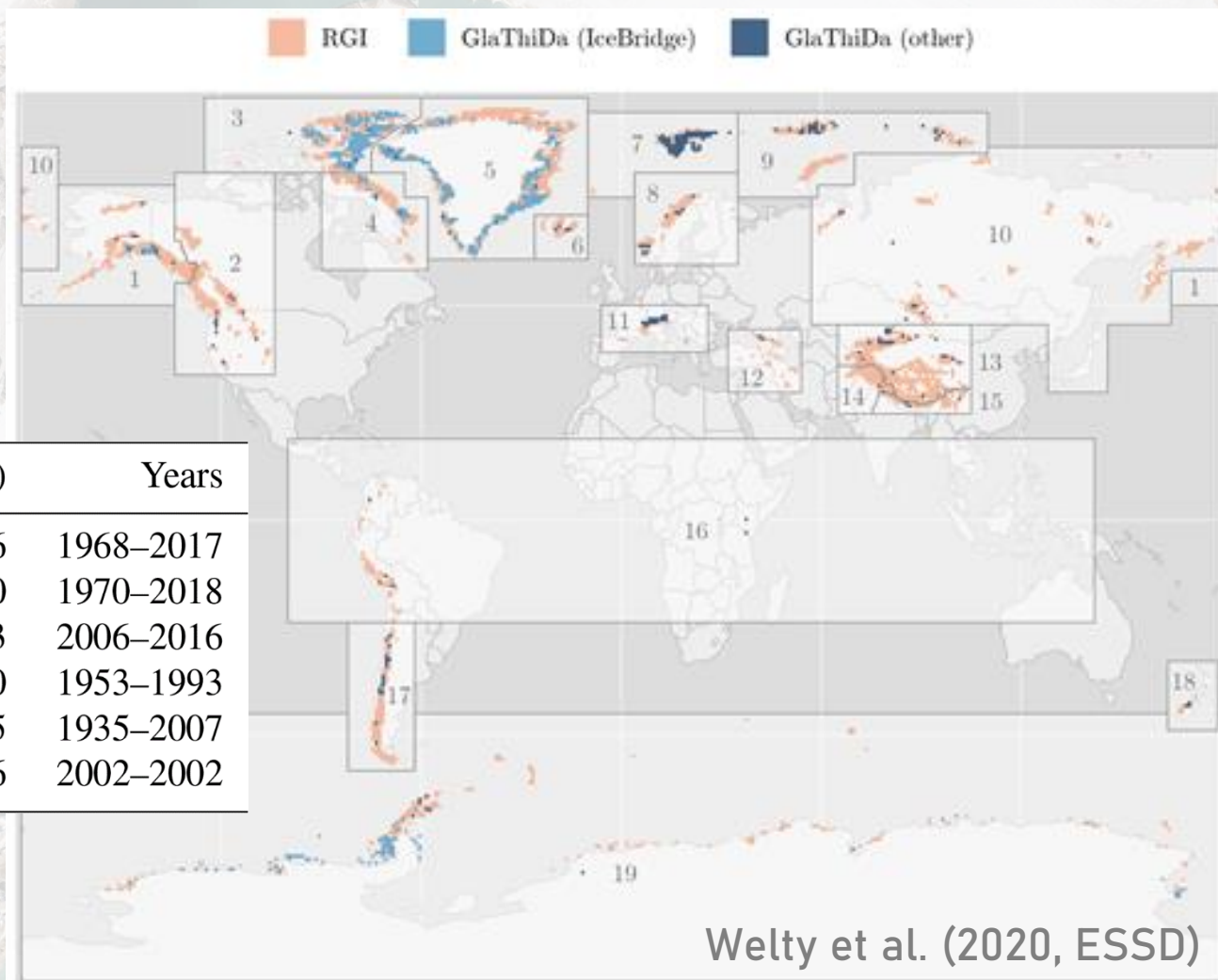
Radic & Hock, (2010, JGR)



In-situ and airborne ice thickness observations

The Glacier Thickness Database compiles observation of ice thickness from various methods from around the globe.

Method	Surveys	Points	Thickness (m)	Years
Radar (airborne)	4624	3 064 055	104–456	1968–2017
Radar (terrestrial)	412	700 066	87–330	1970–2018
Radar (both or unknown)	25	87 481	179–323	2006–2016
Seismic	43	31	218–440	1953–1993
Drilling	18	35	40–135	1935–2007
Electromagnetic	2	2611	47–86	2002–2002

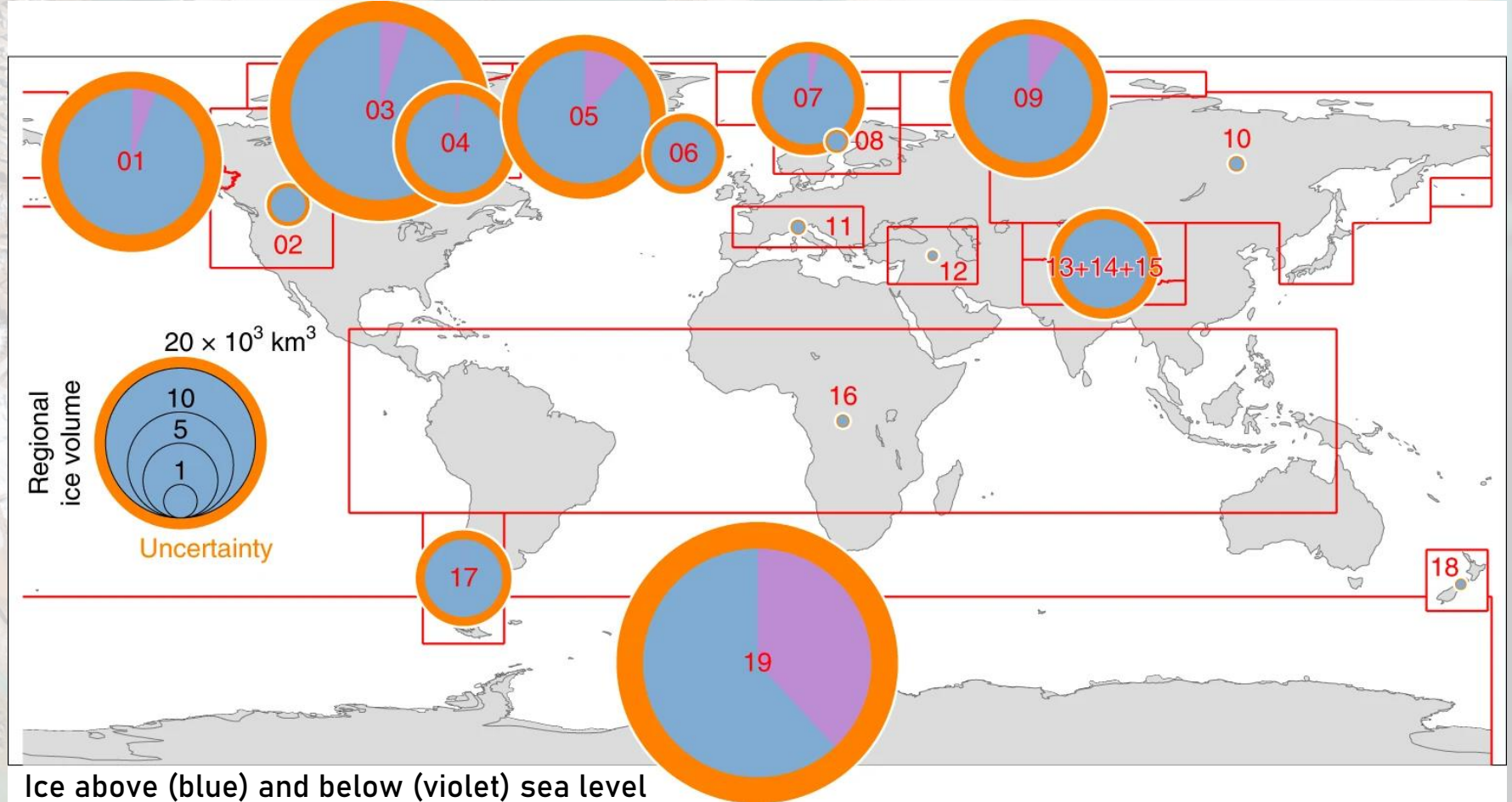


<https://gitlab.com/wgms/glathida/>

Glacier Thickness Database

Application: global ice thickness estimates

Total volume of $158 \pm 41 \times 10^3 \text{ km}^3$, which is equivalent to $0.32 \pm 0.08 \text{ m}$ of sea-level change when the fraction of ice located below present-day sea level (roughly 15%) is subtracted.



(excluding glaciers on Antarctic mainland)

Farinotti et al. (2019, NCEO)



<https://www.gtn-g.org>

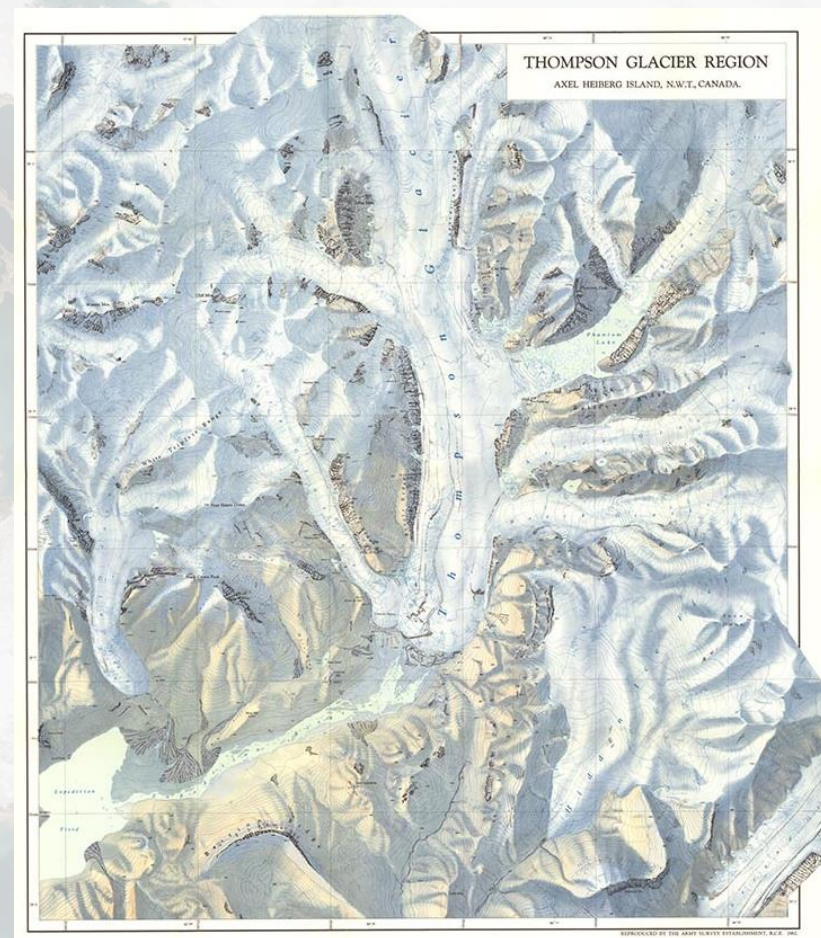
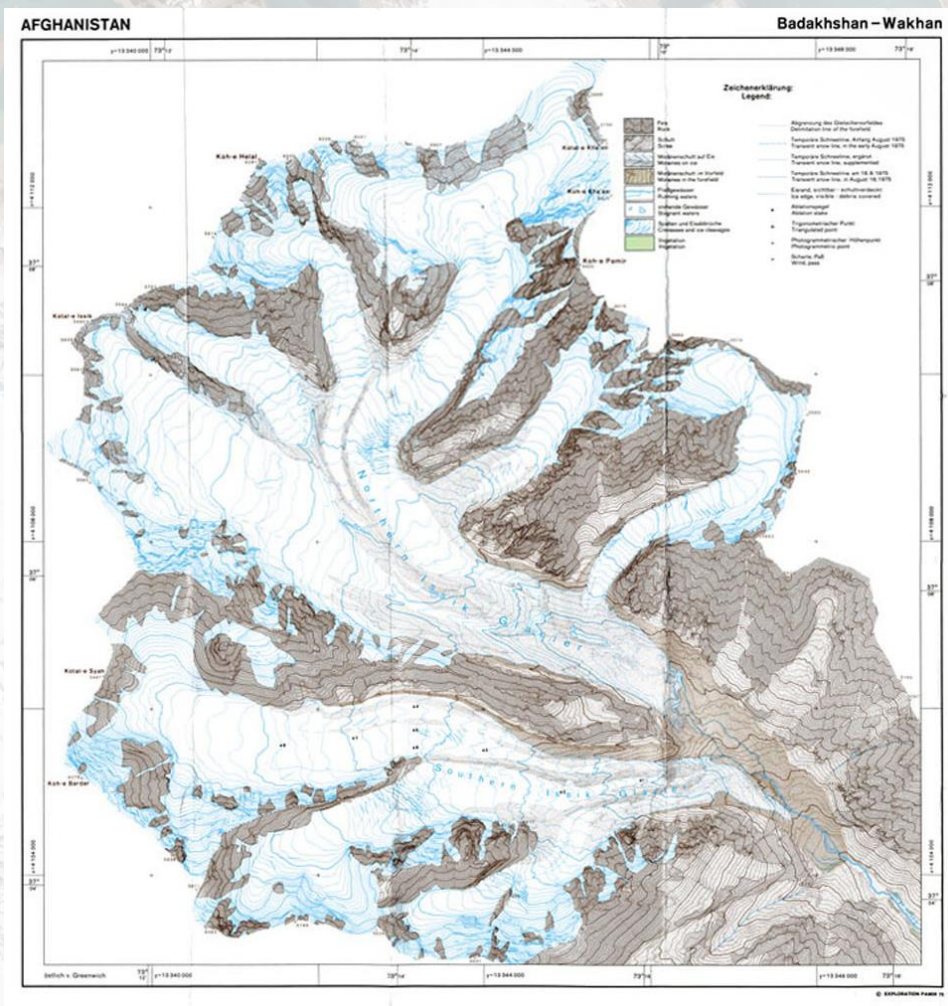


Glacier Map Collection

Historical & current maps of glaciers around the world

This collection currently contains over 150 maps from glaciers around the world.

Issik Glaciers, Afghanistan, Patzelt (1985)



Thompson Glacier, CA, Haumann & Honegger (1962)

Svalbard, Copernicus Sentinel-2 by ESA

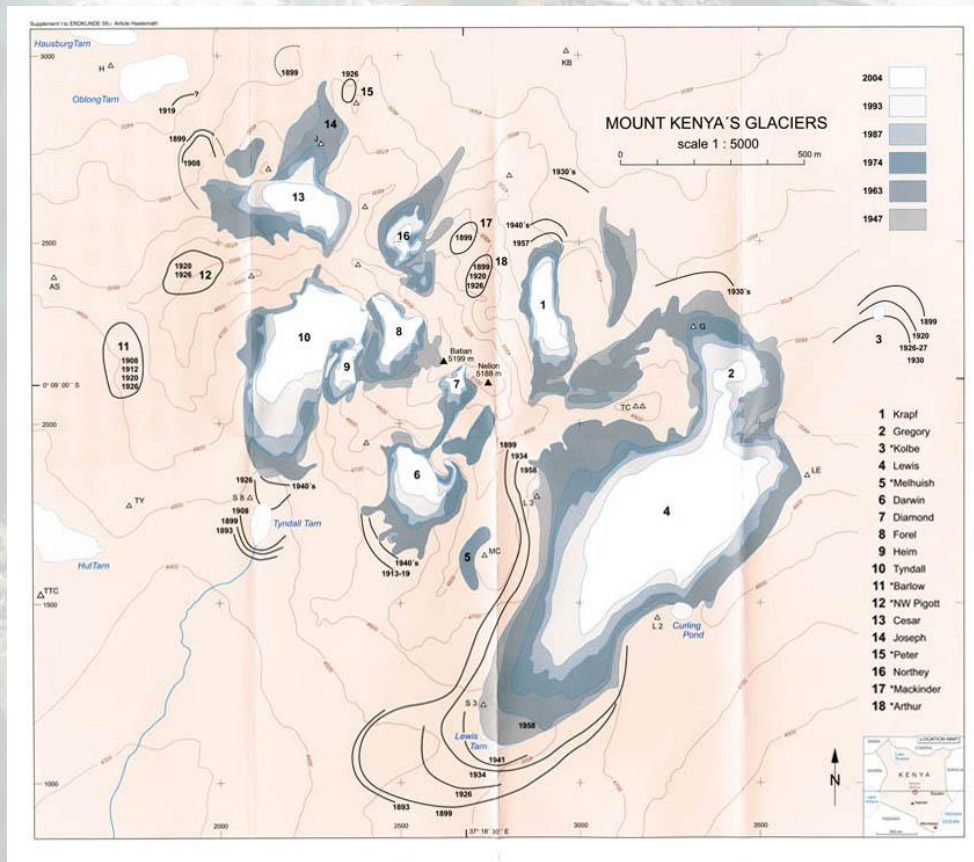


<https://www.gtn-g.org>



Glacier Map Collection

Application: retreat of Lewis Glacier in Kenya since 1934



Hastenrath (2008)

<https://www.simonnorfolk.com/>



<https://www.gtn-g.org>



Glacier
Photograph
Collection

Worldwide collection of glacier photographs



ISS004E6299

Grey Glacier, Patagonia, 2002, from International Space Station.



https://nsidc.org/data/glacier_photo/

Svalbard, Copernicus Sentinel-2 by ESA



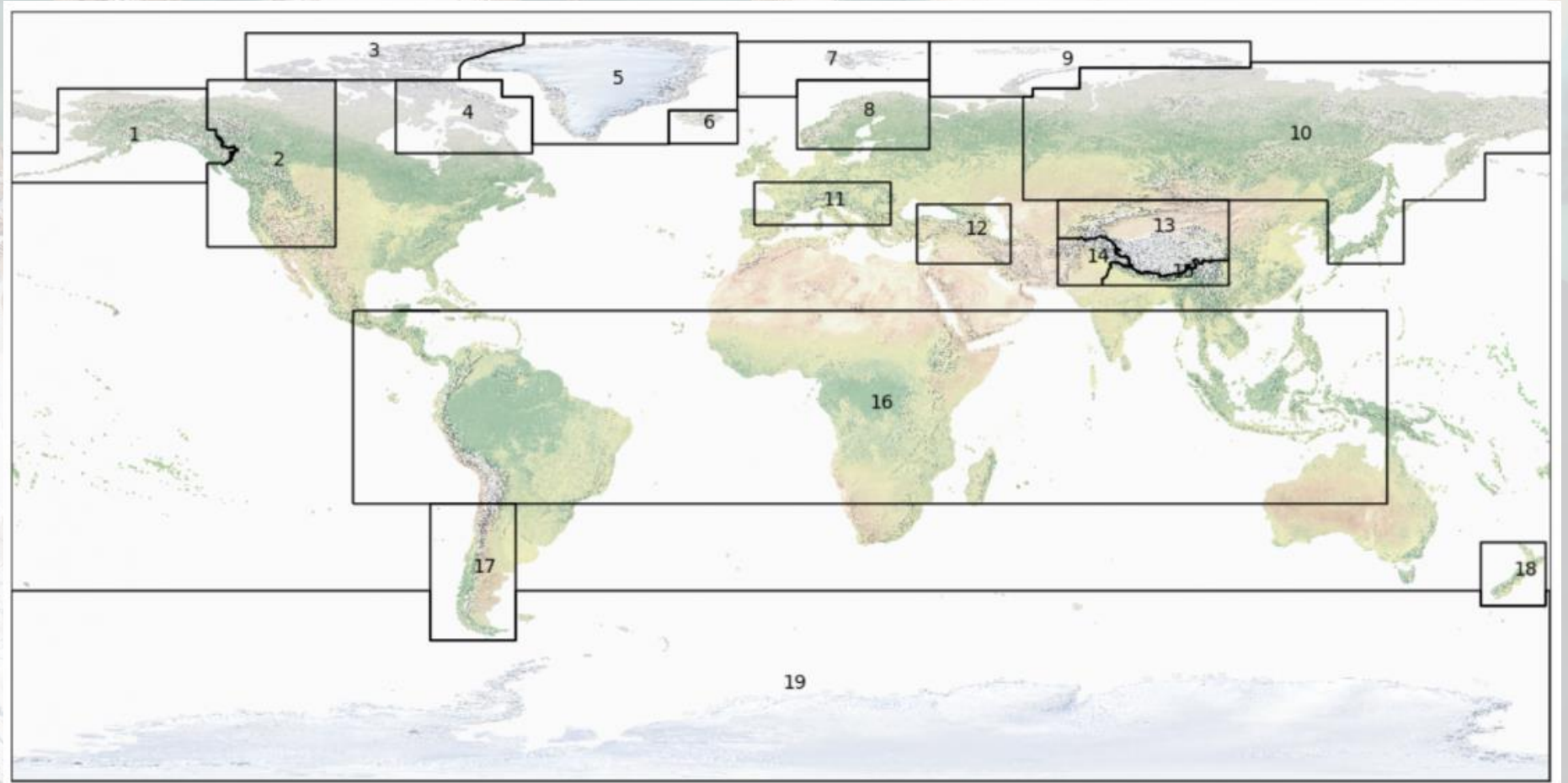
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Glacier Regions

Regions for glacier distribution & change assessments

Standardize glacier regions ensure comparability between glacier studies. This dataset provides outlines for 19 first-order and >90 second-order glacier regions.

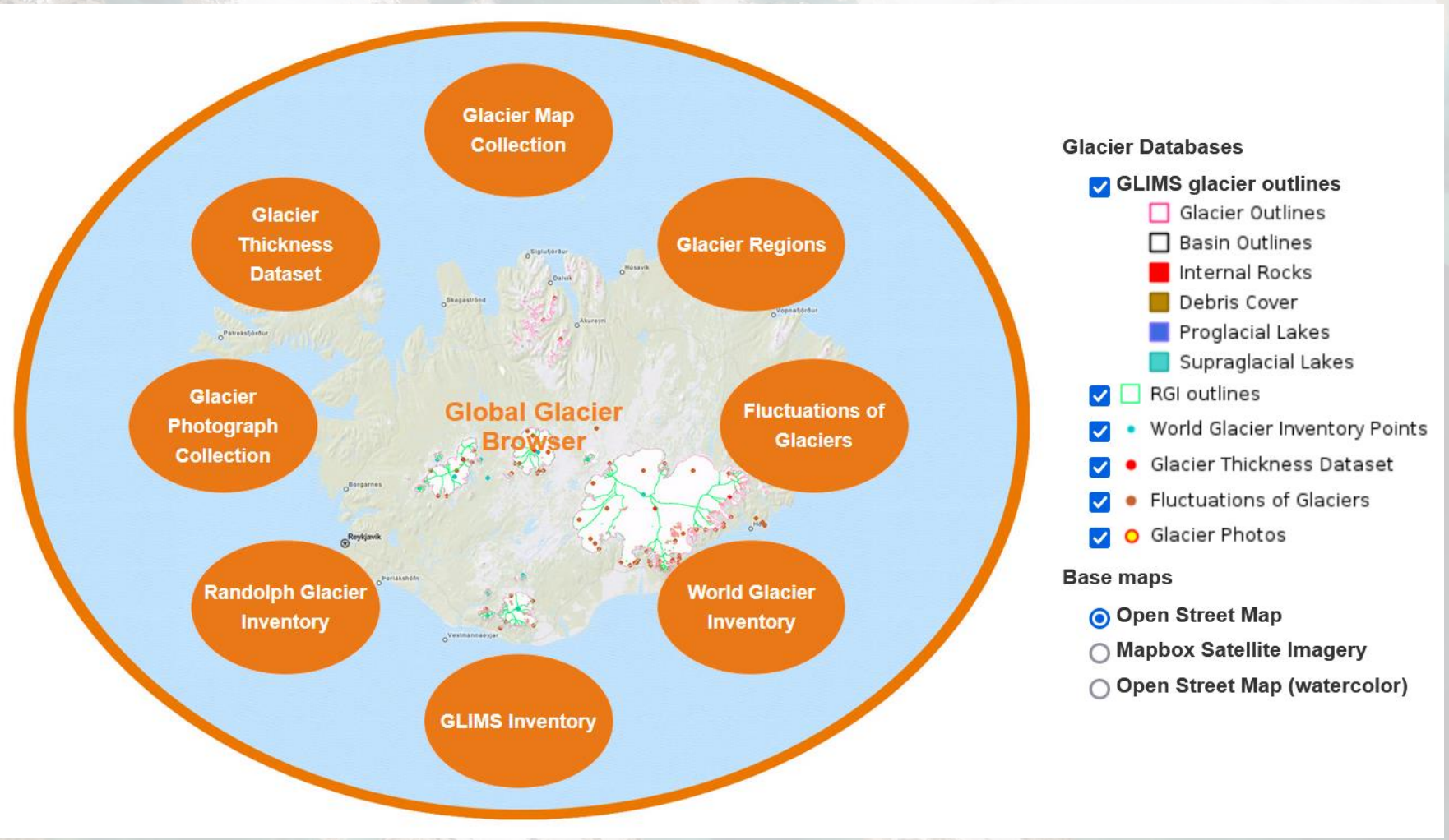


https://www.gtn-g.ch/data_catalogue_glacreg/

Global Glacier Browser

One-stop portal for all GTN-G datasets

All global glacier dataset are open access under the requirement of correct citation. The data sets can be downloaded from the website of the Global Terrestrial Network for Glaciers (GTN-G).



Global Terrestrial Network for Glaciers



Svalbard, Copernicus Sentinel-2 by ESA



<https://www.gtn-g.org>

