National Snow and Ice Data Center
ADVANCING KNOWLEDGE OF EARTH'S FROZEN REGIONS

# A Summary of the Global Glacier Landscape:
## The Largest Glaciers and Glacier Complexes in the 19 Glacial Regions of the World

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**A. Windnagel**
**NSIDC**

# Contents



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Cover Image: Grosser Aletsch Glacier, credit: Ladina Glaus, NSIDC Glacier Photograph Collection

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# PREFACE

This research was undertaken as part of a capstone project for a graduate certificate in Earth Science Data Analysis at the University of Colorado, Boulder. This analysis resulted in a published data set called the *Largest Glaciers and Glacier Complexes in the World* and a published paper Windnagel et al. (2022). This document is a detailed description of the development and analysis of this data set that summarizes the results and provides notes on decisions made during this investigation.

# INTRODUCTION

Not only are glaciers a beautiful part of our landscape that are retreating at an alarming rate, but they are also a source of fresh water and energy in many parts of the world. As glaciers retreat, these nations may have to contend with water scarcity or the need to find alternative forms of energy. In addition, as glaciers retreat, it upsets the balance of ecosystems and threatens biodiversity of these regions. Studying glaciers helps to inform our knowledge of climate change and helps biologists and water and energy resource managers plan for the future. Researchers have performed many regional studies of glaciers; however, global studies are scarce. In addition, there is no formal record of the largest glaciers on Earth. To fill this gap, this global assessment of glaciers strives to further our knowledge of these important natural resources on a worldwide scale. Here, I present a systematic assessment of the largest glaciers in the 19 primary glacier regions of the world as defined by the Global Terrestrial Network for Glaciers (GTN-G).

The GTN-G has divided the Earth into 19 primary glacial regions (GTN-G, 2017) (Figure 1 and Table 1). Depending on the region being examined, glaciers can have different characteristics and sizes. For example, glaciers on the Greenland and Antarctic ice sheets are quite large due to their locations at the North and South Poles, respectively, and the amount of ice surrounding them. Alpine glaciers, on the other hand, like those that reside in the mountains of Europe, are relatively quite small. The glaciers in each region tell a specific story about the climate change happening there. The goal of this project is to determine the three largest glaciers and glacier complexes in each of these 19 regions to tell a global tale of glacier sizes.

Because this study is exclusively focused on glaciers and glacier complexes, I exclude the Greenland and Antarctic ice sheets from this analysis but do include the glaciers in their periphery and the ice body on the Antarctic Peninsula (north of 70° South). Further, I subdivided region 19 into two subregions: the Antarctic mainland and the Antarctic and Subantarctic Islands. Finally, while other entities in Antarctica are also named glaciers (e.g., Thwaites and Pine Island), they are outlet glaciers of the Antarctic Ice Sheet (Fretwell et al., 2013). As such, I have also excluded them from this analysis.

# BACKGROUND

Researchers have completed many regional inventories of glaciers; however, global compendiums are scarce. They do exist – for example, GLIMS and NSIDC (2019) and RGI Consortium (2017) – both of which are used in this analysis. However, these inventories do not provide a definitive list of the largest glaciers and glacier complexes. Using these two databases, I endeavored to fill this gap by performing a global assessment of the largest glaciers and glacier complexes, specifically ice caps and icefields, to further our knowledge of these important natural resources on a worldwide scale.

This project was undertaken as part of a graduate certificate in Earth science data analysis. The goal was to create reproducible science via programming with Python. This allows for a science-based, data-driven approach to this inquiry derived from two consistent glacier databases designed to monitor the world's glaciers that can be easily applied to future versions of these databases. In addition, this study builds on those glacier databases by also characterizing glacier complexes, which are not currently part of either database.

To begin the investigation and answer the question of which glaciers are the largest in the world, several other initial questions must be addressed. First, the metric used to evaluate which is largest must be selected. Second, one needs a consistent definition of what a glacier and glacier complex are. Third, the availability of global data sets that provide the data for the chosen metric is required. These matters are addressed below.

**Which metric should be used?**

With respect to glaciers, largeness can be evaluated using area, volume, mass, and length. The answer to the question, "What data sets are available?", also informs the answer to which metric to choose. For this analysis, area was chosen as the metric for determining glacier size because area measurements can be calculated from satellite imagery, so the data are more readily available. In addition, area data already exist in both the GLIMS and NSIDC (2019) and RGI Consortium (2017) databases. Further, the volume and mass (Huss and Farinotti, 2012; Farinotti et al., 2019) and length (Machguth and Huss, 2014) studies that exist use the outlines from RGI as their input data. Thus, I chose to also perform my analysis with similar input data but chose area as my metric. A short case study of the differences that might be encountered if volume is used as the metric instead of area can be found in the Discussion section.

**How do we define glacier, glacier complex, and other ice bodies?**

Depending on the research community, glaciers can be defined in different ways. The definitions used for this study are from the Glossary of Glacier Mass Balance and Related Terms (Cogley et al., 2011). These definitions are the following (additions with relation to the present paper are added in [*brackets*]):

- **Glacier**: A perennial mass of ice, and possibly firn and snow, originating on the land surface by the recrystallization of snow or other forms of solid precipitation and showing evidence of past or present flow. [*compressed snow accumulated over time*]
- **Ice Cap**: A dome-shaped ice body with radial flow, largely obscuring the subsurface topography and generally defined as covering less than 50,000 km$^2$. That is, it is smaller than an ice sheet.
- **Icefield**: A large ice body that covers mountainous terrain but is not thick enough to obscure all the subsurface topography, its flow therefore not being predominantly radial as is that of an ice cap.
- **Glacier complex**: A number of contiguous glaciers; a generic term for all collections of glaciers that meet at divides [*e.g., icefields or ice caps. Note that*

*both ice caps and icefields typically have outlet glaciers that drain ice from sectors of the accumulation area in individual glacier tongues reaching out into the lowlands*].

- **Ice sheet**: An ice body that covers an area of continental size, generally defined as covering 50,000 $km^2$ or more.
- **Ice body**: Any continuous mass of ice, possibly including snow and firn, at or beneath the Earth's surface.
- **Outlet glacier**: A glacier, usually of valley-glacier form, that drains an ice sheet, icefield, or ice cap.

**What global data sets are available?**

Currently, there are two databases that provide nearly global coverage of glaciers as digital vector outlines: The Global Land Ice Measurements from Space (GLIMS) (GLIMS and NSIDC, 2019) and The Randolph Glacier Inventory (RGI) (RGI Consortium, 2017). The availability and quality of these databases drove the decision to use area as the metric for this analysis – both databases contain area as an attribute. I chose to use both because they are not identical inventories. GLIMS has some glaciers that RGI does not and vice versa. In addition, ice divides were not always consistent between the two, and in some instances, GLIMS has more recent outlines that RGI.

GLIMS is a project designed to monitor the world's glaciers primarily using data from optical satellite instruments. It provides glacier outlines at multi-temporal resolution for glaciers around the world. RGI is a globally complete inventory of glacier outlines and is intended to be a snapshot of the world's glaciers as they were near the beginning of the 21st century. The dates of the glacier outlines in these two databases were not necessarily acquired at the same time. Due to the asynchronous nature of the data, accurately comparing size can be somewhat challenging because most glaciers have been retreating significantly over the last half century. Thus, comparing outlines from dates that are years apart could lead to inaccuracies in the results. However, these are the best databases that are currently available, so they are used for this analysis, but this limitation is covered more in the Discussion section.

Taking the answers to these questions into consideration, I determine the largest glaciers in the world in each of the 19 GTN-G regions. This report describes the methods and results for this investigation.

# METHODS

The study area for this analysis is the entire globe subdivided into 19 regions. The GTN-G has divided the Earth into 19 glacial regions (GTN-G, 2017). The region outlines are displayed in Figure 1 and listed in Table 1.

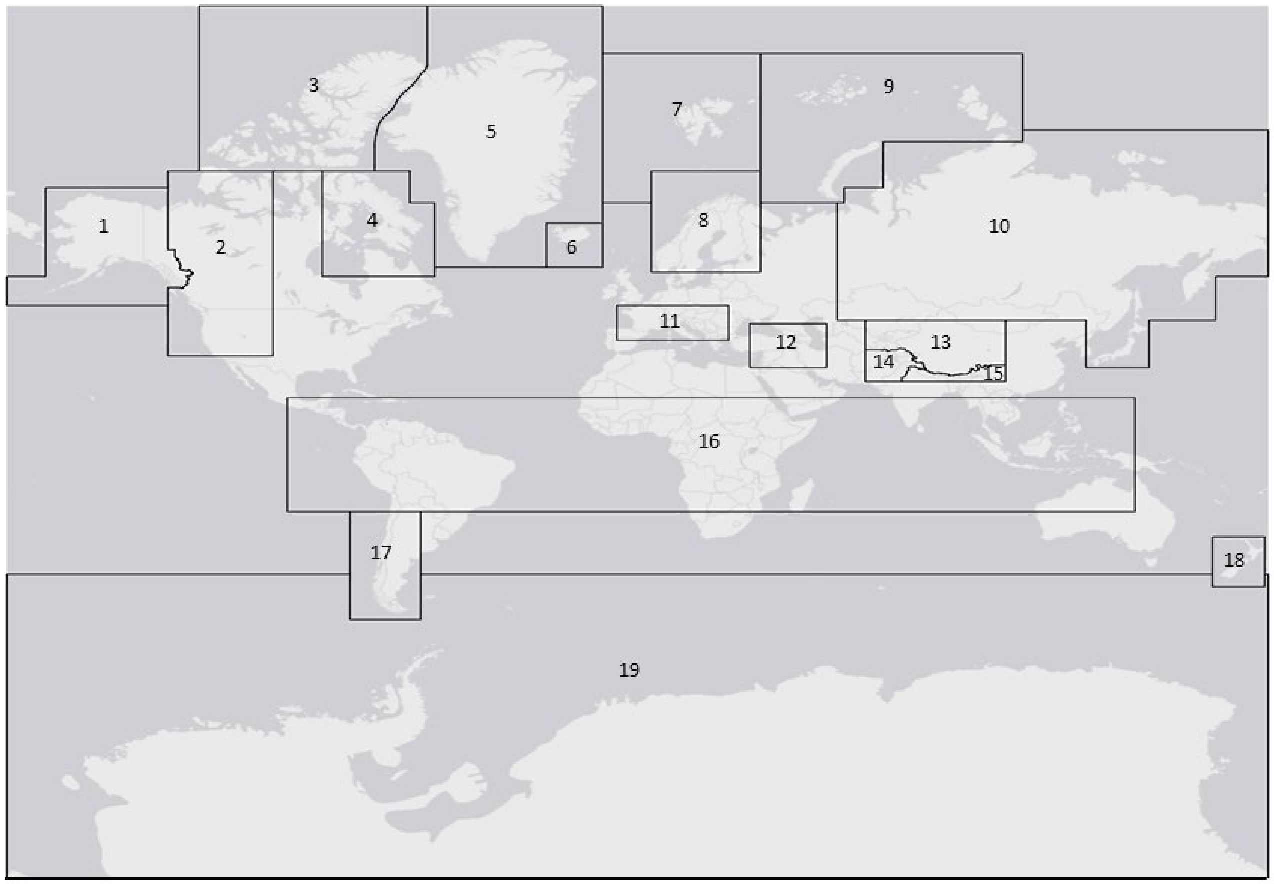


**Figure 1. World map with the 19 GTN-G glacier regions outlined.**

**Table 1. List of the 19 GTN-G glacier region numbers and names.**

| Region Number | Region Name | Region Number | Region Name |
|---|---|---|---|
| 1 | Alaska | 11 | Central Europe |
| 2 | Western Canada and USA | 12 | Caucasus and Middle East |
| 3 | Arctic Canada, North | 13 | Asia, Central |
| 4 | Arctic Canada, South | 14 | Asia, Southwest |
| 5 | Greenland Periphery | 15 | Asia, Southeast |
| 6 | Iceland | 16 | Low Latitudes |
| 7 | Svalbard and Jan Mayen | 17 | Southern Andes |
| 8 | Scandinavia | 18 | New Zealand |
| 9 | Russian Arctic | 19 | Antarctic and Subantarctic |
| 10 | Asia, North | | |

Using two well established databases of digital vector outlines designed with worldwide glacier monitoring in mind, I performed an analysis of the largest individual glaciers and glacier complexes in each of the 19 GTN-G regions to identify the three largest, with one exception. For Region 19 (Antarctic and Subantarctic), I further subdivided it into two subregions – the Antarctic mainland (subregion 19-31 in GTN-G, 2017) and the Antarctic and Subantarctic islands (subregions 19-01 to 19-24 in GTN-G, 2017) – and identified the three largest in each of those subregions. This subdivision was done because the Antarctic ice sheet and the Antarctic and Subantarctic islands are distinctly different from one another, and I wanted to explore the glaciers and glacier complexes within each subregion. As was noted in the Introduction, I also excluded the Greenland and Antarctic ice sheets but do include the glaciers in their periphery and the ice body on the Antarctic Peninsula (north of 70° South).

The two databases I used were the Global Land Ice Measurements from Space (GLIMS) Version 20190304 (GLIMS and NSIDC, 2019) and the Randolph Glacier Inventory (RGI) Version 6.0 (RGI Consortium, 2017). These both contain nearly globally complete information on the area and shape of glaciers around the world. Note: Because the GLIMS database is multi-temporal where some glaicers have multiple outlines with different dates, the first step was to filter GLIMS to use only the most recent outlines and use that filtered version for the analysis.

## Individual Glacier Size

To determine the three largest glaciers in each of the 19 GTN-G glacial regions, I queried the GLIMS and RGI databases for glaciers in each region and then compared their sizes, by area. These area measurements are included as attributes in the shapefiles in these two databases. If GLIMS and RGI agreed on the size of a glacier, then I simply chose that area as the size. If GLIMS and RGI differed on sizes, I compared the dates of the measurements and chose the value from the latest date. If the dates matched (same year), then I averaged the areas from both to the nearest hundredths of a square kilometer.

For Region 5 (Greenland) and Region 19 (Antarctic and Subantarctic), which both contain large ice sheets, an additional filtering step was performed to only include the glaciers that exist in their periphery. The glaciers in these two regions were filtered by their connectivity level to the ice sheet. Rastner et al. (2012) developed this connectivity level model to help describe how attached or detached a glacier is to an ice sheet to help distinguish between local glaciers around the periphery of an ice sheet from the outlet glaciers of the ice sheet. Rastner et al. (2012) created three connectivity levels for this purpose; they are described in Table 2. Rastner et al. (2012) recommends that glaciers with a connectivity level of 2 be treated as part of the ice sheet. Therefore, for this study, only glaciers with connectivity level of 0 or 1 were considered.

**Table 2. Connectivity Level Description from Rastner et al. (2012)**

| Value | Connectivity Description |
|---|---|
| 0 | Indicates that the glacier is physically detached from the ice sheet and is not connected. |
| 1 | Indicates that the glacier is weakly connected to the ice sheet. This means that the glacier is only in contact with the ice sheet at a well-defined divide in the accumulation zone. |
| 2 | Indicates that the glacier is strongly connected. This means that the divide between the glacier and the ice sheet is indistinct in the accumulation zone and/or confluent with an ice-sheet outlet in the ablation zone. |

## Glacier Complex Size

Because neither of the databases explicitly differentiates between polygons of individual glaciers and glacier complexes such as ice caps and icefields, a method was needed to extract the glacier complexes and determine their sizes. The GLIMS database, alone, was chosen for the glacier complex analysis, except for the Greenland Periphery (Region 5) and the Antarctic and Subantarctic islands (Region 19) where RGI was used. See the results section of Region 5 and Region 19 for details. For each region, a literature search was first conducted to learn about the glacier complexes for the region to help with identifying them.

To create the polygon outline for each glacier complex, I performed a process to merge the individual glacier polygons that shared common boundaries with one or more neighboring glaciers from each region. The individual glacier polygons were merged using a process called *exploding* to form one polygon. This one polygon covers the entire glacier complex. This exploding process, also known as *separating a multipart feature*, was done using a custom function in Python that combined any polygon outlines that shared an edge. Only glacier polygons with shared edges were exploded, thus defining the glacier complex. The exception to this is Iceland (Region 6) where the glacier complexes were already defined in GLIMS so the merging function was not needed. See the Region 6 results sections for details. Finally, the area of each was determined using a Python planar area function applying an equal area projection - Lambert Cylindrical Equal Area (LAEA). The three largest glacier complexes were chosen and their names identified from the literature. If a name could not be found for a glacier complex, then I created one from either the largest glacier in the complex or a prominent geographical feature within complex (e.g., Grosser Aletsch Glacier Complex, Vilcanota Glacier Complex). The date of measurement for a glacier complex was chosen as the range of dates of all the glaciers outlines that made up that glacier complex.

Note that in several instances this method produced glacier complexes that were different than described in the literature. For example, in Svalbard, Norway (Region 7), the Asgardfonna, Balderfonna, and Olaf V icefields are all merged into one glacier complex that I call the Asgardfonna-Balderfonna-Olaf V Glacier Complex. However, they are generally considered separate ice bodies (Liestøl, 1993). Even though these few occurnances created glacier complexes that are not generally considered one ice body, I have chosen to keep them as one because it shows how large some of these contigous ice bodies can be. This occurred in three regions: Region 5 (Greenland), Region 7 (Svalbard), and Region 9 (Russian Arctic). For these regions, I perform a secodary analysis and separate each individual ice body from the larger glacier complex into their component parts. To do this, I manually drew a polygon shapefile by plotting points on a map in ArcMap while referencing the literature on the shape of the glacier complex. This led to a polygon that roughly encompassed its area, which was then used to exclude the ice bodies that did not belong to it by applying a python clipping function. Then the area was computed as stated above. I provide both the fully merged glacier complex results as well as the clipped ice body results. For futher details and the results on these glacier complexes, see the results section for each of the rboxegions mentioned.

All the Python code used for this analysis is available on GitHub at the following URL: https://github.com/windnage/wgms-glacier-project.

# RESULTS

The results from this analysis reveal that the three largest glaciers in the world are in the Antarctic and Subantarctic (Region 19). The largest is Seller Glacier (7,018.3 $km^2$) on the Antarctic mainland followed by Thurston Island Glacier No. 1 (5,260.7 $km^2$) and Alexander Island Glacier No. 1 (4,766.1 $km^2$) on the Antarctic Islands. If one excludes the Antarctic region from the analysis, the top three glaciers as Malaspina-Seward Glacier (3,362.7 $km^2$) in Alaska (Region 1), Wykeham Glacier South (3,175.8 $km^2$) on Ellesmere Island in Arctic Canada North (Region 3), and Bering Glacier (3,025.1 $km^2$) also in Alaska.

The three largest glacier complexes are the Alexander Island Glacier Complex (47,486.2 $km^2$) in the Antarctic and Subantarctic (Region 19), Malaspina-Seward Glacier Complex (30,194.9 $km^2$) in Alaska (Region 1), and Severny Island Northern Ice Cap (20,666.8 $km^2$) in the Russian Arctic (Region 9). Note, however, if one includes the Antarctic Peninsula glacier complex, it becomes the largest with a size of 80,851.9 $km^2$.

The following sections lists the largest glaciers and glacier complexes in each of the 19 GTN-G glacier regions. See Appendix A – List of Largest Glaciers by Region and Appendix B – List of Largest Glacier Complexes by Region for a compiled list.

In the following tables in the results section for each region, the area of the glacier in the *size* column is marked by either one, two, or three asterisks (*), which denote the following:

- * Denotes that the area is an average from both the GLIMS and RGI databases.
- ** Denotes that the area came from the GLIMS database only. This generally meant that the GLIMS outline was newer than the RGI outline, so it was chosen as the outline.
- *** Denotes that the area came from the RGI database. This generally meant that the outline did not exist in the GLIMS database.

In addition, if the month or day are unknown for a glacier outline, then a fill value of *99* is used in the *measurement date* column.

## Region 1 – Alaska

Region 1 of the GTN-G glacier region classification encompasses Alaska. The region outline extends from 50° N to 72° N latitude and 180° W to 127° W longitude (Figure 1). Alaska is the northernmost state of the United States and has an area of approximately 1.53 million $km^2$. Alaska is bordered by Canada on its eastern side and by water bodies on its other three sides: the Bering Sea and the Chukchi Sea on its western side, the Arctic Ocean and the Beaufort Sea on its northern side, and the Pacific Ocean and the Gulf of Alaska on its southern side. Approximately 5% of Alaska is covered by glaciers (Molnia, 2008).

### Largest Individual Glaciers

The three largest glaciers in this region from largest to smallest are Malaspina-Seward Glacier, Bering Glacier, and Hubbard Glacier. They are adjacent glaciers residing in the St. Elias Range and Chugach Mountains along the coast of the Gulf of Alaska. They are all classified as outlet glaciers but with distinctions. Hubbard is a tidewater outlet glacier, while Bering and Malaspina-Seward are surging outlet glaciers with piedmont lobes. Their sizes are listed in Table 3, and their outlines can be seen in Figure 2.

**Table 3. Three largest glaciers in Region 1 - Alaska**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Malaspina-Seward Glacier | 3,362.7* | 2010-09-12 |
| Bering Glacier | 3,025.1* | 2010-09-10 |
| Hubbard Glacier | 2,834.5* | 2010-09-14 |

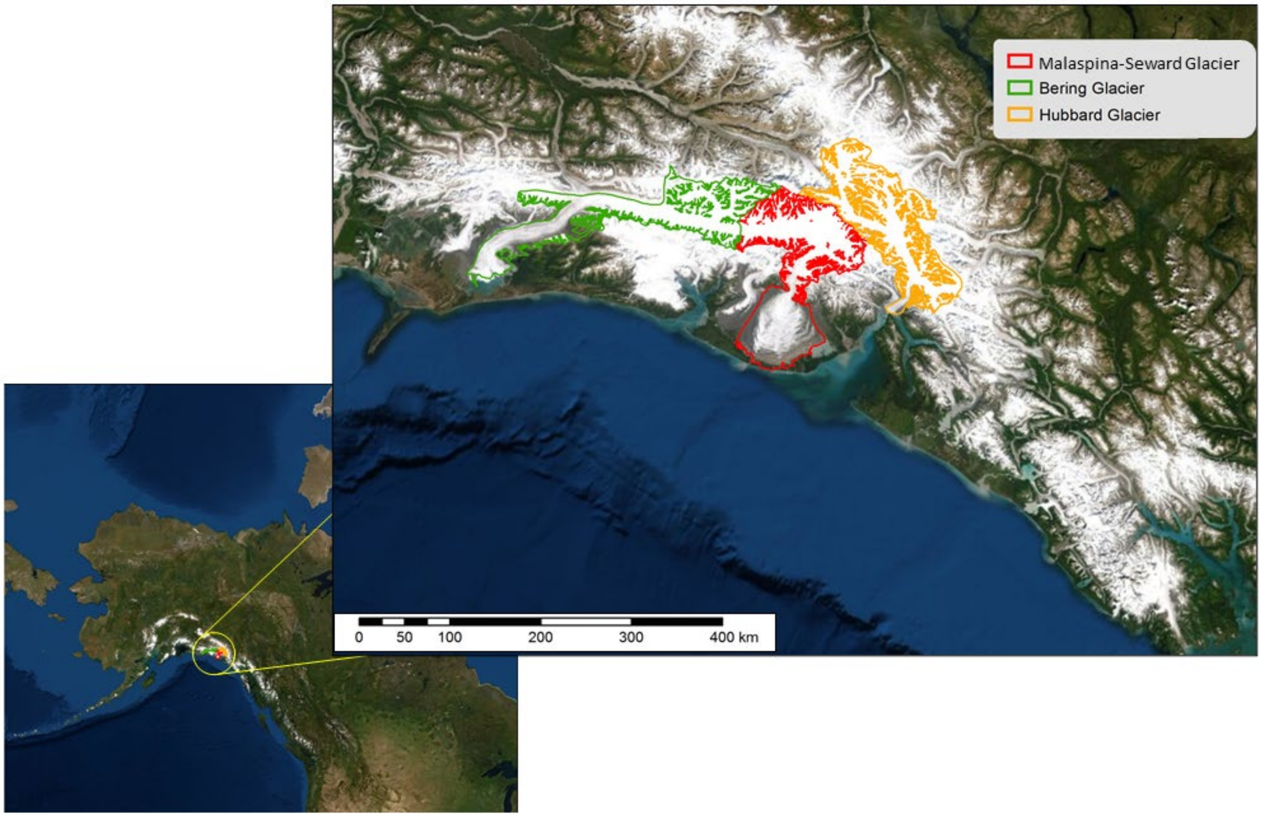


**Figure 2. Three largest glaciers in Region 1 – Alaska**

## Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest are Malaspina-Seward Glacier Complex, Brady-Carroll Glacier Complex, and Knik-Harvard-Columbia Glacier Complex. Their sizes are listed in Table 4, and their outlines can be seen in Figure 3.

**Table 4. Three largest glacier complexes in Region 1 – Alaska**

| Glacier complex name | Size ($km^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Malaspina-Seward Glacier Complex | 30,194.9** | 1999-08-12 to 2010-09-23 |
| Brady-Carroll Glacier Complex | 5,816.7** | 2005-08-09 to 2010-09-23 |
| Knik-Harvard-Columbia Glacier Complex | 5,182.8** | 2007-07-16 to 2009-09-06 |

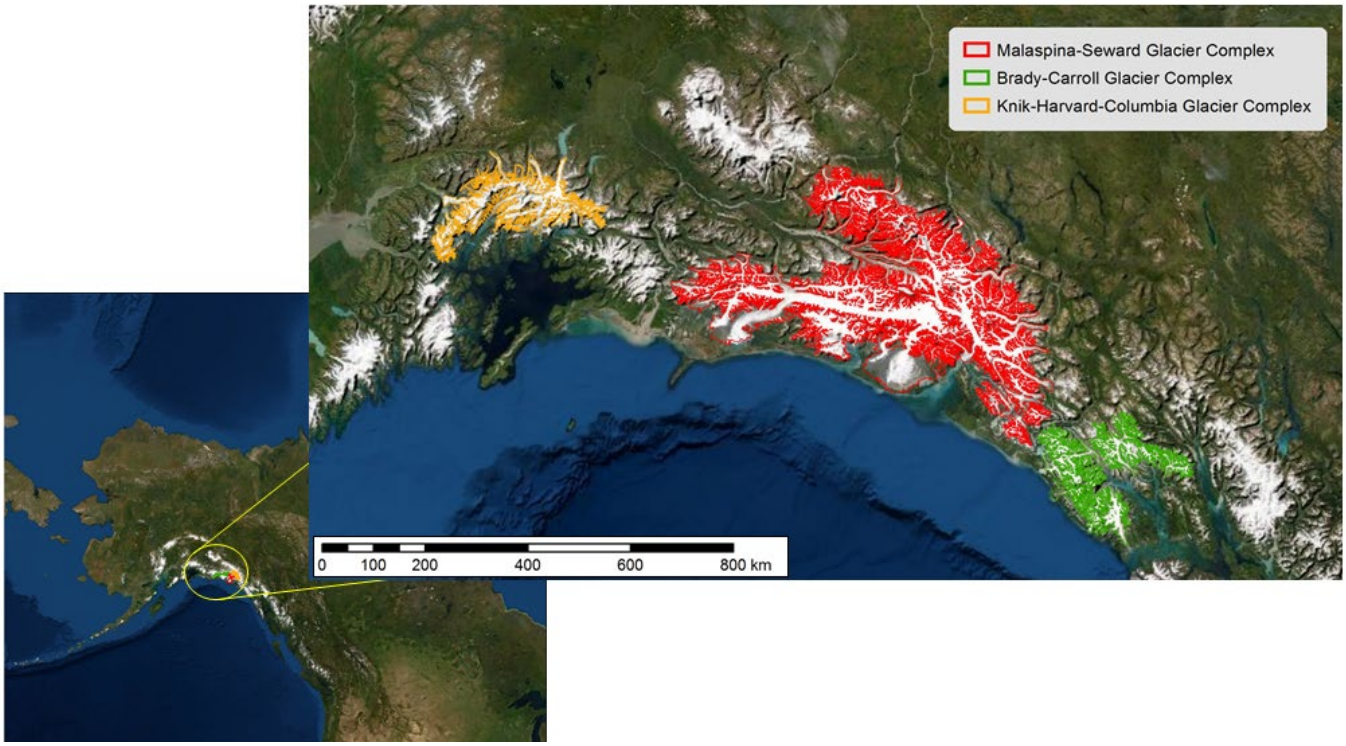


**Figure 3. Three largest glacier complexes in Region 1 – Alaska**

### Notes on Region 1 Results

The regional correspondents for Region 1 noted that the largest glacier is a joint glacier with the name Malaspina-Seward Glacier (email correspondence Nov. 2020). Both GLIMS and RGI list it simply as Seward Glacier. I have renamed it according to the correspondent's suggestion.

### Glacier Outline Literature Citation and GLIMS Submission Information

Beedle, M. J.; Dyurgerov, M.; Tangborn, W.; Khalsa, S. J. S.; Helm, C.; Raup, B.; Armstrong, R.; Barry, R. G. (2008). Improving estimation of glacier volume change: a GLIMS case study of Bering Glacier System, Alaska. *The Cryosphere* 2 (1):33--51.

**Submitters**: G. Cogley, University of Colorado

## Region 2 – Western Canada and USA

Region 2 of the GTN-G glacier region classification encompasses Western Canada and USA. The region outline extends from 35° N to 74° N latitude and 134° W to 104° W longitude (Figure 1). The Western Canada and USA region extends as far north as the Banks and Victoria Islands in the Canadian Arctic Archipelago and as far south as the middle of New Mexico, USA. It extends as far west as the Queen Charlotte Islands of Canada and the Yukon Territory. It extends as far east as the middle of Saskatchewan, Canada and the eastern edge of Wyoming, USA. The largest glaciers in this region lie in the Canadian Coastal Mountains that run along the Canadian Pacific (Clarke and Holdsworth, 2002).

### Largest Individual Glaciers

The three largest glaciers in this region from largest to smallest are Klinaklini Glacier, Franklin Glacier, and Heakamie Glacier. They all reside in the Pacific Range, which is the southern portion of the Canadian Coastal Mountains. They are all classified as valley glaciers. Their sizes are listed in Table 5, and their outlines can be seen in Figure 4.

**Table 5. Three largest glaciers in Region 2 – Western Canada and USA**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Klinaklini Glacier | 469.8* | 2004-07-22 |
| Franklin Glacier | 153.4* | 2004-07-22 |
| Heakamie Glacier | 136.9*** | 2004-99-99 |

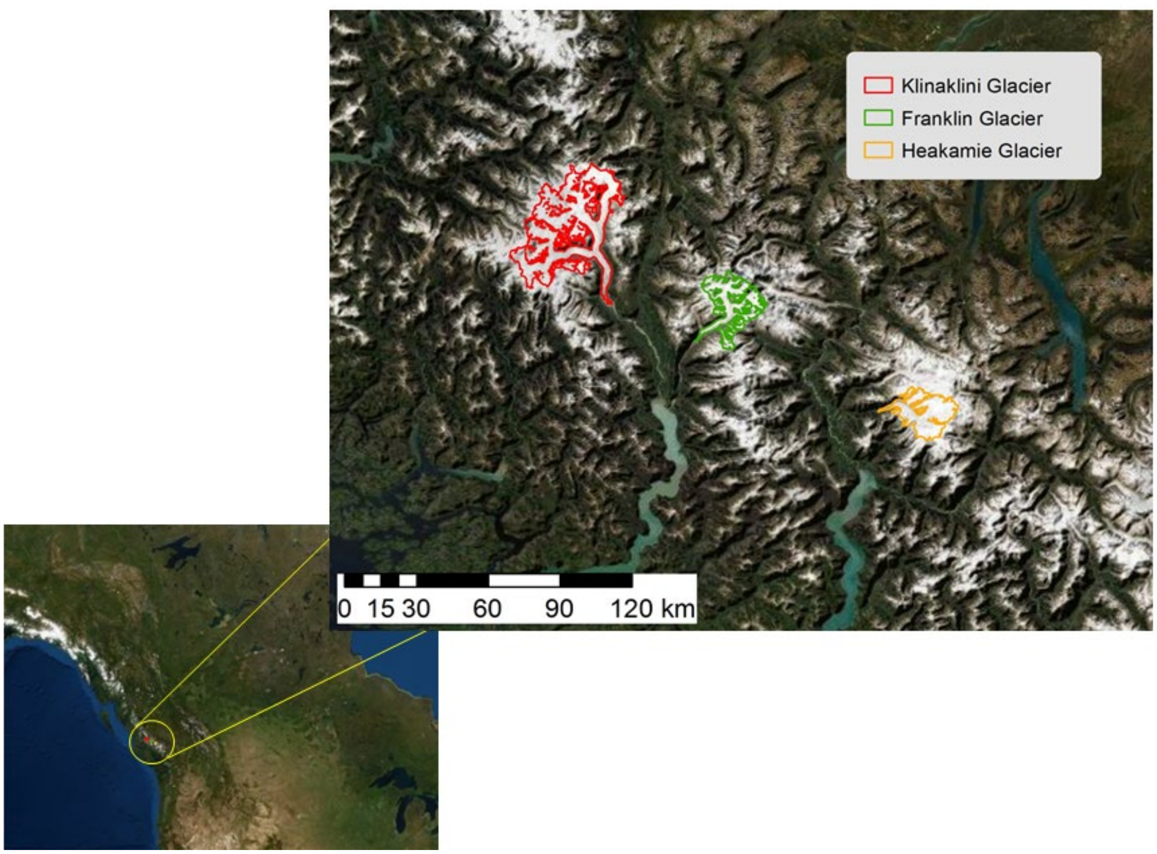


**Figure 4. Three largest glaciers in Region 2 – Western Canada and USA**

### Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest are Klinaklini Glacier Complex, Franklin Glacier Complex, and Bishop Glacier Complex. Their sizes are listed in Table 6, and their outlines can be seen in Figure 5.

**Table 6. Three largest glacier complexes in Region 2 – Western Canada and USA**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Klinaklini Glacier Complex | 905.1** | 2004-07-22 |
| Franklin Glacier Complex | 703.7** | 2004-07-22 to 2004-08-16 |
| Bishop Glacier Complex | 509.3** | 2004-08-09 |

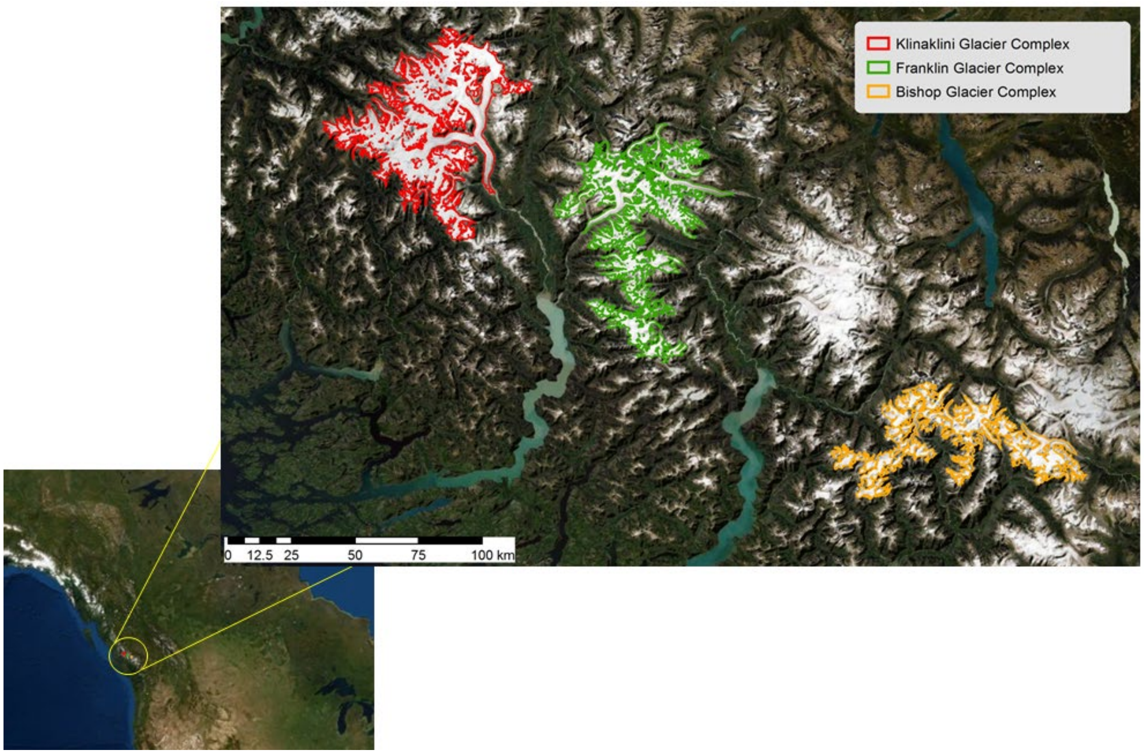


**Figure 5. Three largest glacier complexes in Region 2 – Western Canada and USA**

### Notes on Region 2 Results

The third largest glacier in Region 2 was not named in either GLIMS or RGI. I found the name of Heakamie Glacier in the World Glacier Monitoring Service (WGMS) Fluctuation of Glaciers (FoG) database.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: T. Bolch, University of Northern British Columbia

## Region 3 – Arctic Canada, North

Region 3 of the GTN-G glacier region classification encompasses the Queen Elizabeth Islands in Northern Arctic Canada. The region outline extends from 74° N to 85° N latitude and 125° W to 60° W longitude (Figure 1). The Queen Elizabeth Islands are a group of islands in the Arctic Ocean that belong to the northernmost part of Canada's Arctic Archipelago. They are some of the largest islands in the world with the largest ones in the group including Ellesmere, Devon, Axel Heiberg, and Melville. They comprise roughly 14% of the area of glaciers and ice caps on the Earth (Sharp et al., 2011). The islands are in the Nunavut territory of Canada with Greenland off the east coast of Ellesmere Island.

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Wykeham Glacier South located on the Prince of Wales Icefield on Ellesmere Island, and Devon Ice Cap Southeast Glacier No. 2 and Croker Bay Glacier located on the Devon Ice Cap on Devon Island. They are all classified as outlet glaciers. Their sizes are listed in Table 7, and their outlines can be seen in Figure 6.

**Table 7. Three largest glaciers in Region 3 – Arctic Canada, North**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Wykeham Glacier South | 3,175.8* | 1999-07-09 |
| Devon Ice Cap Southeast Glacier No. 2 | 2,622.8* | 1999-06-15 |
| Croker Bay Glacier | 2,170.5* | 1999-06-15 |

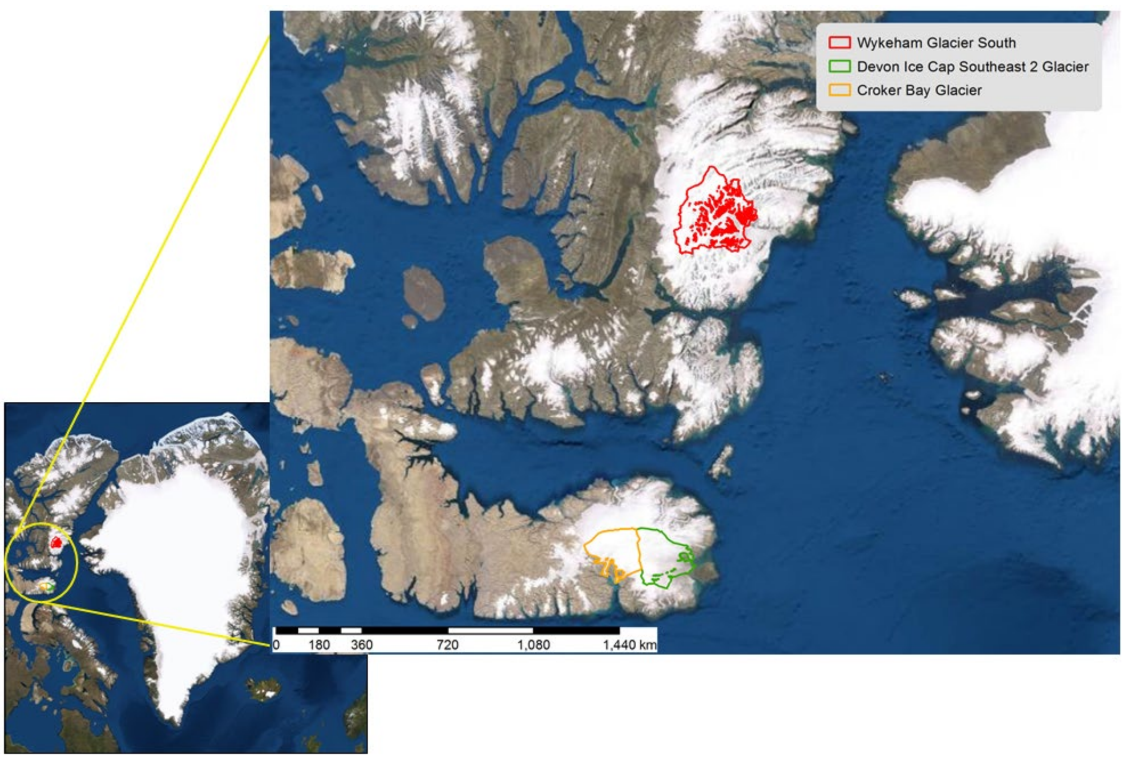


**Figure 6. Three largest glaciers in Region 3 – Arctic Canada, North**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 3, the following literature was consulted: Koerner (2002), Sharp et al. (2011), Van Wychen et al. (2014), and Wyatt and Sharp (2015). The three largest glacier complexes in this region, from largest to smallest, are Northern Ellesmere Icefield, Prince of Wales Icefield, and Agassiz Ice Cap all on Ellesmere Island. Their sizes are listed in Table 8, and their outlines can be seen in Figure 7.

**Table 8. Three largest glacier complexes in Region 3 – Arctic Canada, North**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Northern Ellesmere Icefield | 19,521.3** | 1999-06-15 |
| Prince of Wales Icefield | 19,009.2** | 1999-06-15 to 1999-07-09 |
| Agassiz Ice Cap | 18,038.0** | 1999-06-15 |

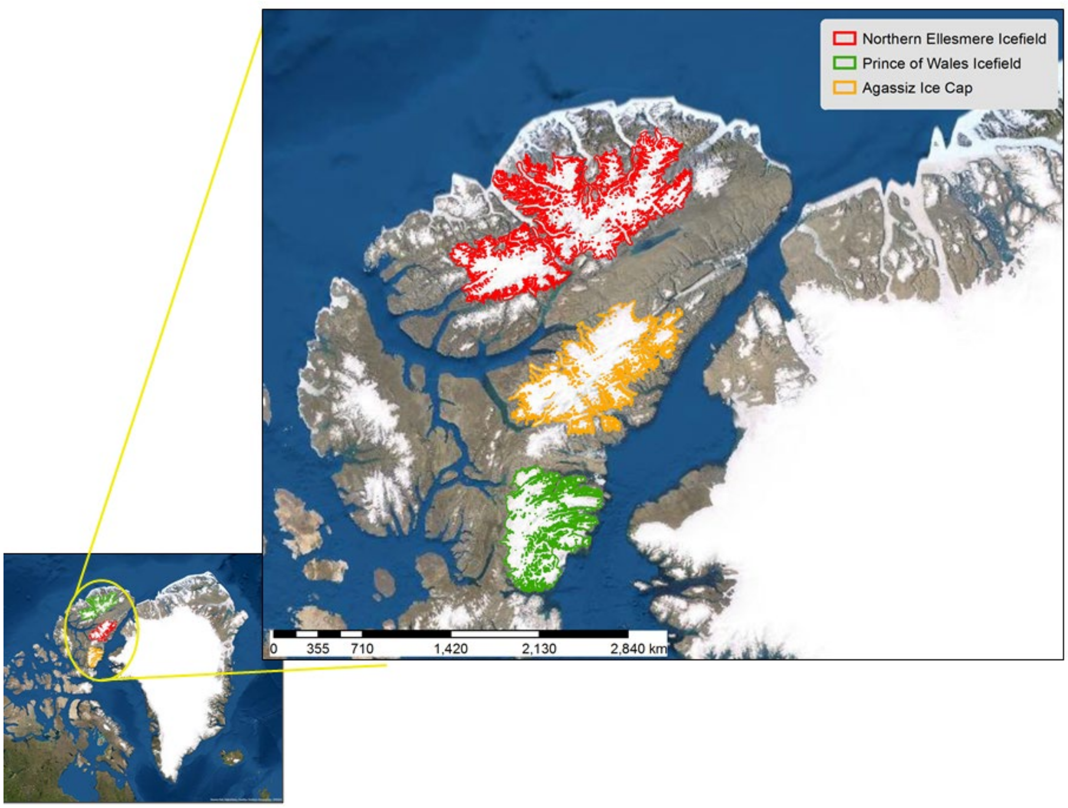


**Figure 7. Three largest glacier complexes in Region 3 – Arctic Canada, North**

## Notes on Region 3 Results

Although the GLIMS and RGI databases list Croker Bay Glacier as one glacier, Boon et al. (2010) characterizes it as two: North Croker Bay and South Croker Bay. The regional correspondent for Region 3 noted that many of the RGI/GLIMS outlines from the Canadian Arctic region do not follow the GLIMS guidelines. For example, a glacier is all ice flowing towards a common terminus and hence there are several glacier complexes present in the databases instead of glaciers defined by their flow basin (email correspondence Nov. 2020). Crocker Bay Glacier is one such example.

**Glacier Outline Literature Citation and GLIMS Submission Information**

No literature citation available.

**Submitters**: G. Hartman, University of Alberta; T. Bolch, University of Colorado

## Region 4 – Arctic Canada, South

Region 4 of the GTN-G glacier region classification encompasses Baffin Island, Bylot Island, Prince Charles Island, and Southampton Island in Nunavut, Canada as well as portions of northern mainland Nunavut, Quebec, and Newfoundland. The region outline extends from 57° N to 74° N latitude and 90° W to 58° W longitude (Figure 1). Baffin Island is the largest island in Canada and one of the five largest islands in the world (Andrews, 2002). It is located in the Arctic Ocean north of the Hudson Bay and Quebec, Canada. The island is bordered by mainland Nunavut to the west with Greenland off the coast to the northeast.

**Largest Individual Glaciers**

The three largest glaciers in this region all reside on Baffin Island. From largest to smallest, they are Barnes Ice Cap South Dome North Slope Glacier, Barnes Ice Cap Loeken Glacier No. 2, and Barnes Ice Cap Southeast Slope Glacier all on the Barnes Ice Cap. They are all classified as outlet glaciers. Their sizes are listed in Table 9, and their outlines can be seen in Figure 8.

**Table 9. Three largest glaciers in Region 4 – Arctic Canada, South**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Barnes Ice Cap South Dome North Slope Glacier | 2,771.4* | 2002-08-02 |
| Barnes Ice Cap Loeken Glacier No. 2 | 1,051.3* | 2000-07-27 |
| Barnes Ice Cap Southeast Slope Glacier | 959.9* | 2000-07-27 |

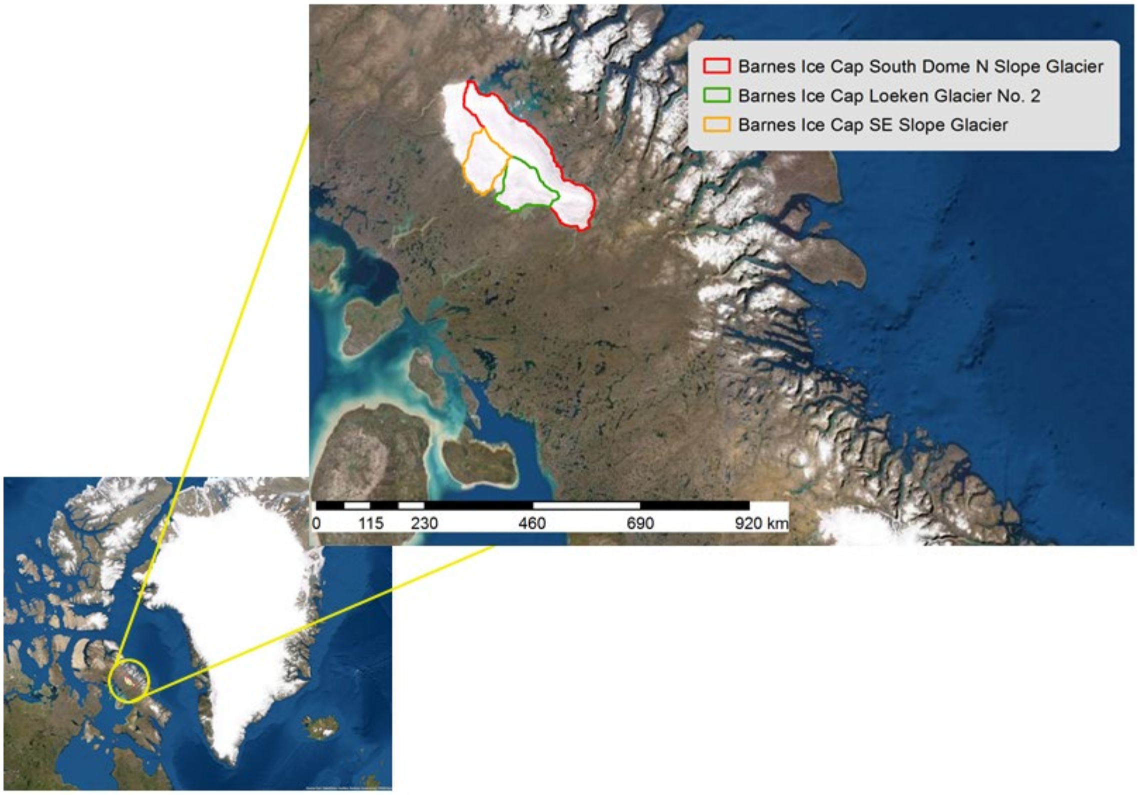


**Figure 8. Three largest glaciers in Region 4 – Arctic Canada, South**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 4, the following literature was consulted: Andrews (2002) and Dowdeswell et al. (2007). The three largest glacier complexes in this region, from largest to smallest, are Penny Ice Cap and Barnes Ice Cap on Baffin Island, and Bylot Island Icefield on Bylot Island. Their sizes are listed in Table 2, and their outlines can be seen in Figure 3.

**Table 10. Three largest glacier complexes in Region 4 – Arctic Canada, South**

| Glacier complex name | Size ($km^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Penny Ice Cap | 6,508.1** | 2000-08-13 to 2002-08-01 |
| Barnes Ice Cap | 5,862.7** | 2000-07-27 to 2002-08-02 |
| Bylot Island Icefield | 4,711.9** | 2000-08-10 to 2001-08-09 |

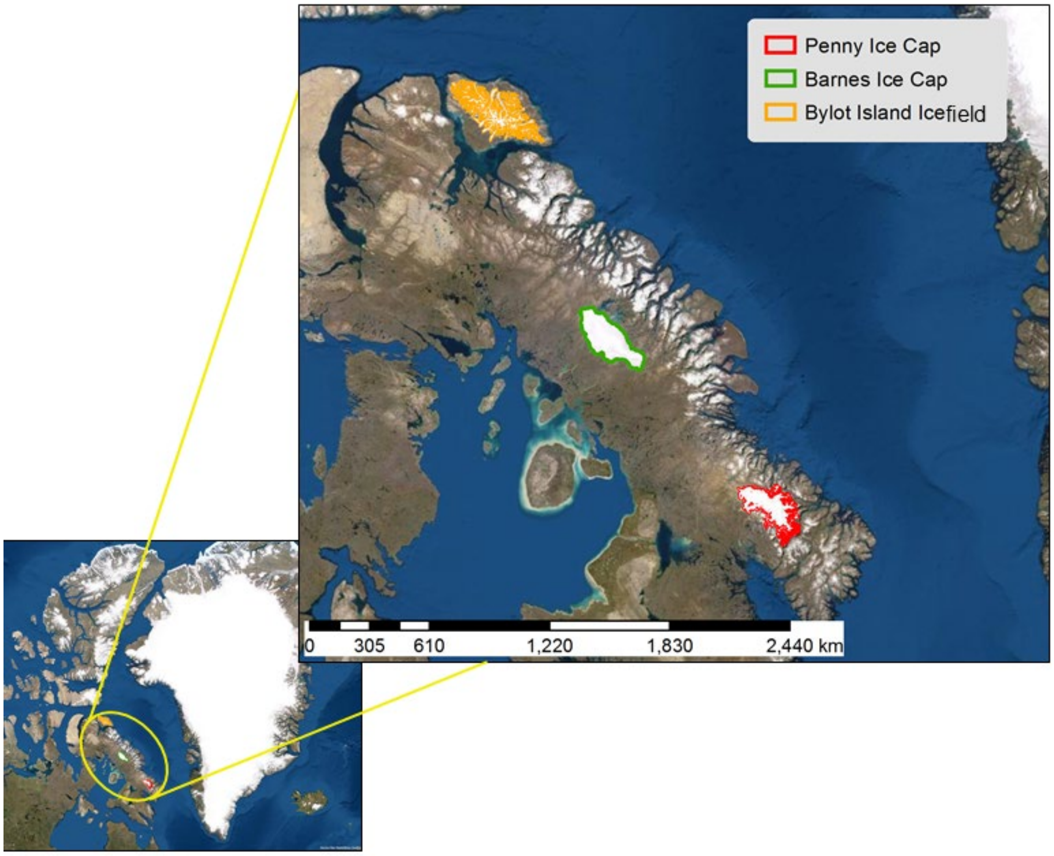


**Figure 9. Three largest glacier complexes in Region 4 – Arctic Canada, South**

### Notes on Region 4 Results

My method of merging all connected glaciers to create the glacier complex outlines may lead to slightly different area results than as seen in the literature. For example, Andrews (2002), gives a value of 5,960 $km^2$ for Penny Ice Cap where my value is 6,133 $km^2$. The Region 4 correspondent notes that this difference is likely a biproduct of my merging strategy and is acceptable. However, users should be aware that these differences can occur and should use caution when directly comparing my values with other studies that define the ice mass extents differently (email correspondence Nov. 2020). The third largest glacier in this region was unnamed, and I could not find a name in the literature, so I named it Barnes Ice Cap Southeast Slope Glacier due to its geographical location.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: T. Bolch, University of Colorado

## Region 5 – Greenland Periphery

Region 5 of the GTN-G glacier region classification covers the periphery (coast) of Greenland. The region outline extends from 59° N to 85° N latitude and 75° W to 10° W longitude (Figure 1). Greenland is the largest island on Earth (Williams and Ferrigno, 2012) and is located between the Arctic Ocean to the north and the Atlantic Ocean to the south. It contains the second largest ice sheet in the world, second only to Antarctica, and approximately 80 percent of it is covered in ice (Weidick, 1995). The periphery of Greenland contains many outlet glaciers and ice caps and covers a total area of approximately 90,000 km$^2$ (Noël, 2017).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Tjalfe Glacier on the Hans Tausen Ice Cap, Qaarajuttok Ice Cap Southeast Glacier in southwest Greenland, and Knud Rasmussen Glacier in southeast Greenland. They are all classified as outlet glaciers. Their sizes are listed in Table 11, and their outlines can be seen in Figure 10.

**Table 11. Three largest glaciers in Region 5 – Greenland Periphery**

| Glacier name | Size (km$^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Tjalfe Glacier | 739.0* | 1999-09-01 |
| Qaarajuttok Ice Cap Southeast Glacier | 603.8* | 2000-08-23 |
| Knud Rasmussen Glacier | 583.1* | 2000-09-09 |

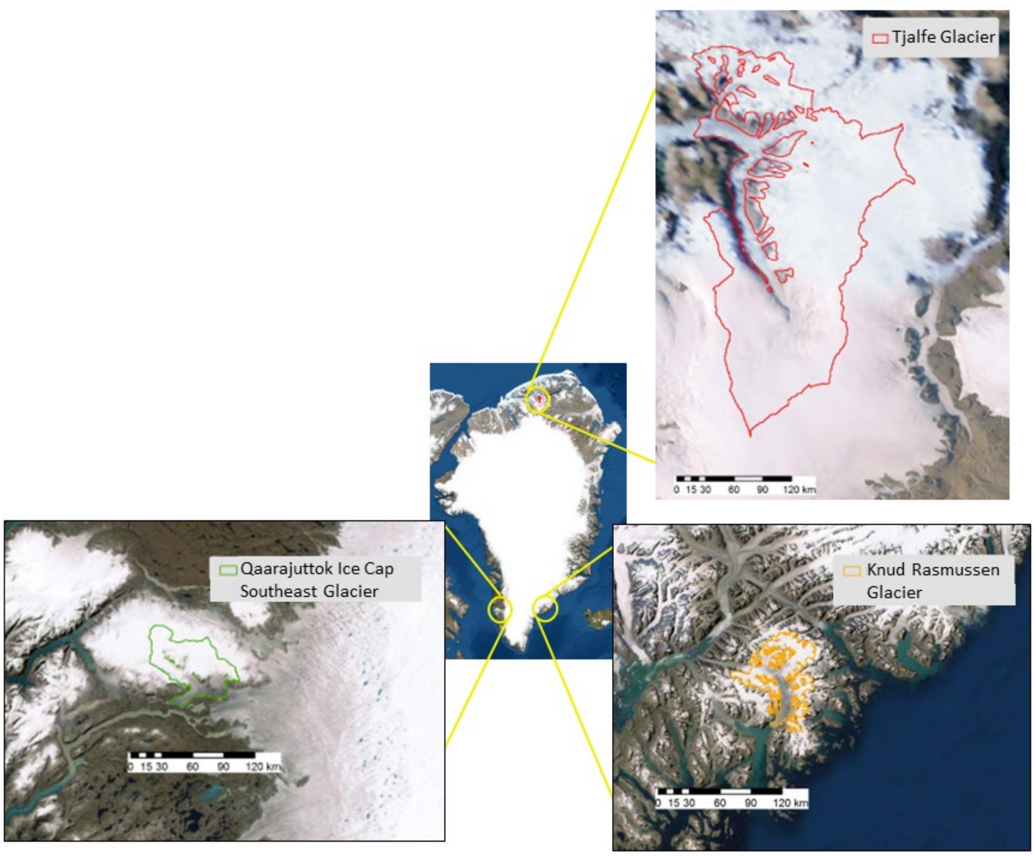


**Figure 10. Three largest glaciers in Region 5 – Greenland Periphery**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 5, the following literature was consulted: Weidick (1995), Rastner et al. (2012), Bolch et al. (2013), and Landvik et al. (2001). The three largest glacier complexes in this region, from largest to smallest, are Flade Isblink Glacier Complex, Hans Tausen-Bure Glacier Complex, and Stauning Alps Glacier Complex. Their sizes are listed in Table 12, and their outlines can be seen in Figure 11.

**Table 12. Three largest glacier complexes in Region 5 – Greenland Periphery**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Flade Isblink Glacier Complex | 9,025.3*** | 2001-07-03 |
| Hans Tausen-Bure Glacier Complex | 4,114.0*** | 1999-99-99 |
| Stauning Alps Glacier Complex | 3,466.0*** | 2000-08-19 to 2001-08-20 |

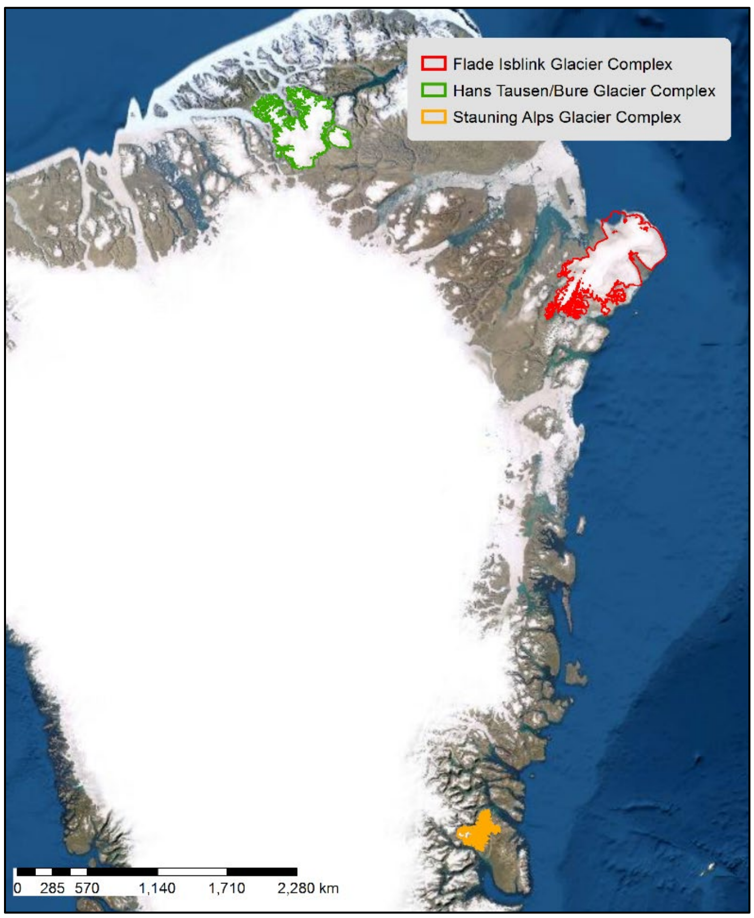


**Figure 11. Three largest glacier complexes in Region 5 – Greenland Periphery**

### Largest Separated Glacier Complexes

If a second manual clipping step is used to separate the ice caps into their more commonly known ice formations as described in the literature (e.g. Weidick, 1995; Rastner et al., 2012; Bolch et al., 2013; Landvik et al., 2001), rankings change slightly. The three largest separated glacier complexes in this region, from largest to smallest, are Flade Isblink, Hans Tausen Ice Cap, and North Ice Cap. Their sizes are listed in Table 13, and their outlines can be seen in Figure 12.

**Table 13. Three largest clipped glacier complexes in Region 5 – Greenland Periphery**

| Glacier complex name | Size (km$^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Flade Isblink | 7,537.6*** | 2003-07-01 to 2003-07-01 |
| Hans Tausen Ice Cap | 3,721.5*** | 1999-09-01 to 1999-09-01 |
| North Ice Cap | 3,141.0*** | 2000-06-28 to 2002-08-23 |

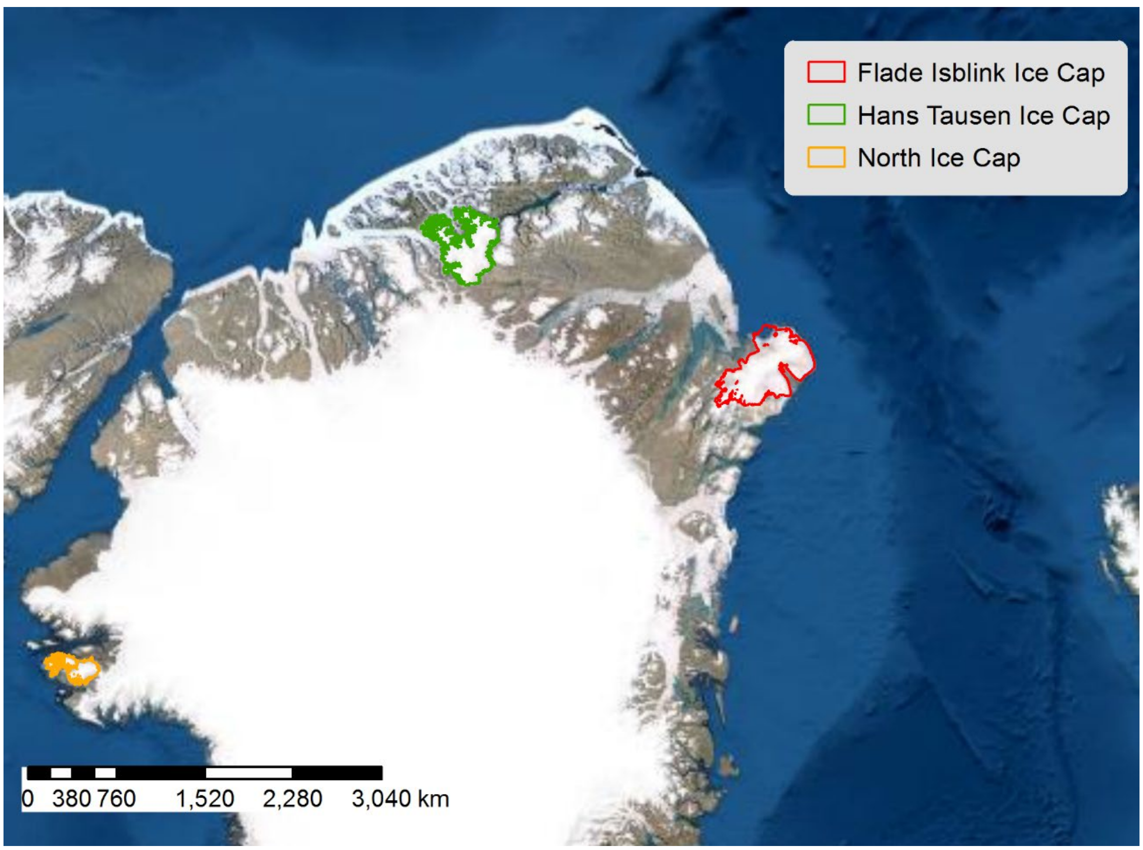


**Figure 12. Three largest clipped glacier complexes in Region 5 – Greenland Periphery**

### Notes on Region 5 Results

For the Greenland ice sheet, I only inspected glaciers that have connectivity level of 0 or 1 (Table 2). If they were level 2, I filtered them out of this analysis because those ice masses are too connected to the ice sheet and do not fit the definition of a glacier used in this project. Only the RGI database contains connectivity level information. For the individual glacier analysis, the connectivity information was extracted from RGI and then I cross-referenced the filtered glaciers with the same ones in GLIMS. For the glacier complex analysis, RGI alone was used since the number of glaciers in each complex made it challenging to cross reference all of the same ones from GLIMS.

None of the glaciers were named in the GLIMS or RGI databases. The name for the largest glacier came from communication with the Region 5 correspondent and Bjørk et al. (2015). No name could be found for the second largest glacier so the name Qaarajuttok Ice Cap Southeast Glacier was created due to its geographical location, and the name for the third largest was found in Google Earth.

As noted in Methods section, during the merging operation for the glacier complex analysis, Hans Tausen Ice Cap and another small ice cap next to it, Bure Ice Cap, became merged together. For the final published dataset, I chose to keep them merged. However, for completeness, I did separate the two to get a size estimate. I created a polygon around Hans Tausen to clip it away from Bure Ice Cap to arrive at the final Han Tausen outline and its size as seen in Figure 12 and  Table 13.

**Glacier Outline Literature Citation and GLIMS Submission Information**

No literature citation available.

**Submitters**: G. Cogley, University of Colorado

## Region 6 – Iceland

Region 6 of the GTN-G glacier region classification covers Iceland. The region outline extends from 59° N to 67° N latitude and 26° W to 10° W longitude (Figure 1). Iceland is an island country in the North Atlantic Ocean to the southeast side of Greenland. Approximately 10 percent of the country is covered in ice and about 60 percent of that ice lies on top of active volcanoes (Björnsson, 2017).

**Largest Individual Glaciers**

The three largest glaciers in this region, from largest to smallest, are Skeidararjökull, Bruarjökull, and Breidamerkurjökull all on the Vatnajökull Ice Cap on the southeast side of Iceland. They are all classified as outlet glaciers. Their sizes are listed in Table 14, and their outlines can be seen in Figure 13.

**Table 14. Three largest glaciers in Region 6 – Iceland**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Skeidararjökull | 1,561.2*** | 2000-99-99 |
| Bruarjökull | 1,428.7*** | 2000-99-99 |
| Breidamerkurjökull | 1,067.7*** | 2000-99-99 |

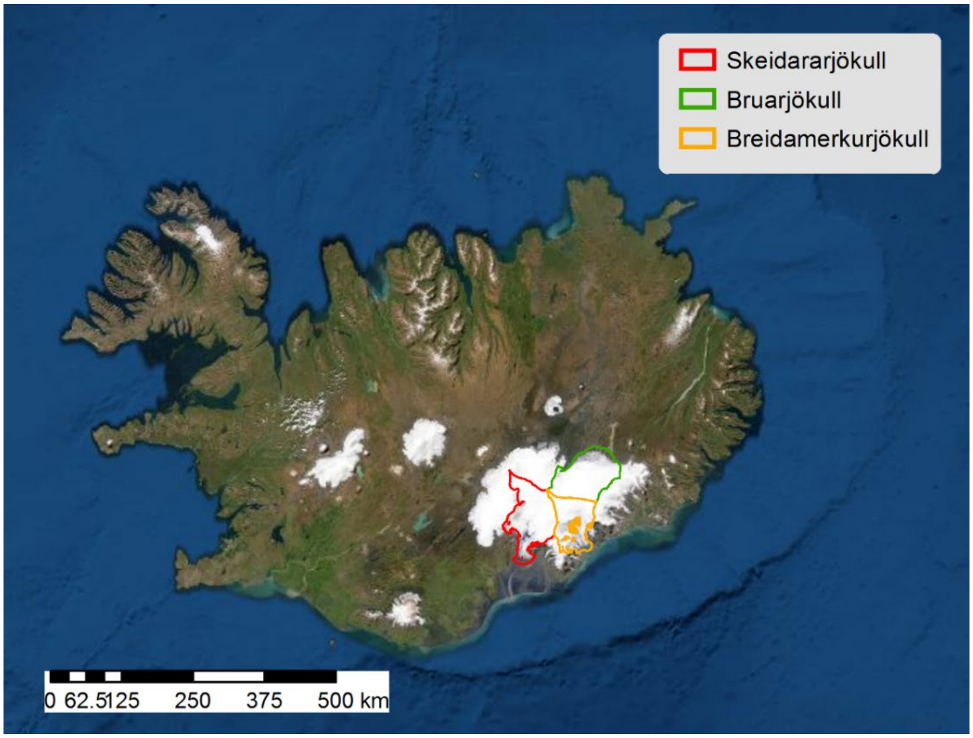


**Figure 13. Three largest glaciers in Region 6 – Iceland**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 6, the following literature was consulted: Björnsson (2017) and Sigurðsson and Williams (2008). The three largest glacier complexes in this region, from largest to smallest, are Vatnajökull Ice Cap, Langjökull Ice Cap, and Hofsjökull Ice Cap. Their sizes are listed in Table 15, and their outlines can be seen in Figure 14.

**Table 15. Three largest glacier complexes in Region 6 – Iceland**

| Glacier complex name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Vatnajökull Ice Cap | 8,091.7** | 1999-01-01 |
| Langjökull Ice Cap | 920.6** | 2000-08-20 |
| Hofsjökull Ice Cap | 889.5** | 1999-08-01 |

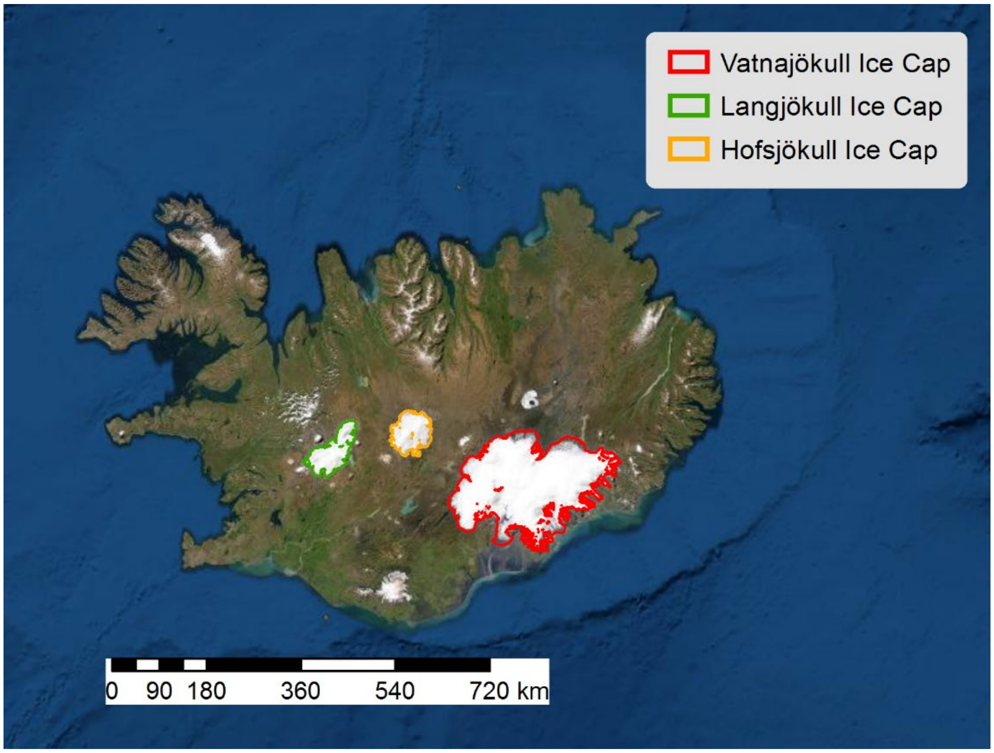


**Figure 14. Three largest glacier complexes in Region 6 – Iceland**

**Notes on Region 6 Results**

From communication with the Region 6 correspondent, the glacier outlines in the version of GLIMS and RGI used for this study do not seem to follow the known ice divides. The Region 6 correspondent and the University of Iceland have recently compiled a national glacier outline inventory for Iceland (Hannesdóttir et al., 2020) that they plan to submit to GLIMS in late 2021 (email correspondence Nov. 2020). Future work would be to use these new outlines once they are submitted to GLIMS and provide an updated version of this data.

During the analysis of Region 6, it was found that only the RGI database contained the outlines for the glaciers in this region, whereas GLIMS contained the outlines for the glacier complexes. Therefore, the RGI database, alone, was used for determining the largest glaciers in this region. The GLIMS outlines were directly used for the glacier complex analysis, so the glacier merging step was not needed for this region.

**Glacier Outline Literature Citation and GLIMS Submission Information**

No literature citation available.

**Submitters**: O. Sigurdsson, National Energy Authority of Iceland

## Region 7 – Svalbard and Jan Mayen

Region 7 of the GTN-G region classification encompasses Svalbard and Jan Mayen. The region outline extends from 70° N to 83° N latitude and 10° W to 35° E longitude (Figure 1). Svalbard is a group of Norwegian islands situated in the Arctic Ocean north of mainland Europe from 74° N to 81° N and from 10° E to 35° E (Liestøl, 1993). Jan Mayen is a Norwegian island southwest of Svalbard at 71° N and 8° W (Hagen et al., 1993). Approximately 60% of Svalbard (Liestøl, 1993) and 30% of Jan Mayen (Hagen et al. 1993) are covered in glaciers.

### Largest Individual Glaciers

The three largest glaciers in this region are all in Svalbard. From largest to smallest, they are Storstraumbreen and Bråsvellbreen on the Austfonna Ice Cap, and Negribreen in Olav V Land. They are all classified as outlet glaciers. Their sizes are listed in Table 16, and their outlines can be seen in Figure 15.

**Table 16. Three largest glaciers in Region 7 - Svalbard and Jan Mayen**

| Glacier name | Size (km$^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Storstraumbreen | 1,226.4* | 2001-07-10 |
| Bråsvellbreen | 1,095.9* | 2001-07-10 |
| Negribreen | 963.9* | 2008-09-01 |

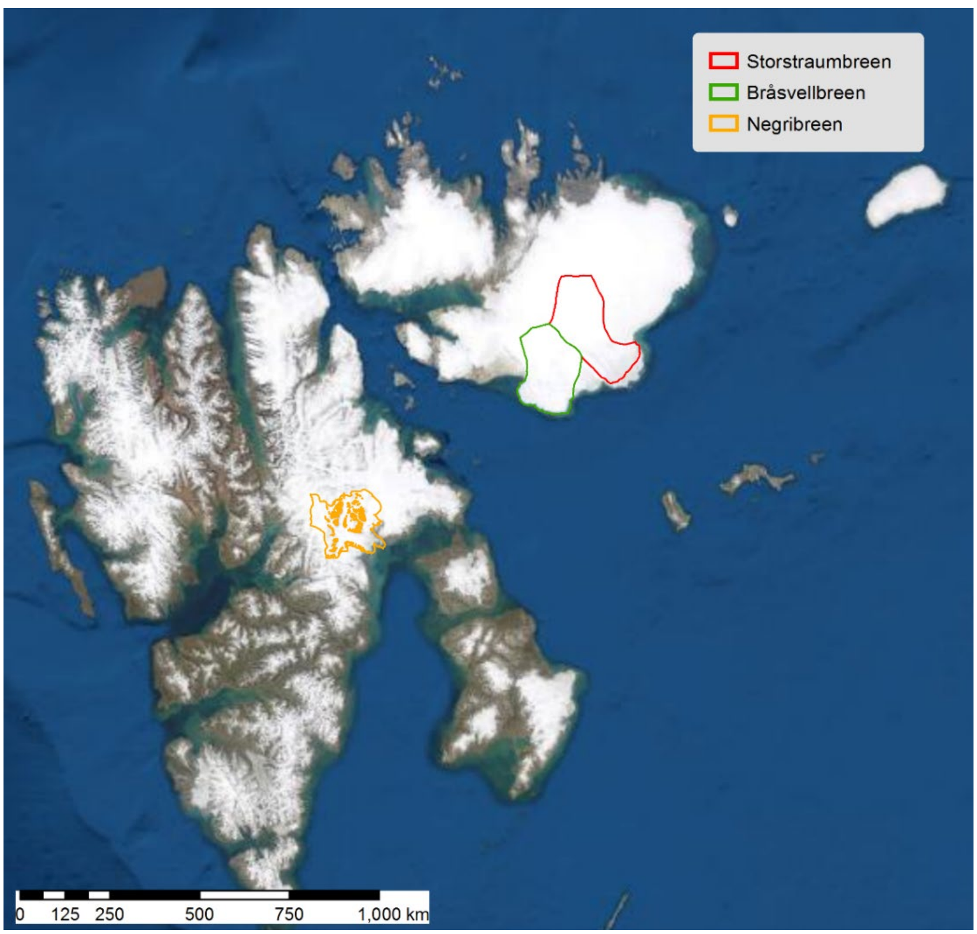


**Figure 15. Three largest glaciers in Svalbard and Jan Mayen**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 7, the following literature was consulted: Hagen et al. (1993), Harland (1997), Liestøl (1993), and Orheim (1993). The three largest glacier complexes in this region are all in Svalbard. From largest to smallest, they are Austfonna Ice Cap and Vestfonna Ice Cap on Nordaustlandet Island, and Asgardfonna Ice Cap on Spitsbergen. Their sizes are listed in Table 17, and their outlines can be seen in Figure 16.

**Table 17. Three largest glacier complexes in Region 7 - Svalbard and Jan Mayen**

| Glacier complex name | Size ($km^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Asgardfonna-Balderfonna-Olaf V Glacier Complex | 8,370.5** | 1961-01-01 to 2008-09-01 |
| Austfonna Ice Cap | 8,066.9** | 2001-07-10 to 2008-08-14 |
| Holtedalfonna-Isachsenfonna Glacier Complex | 5,376.8** | 1966-01-01 to 2010-07-15 |

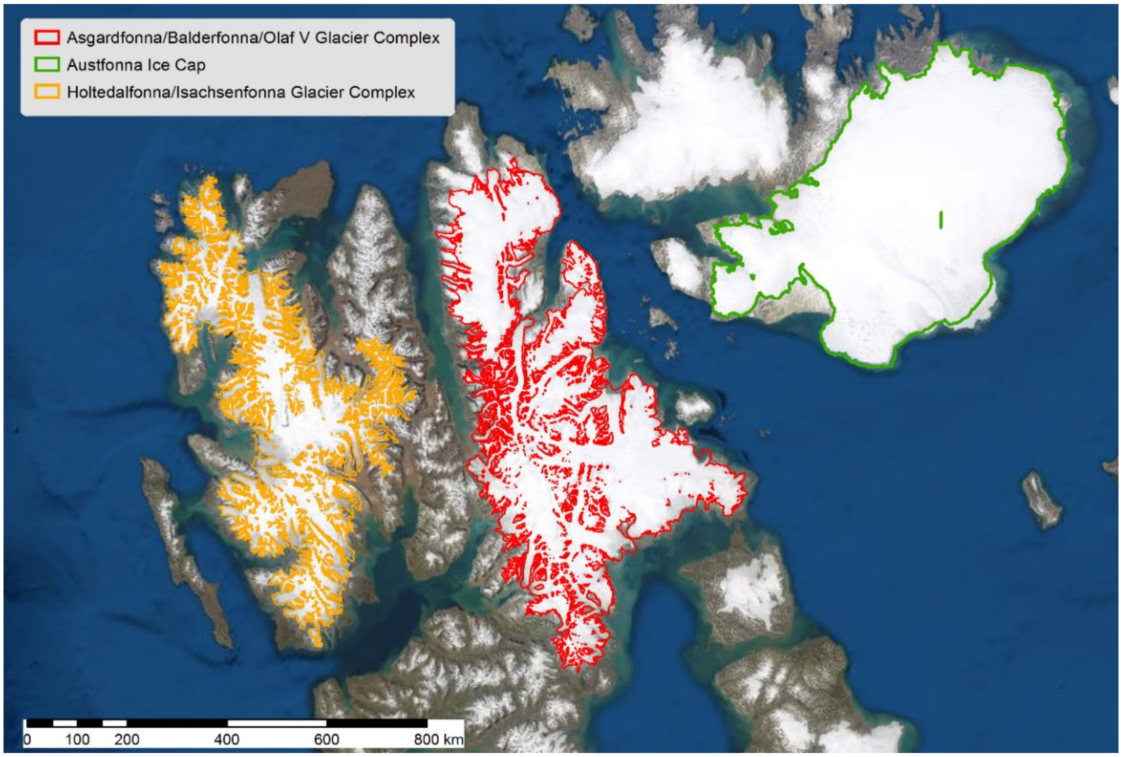


**Figure 16. Three largest glacier complexes in Region 7 – Svalbard and Jan Mayen**

## Largest Separated Glacier Complexes

If a second manual clipping step is used to separate the ice caps into their more commonly known ice formations as described in the literature (e.g. Hagen et al., 1993; Harland, 1997; Liestøl, 1993; Orheim, 1993), rankings change slightly. From largest to smallest, the separated glacier complexes are Austfonna Ice Cap and Vestfonna Ice Cap on Nordaustlandet Island, and Asgardfonna Ice Cap on Spitsbergen. Their sizes are listed in Table 18, and their outlines can be seen in Figure 17.

**Table 18. Three largest clipped glacier complexes in Region 7 - Svalbard and Jan Mayen**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Austfonna Ice Cap | 8,066.9** | 2001-07-10 to 2008-08-14 |
| Vestfonna Ice Cap | 2,367.4** | 2008-08-14 |
| Asgardfonna Ice Cap | 1,580.5** | 2008-06-07 |

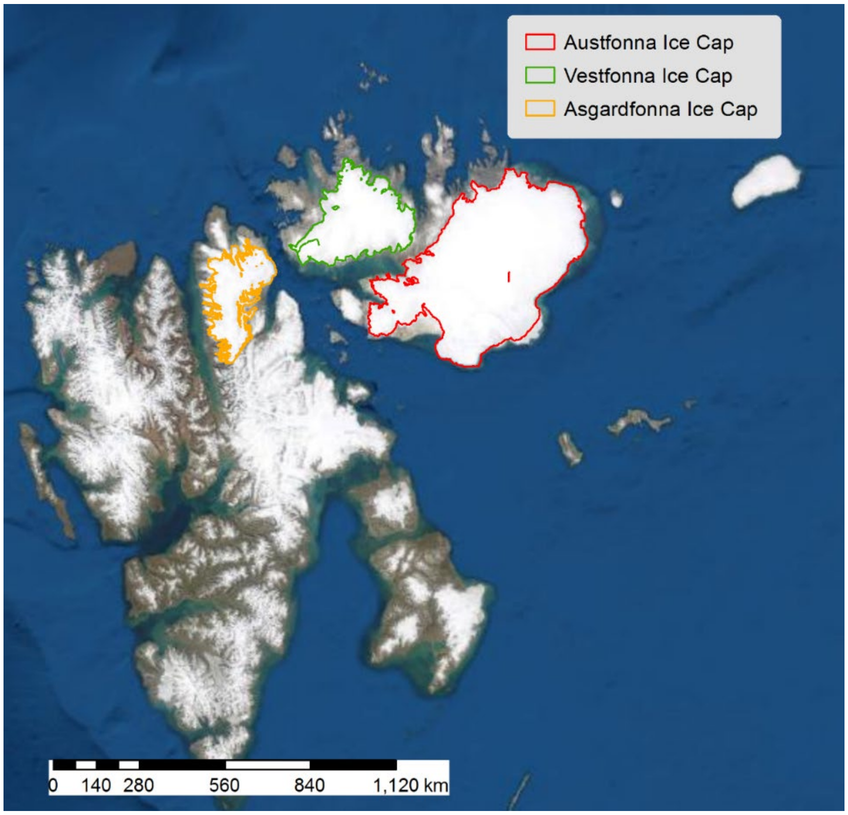

**Figure 17. Three largest clipped glacier complexes in Region 7 - Svalbard and Jan Mayen**

## Notes on Region 7 Results

The largest glacier was unnamed in both GLIMS and RGI. Its name came from communication with the Region 7 correspondent (email correspondence Mar. 2020).

The Region 7 correspondent noted that they are in the process of updating their glacier database and hope to have it released to GLIMS sometime in 2021. The correspondent mentions that the size of Storstraumbreen will certainly be different once this update takes place; since the front of that glacier has advanced significantly, and the surge has altered the drainage divides substantially (email correspondence Mar. 2020). Future work would be to use these new outlines once they are submitted to GLIMS and provide an updated version of this data.

As noted in Methods section, during the merging operation for the glacier complex analysis, Asgardfonna Ice Cap and another smaller ice cap next to it, Balderfonna Ice Cap, became merged together. For the final published dataset, I chose to keep them merged. However, for completeness, I did separate the two to get a size estimate. I created a polygon around Asgardfonna to clip it away from Balderfonna Ice Cap to arrive at the final Asgardfonna outline.

**Glacier Outline Literature Citation and GLIMS Submission Information**

No literature citation available.

**Submitters**: M. Koenig, Norwegian Polar Institute

## Region 8 – Scandinavia

Region 8 of the GTN-G region classification encompasses the Scandinavian countries of Norway, Sweden, and Finland. The region outline extends from 58° N to 74° N latitude and 4° E to 35° E longitude (Figure 1). Scandinavia is bounded by the Norwegian Sea to the west, the Barents Sea to the North, Russia to the East, and the North Sea and the Baltic Sea to the south.

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Austerdalsisen in the Nordland region of Norway, and Tunsbergdalsbreen and Nigardsbreen in the Vestland region of Norway. They are all classified as outlet glaciers. Their sizes are listed in Table 19, and their outlines can be seen in Figure 18.

**Table 19. Three largest glaciers in Region 8 – Scandinavia**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Austerdalsisen | 55.4* | 1999-09-07 |
| Tunsbergdalsbreen | 47.5* | 2006-09-16 |
| Nigardsbreen | 41.9* | 2006-09-16 |

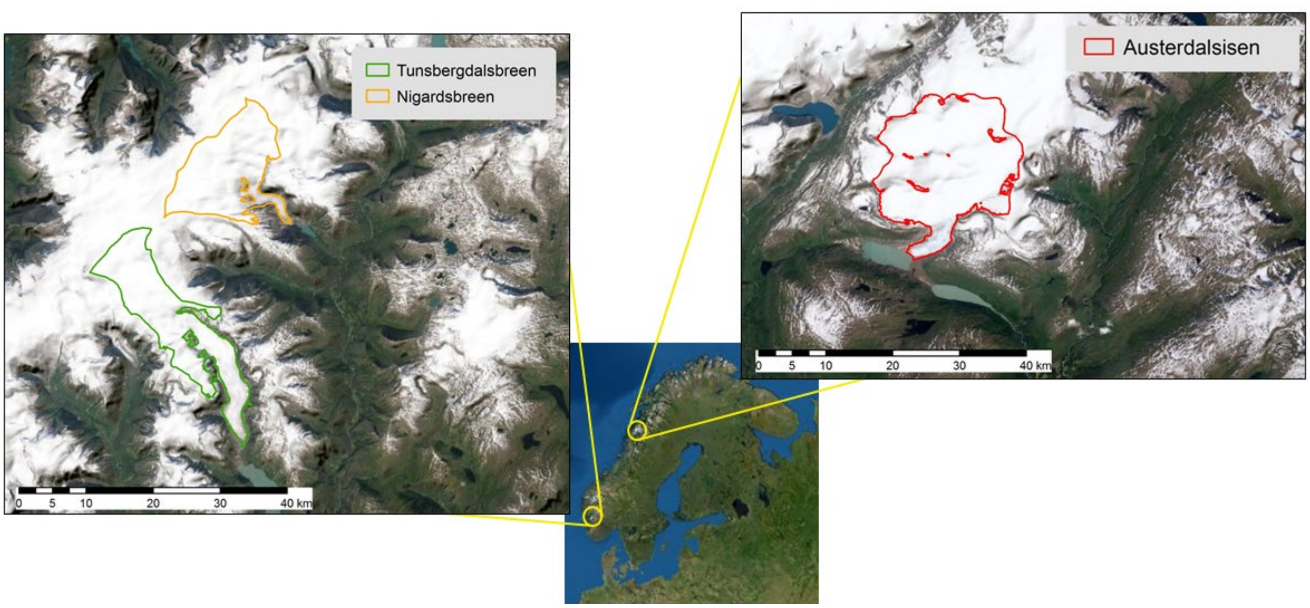


**Figure 18. Three largest glaciers in Region 8 – Scandinavia**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 8, Østrem and Haakensen (1993) was consulted. The three largest glacier complexes in this region, from largest to smallest, are Jostedalsbreen Ice Cap in the Vestland region of Norway, Western Svartisen Ice Cap in the Nordland region of Norway, and Southern Folgefonna Ice Cap in Vestland region of Norway. Their sizes are listed in Table 20, and their outlines can be seen in Figure 19.

**Table 20. Three largest glacier complexes in Region 8 – Scandinavia**

| Glacier complex name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Jostedalsbreen Ice Cap | 499.9** | 2006-09-16 |
| Western Svartisen Ice Cap | 219.3** | 1999-09-07 |
| Southern Folgefonna Ice Cap | 163.4** | 2002-09-13 |

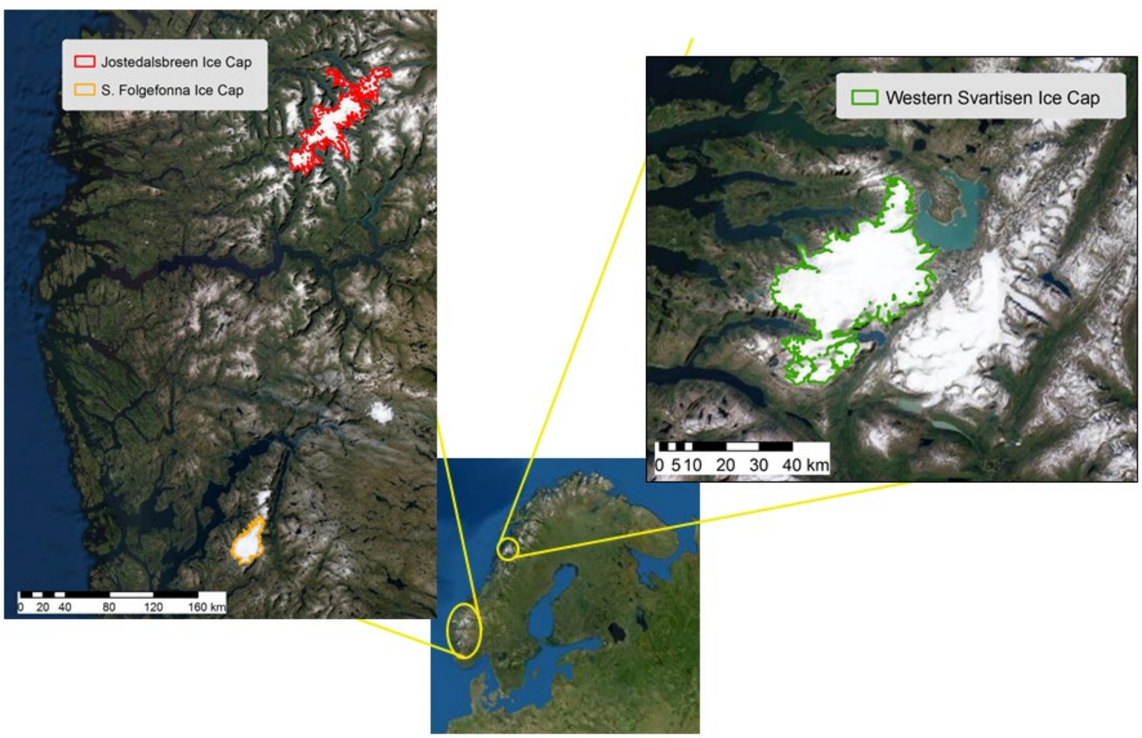


**Figure 19. Three largest glacier complexes in Region 8 – Scandinavia**

## Notes on Region 8 Results

Ice Cap names are from Andreassen et al. (2012). The Region 8 correspondents note that my icefield sizes are slightly larger than what they report in Andreassen et al. (2012) of 473.8 $km^2$, 218.7 $km^2$, and 164.2 $km^2$ (from largest to smallest). This is likely due to my merging method which is including more ice than their method. The correspondents also note that they are working on new outlines that will be added to GLIMS sometime in 2021. Future work would be to use these new outlines once they are submitted to GLIMS and provide an updated version of this data.

**Glacier Outline Literature Citation and GLIMS Submission Information**

Andreassen, L. M., Winsvold, S. H., Paul, F., & Hausberg, J. E. (2012). Inventory of Norwegian glaciers. *Rapport*, *38*.

**Submitters**: S. H. Winsvold, Norwegian Water Resources and Energy Directorate

## Region 9 – Russian Arctic

Region 9 of the GTN-G region classification encompasses the archipelagos Novaya Zemlya, Severnaya Zemlya, and Franz Josef Land in the Russian Arctic. The region outline extends from 70° N to 83° N latitude and 35° E to 110° E longitude (Figure 1). The archipelagos that make up the Russian Arctic reside in the Barents and Kara Seas north of the Russian mainland. The Novaya Zemlya archipelago, to the northwest of Russia, is the largest of the Russian Arctic archipelagoes; and glaciers cover approximately 30% of its area (Kotlyakov, 2010). The Severnaya Zemlya archipelago, to the northeast of Russia, has approximately 50% of its area covered by glaciers. The Franz Josef Land archipelago, the northernmost of the Russian Arctic archipelagoes in the Arctic Ocean, is covered by nearly 85% glaciers (Kotlyakov, 2010).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Moshnyj Glacier located on the Northern Ice Cap on Severny Island, and Academy of Sciences Ice Cap Basin North Glacier and Academy of Sciences Ice Cap Basin West Glacier located on the Academy of Sciences Ice Cap on Komsomolets Island. They are all classified as outlet glaciers. Their sizes are listed in Table 21, and their outlines can be seen in Figure 20.

**Table 21. Three largest glaciers in Region 9 – Russian Arctic**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Moshnyj Glacier | 1,256.8** | 2013-08-19 |
| Academy of Sciences Ice Cap Basin North Glacier | 1,243.5** | 2006-07-13 |
| Academy of Sciences Ice Cap Basin West Glacier | 1,032.8** | 2006-07-13 |

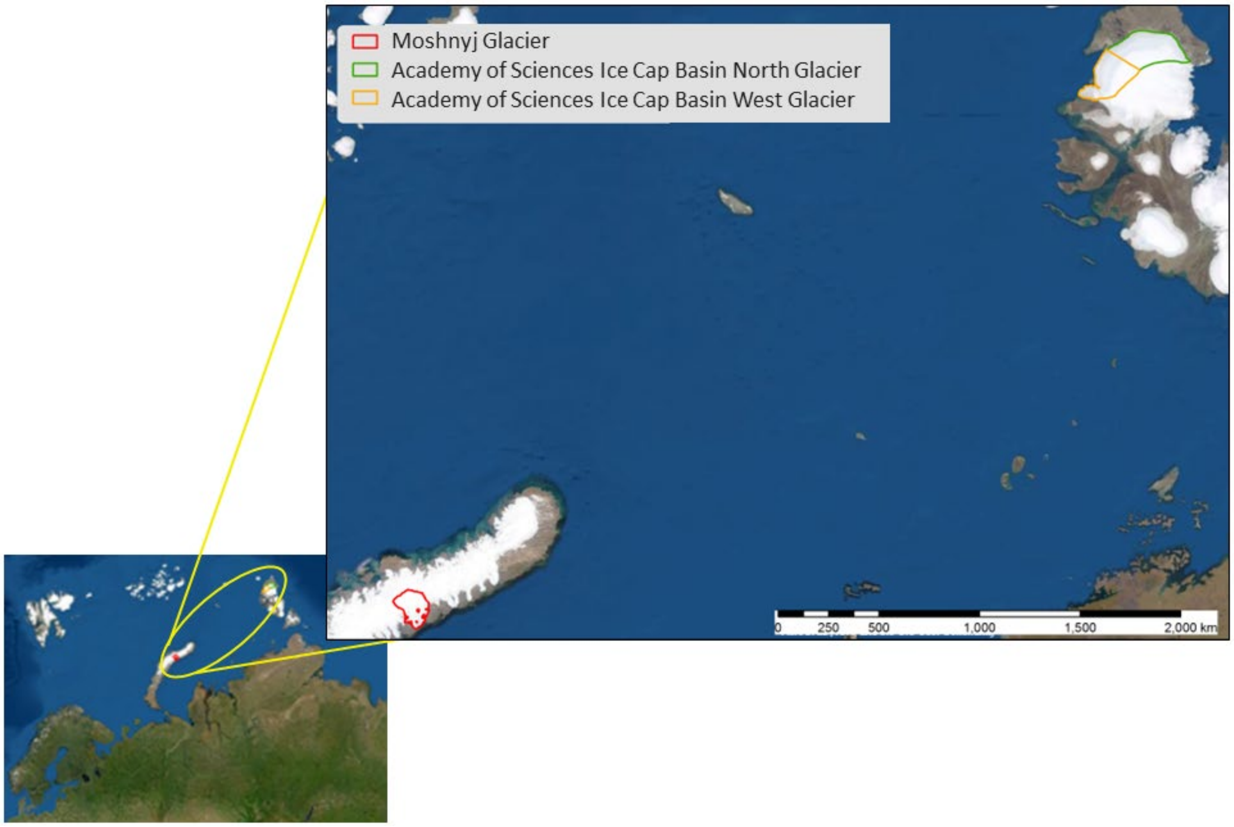


**Figure 20. Three largest glaciers in Region 9 – Russian Arctic**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 9, the following literature was consulted: Carr (2014), Sánchez-Gámez (2019), Sharov (2009), and Kotlyakov (2010). The three largest glacier complexes in this region, from largest to smallest, are Northern Ice Cap on Severny Island, Academy of Sciences Ice Cap on Komsomolets Island, and Karpinsky Ice Cap on October Revolution Island. Their sizes are listed in Table 22, and their outlines can be seen in Figure 21.

**Table 22. Three largest glacier complexes in Region 9 – Russian Arctic**

| Glacier complex name | Size (km²) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Severny Island Northern Ice Cap | 20,666.8 ** | 2002-02-08 to 2015-08-05 |
| Academy of Sciences Ice Cap | 5,573.5 ** | 2006-07-13 |
| Karpinsky-University Glacier Complex | 4,033.2 ** | 2001-06-21 |

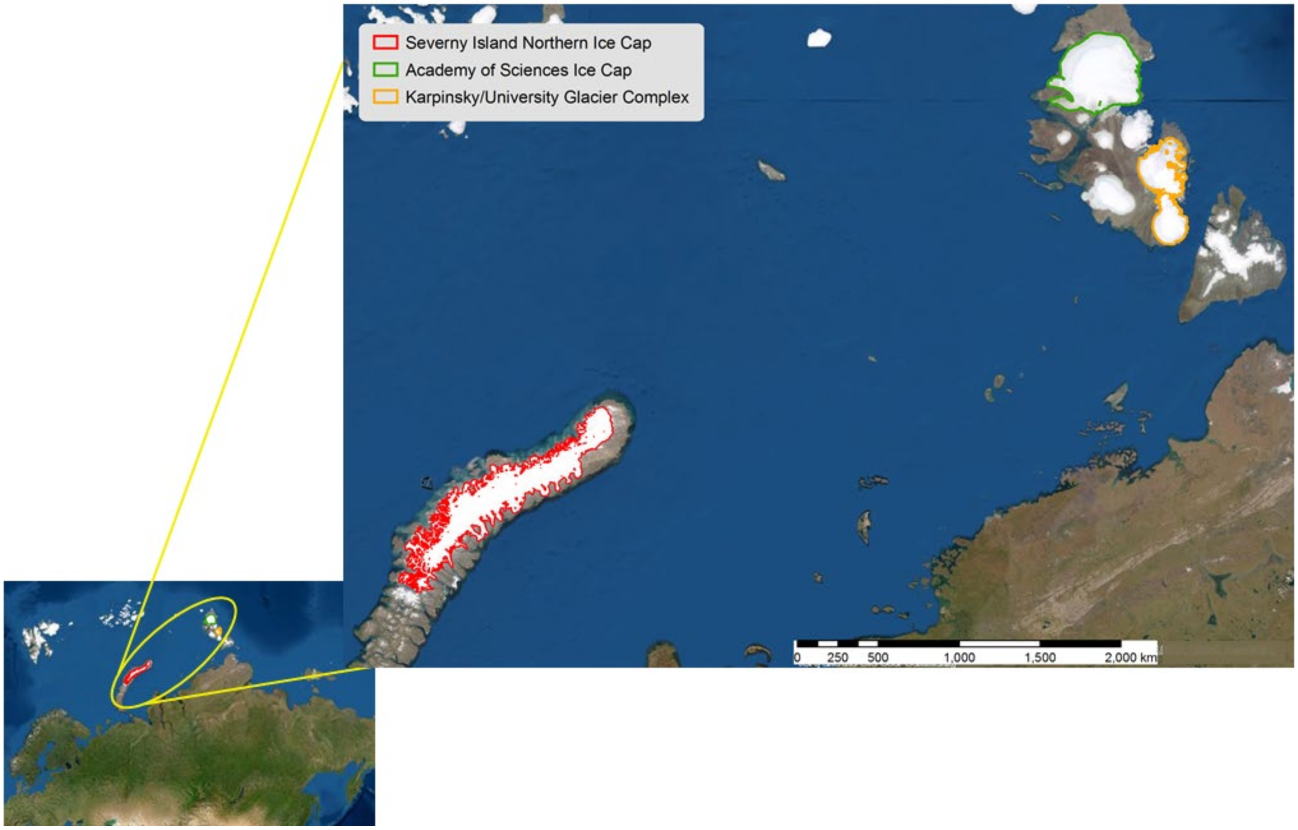


**Figure 21. Three largest glacier complexes in Region 9 – Russian Arctic**

### Separated Glacier Complexes

If a second manual clipping step is used to separate the ice caps into their more commonly known ice formations as described in the literature (e.g. Carr, 2014; Sánchez-Gámez, 2019; Sharov, 2009; Kotlyakov, 2010), rankings change slightly. The three largest glacier complexes in this region, from largest to smallest, are Northern Ice Cap on Severny Island, Academy of Sciences Ice Cap on Komsomolets Island, and Karpinsky Ice Cap on October Revolution Island. Their sizes are listed in Table 23, and their outlines can be seen in Figure 22.

**Table 23. Three largest clipped glacier complexes in Region 9 – Russian Arctic**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Severny Island Northern Ice Cap | 20,666.8** | 2002-02-08 to 2015-08-05 |
| Academy of Sciences Ice Cap | 5,573.5** | 2006-07-13 |
| Karpinsky Ice Cap | 2,378.1** | 2001-06-21 |

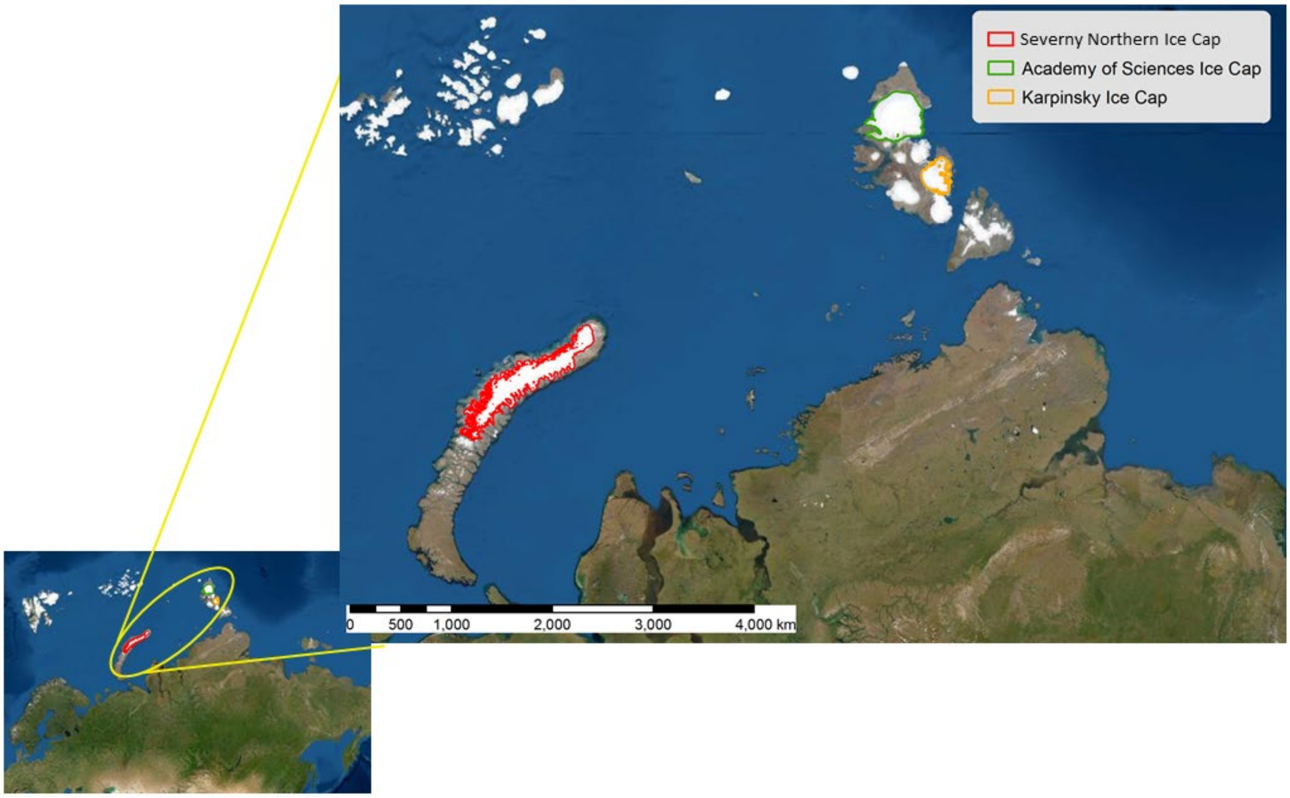


**Figure 22. Three largest clipped glacier complexes in Region 9 – Russian Arctic**

### Notes on Region 9 Results

The names of the glaciers in GLIMS and RGI were not exact, so names were taken from Carr (2014) for the largest glacier and Sánchez-Gámez (2019) for the second and third largest. The names for the ice caps came from Carr (2014) for the largest and Sharov (2009) for the second and third largest.

As noted in Methods section, during the merging operation for the glacier complex analysis, Karpinsky Ice Cap and another smaller ice cap next to it, University Ice Cap, became merged together. For the final published dataset, I chose to keep them merged. However, for completeness, I did separate the two to get a size estimate. I created a polygon around Karpinsky to clip it away from University Ice Cap to arrive at the final Karpinsky outline.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: F. Paul, University of Zurich-Irchel; M. Koenig, Norwegian Polar Institute

## Region 10 – Asia, North

Region 10 of the GTN-G region classification covers most of mainland Russia plus the northern half of Kazakhstan and Mongolia, small portions of northern China, and all of Japan, as well as several small sets of islands north of the Russian mainland in the Laptev and East Siberian Seas (Lyakhovsky Islands, Anzhu Islands, and De Long Islands). The region outline extends from 31° N to 78° N latitude and 57° E to 180° E longitude (Figure 1). This vast region contains approximately 22,000 km$^2$ of glaciated land. These are mostly mountain glaciers that reside in the numerous mountain ranges of Russia such as the Caucasus, Pamirs, Alai Range, Tien Shan, Altay, Ural Mountains, and those of Northeastern Siberia as well as in the Republics of Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, and Mongolia (Kotlyakov et al., 2010).

### Largest Individual Glaciers

The three largest glaciers in Region 10, from largest to smallest, are Potanin Glacier located in Mongolia at the corner where Mongolia meets China, Russia, and Kazakhstan in the Tavan Bogd Massif in the Mongol-Altai Mountains; Slunina Glacier located on the Kamchatka Peninsula in far northwest Russia in the Sredinny Range; and Erman Glacier on the Kamchatka Peninsula in far northwest Russia on the Ushkovsky Volcano. Potanin Glacier is classified as a valley glacier. Slunina Glacier is classified as a mountain glacier, and Erman Glacier is classified as an outlet glacier. Their sizes are listed in Table 24, and their outlines can be seen in Figure 23.

**Table 24. Three largest glaciers in Region 10 – Asia, North**

| Glacier name | Size (km$^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Potanin Glacier | 37.4* | 2011-08-23 |
| Slunina Glacier | 33.7* | 2011-08-03 |
| Erman Glacier | 33.5* | 2011-08-03 |

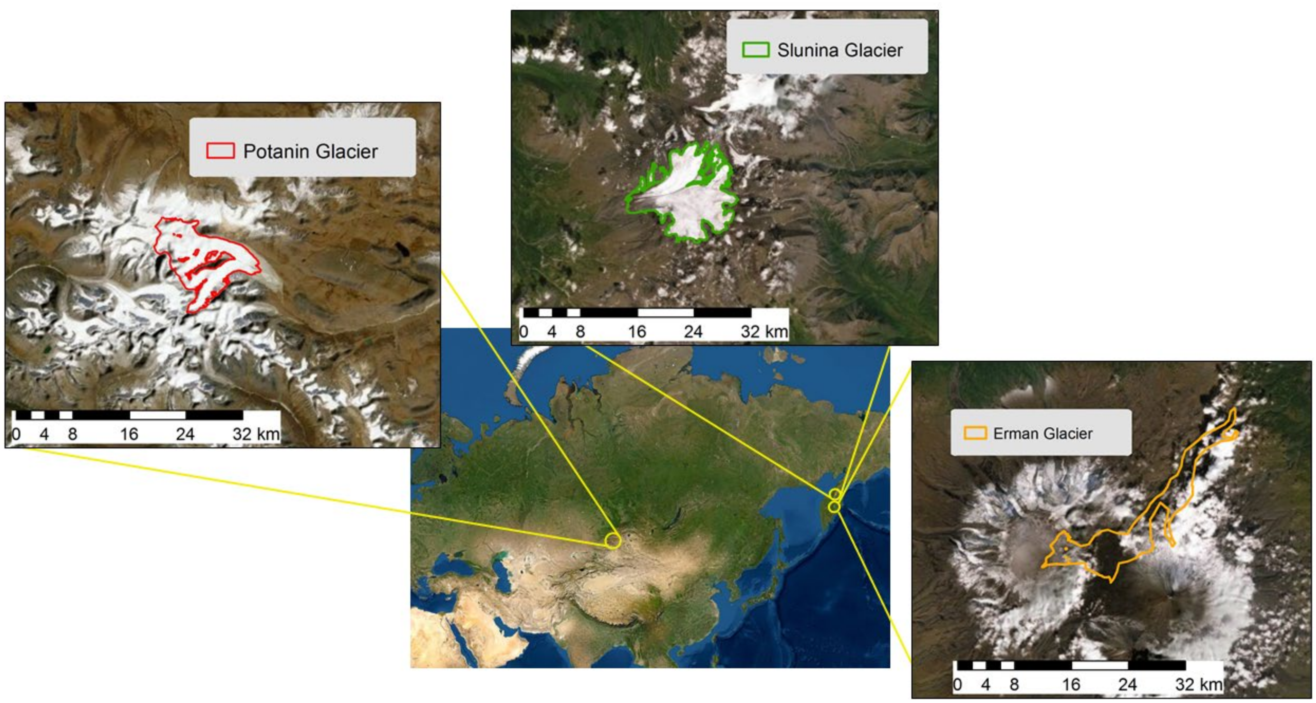


**Figure 23. Three largest glaciers in Region 10 – Asia, North**

### Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 10, the following literature was consulted: Khromova et al. (2014), Muraviev and Muraviev (2016), Kamp et al. (2013), and Kotlyakov et al. (2010). The three largest glacier complexes in this region, from largest to smallest, are the Tavan Bogd Icefield located in Mongolia at the corner where Mongolia meets

China, Russia, and Kazakhstan in the Tavan Bogd Massif in the Mongol-Altai Mountains; and Ushkovsky Volcano Icefield and Snegovoy-Ostry Icefield both on Kamchatka Peninsula in the Sredinny Range. Their sizes are listed in Table 25, and their outlines can be seen in Figure 24.

**Table 25. Three largest glacier complexes in Region 10 – Asia, North**

| Glacier complex name | Size (km²) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Tavan Bogd Icefield | 137.0** | 1989-09-03 to 2011-08-23 |
| Ushkovsky Volcano Icefield | 123.0** | 2011-08-03 |
| Snegovoy-Ostry Icefield | 114.4** | 2000-07-18 |

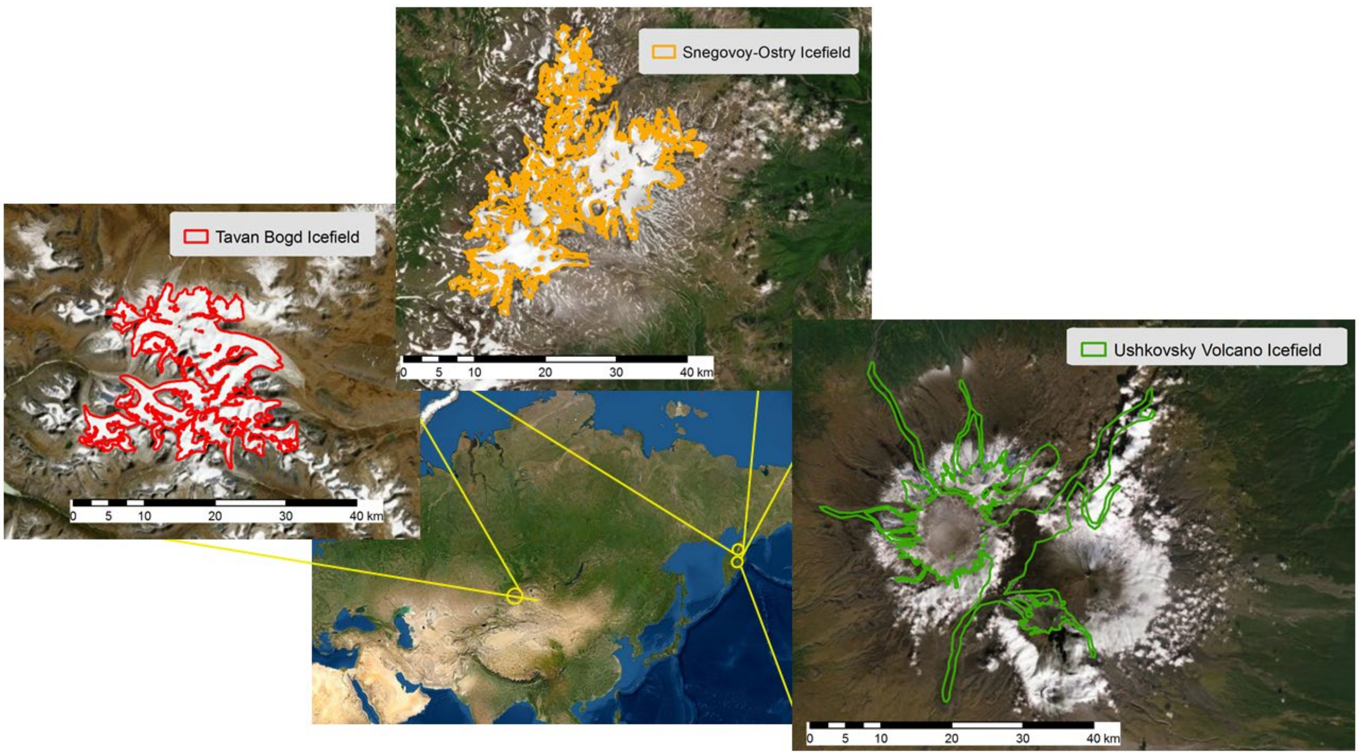


**Figure 24. Three largest glacier complexes in Region 10 – Asia, North**

## Note on Region 10 Results

Neither GLIMS nor RGI had names for the glaciers. The name for the largest came from Kamp et al. (2013), the name for the second largest came from Khromova et al. (2014), and the name for the third largest came from Barr et al. (2018). I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the area or geographical features where the icefields are located. Note that Ushkovsky Volcano Icefield is heavily debris covered, thus its outline extends into areas that do not appear to be ice but that in fact are.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: G. Cogley, University of Colorado

## Region 11 – Central Europe

Region 11 of the GTN-G region classification encompasses the countries of central Europe from Spain and France in the west, Germany and the Czech Republic to the north, Switzerland and Austria in the center, Italy to the South, and parts of Romania and Bulgaria to the east. The region outline extends from 40° N to 50° N latitude and 6° W to 26° E longitude (Figure 1). Most of the glaciers in this region are found in the Alps; a mountain range that extends across central Europe for approximately 1,000 km from east to west. The main glacierized areas lie along the top of the mountain range with the largest of these glaciers typically being found at the highest elevations (Williams and Ferrigno, 1993).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Grosser Aletsch Glacier, Gorner Glacier, and Fiescher Glacier. They all reside in the Swiss Alps and are classified as valley glaciers. Their sizes are listed in Table 26, and their outlines can be seen in Figure 25.

**Table 26. Three largest glaciers in Region 11 – Central Europe**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Grosser Aletsch Glacier | 78.4** | 2009-09-15 |
| Gorner Glacier | 40.2** | 2009-09-15 |
| Fiescher Glacier | 29.5** | 2009-09-15 |

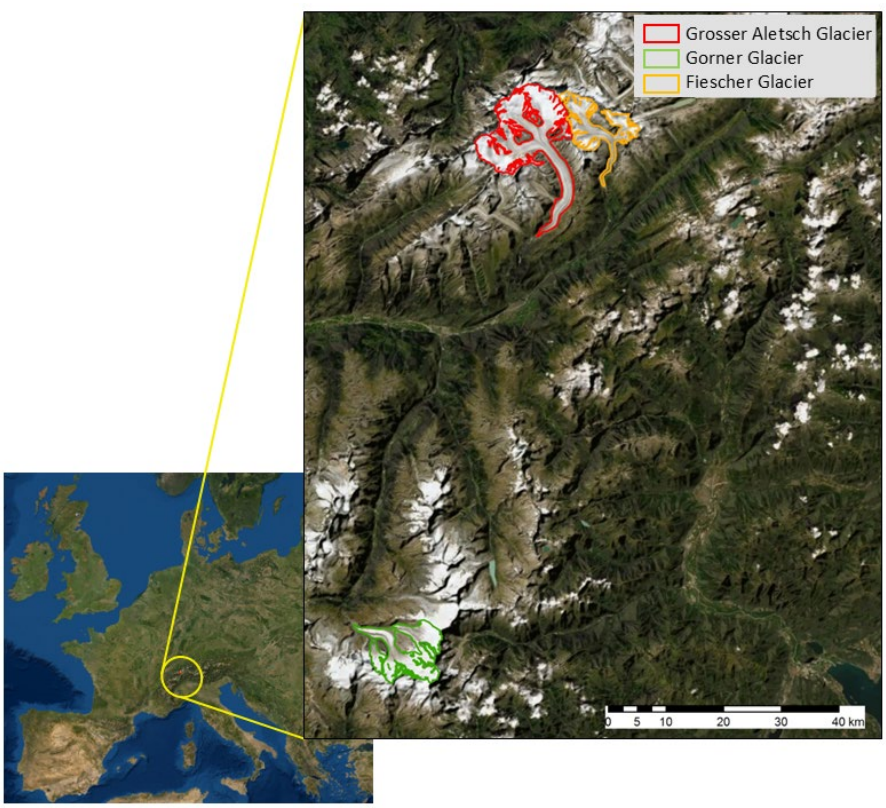


**Figure 25. Three largest glaciers in Region 11 – Central Europe**

## Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Grosser Aletsch Glacier Complex, Gorner Glacier Complex, and Gepatsch-Hintereis Glacier Complex. Their sizes are listed in Table 27, and their outlines can be seen in Figure 26.

**Table 27. Three largest glacier complexes in Region 11 – Central Europe**

| Glacier complex name | Size ($km^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Grosser Aletsch Glacier Complex | 213.9** | 1973-09-01 to 2009-09-15 |
| Gorner Glacier Complex | 112.9** | 1998-08-31 to 2011-09-30 |
| Gepatsch-Hintereis Glacier Complex | 46.7** | 1969-06-30 to 2015-08-26 |

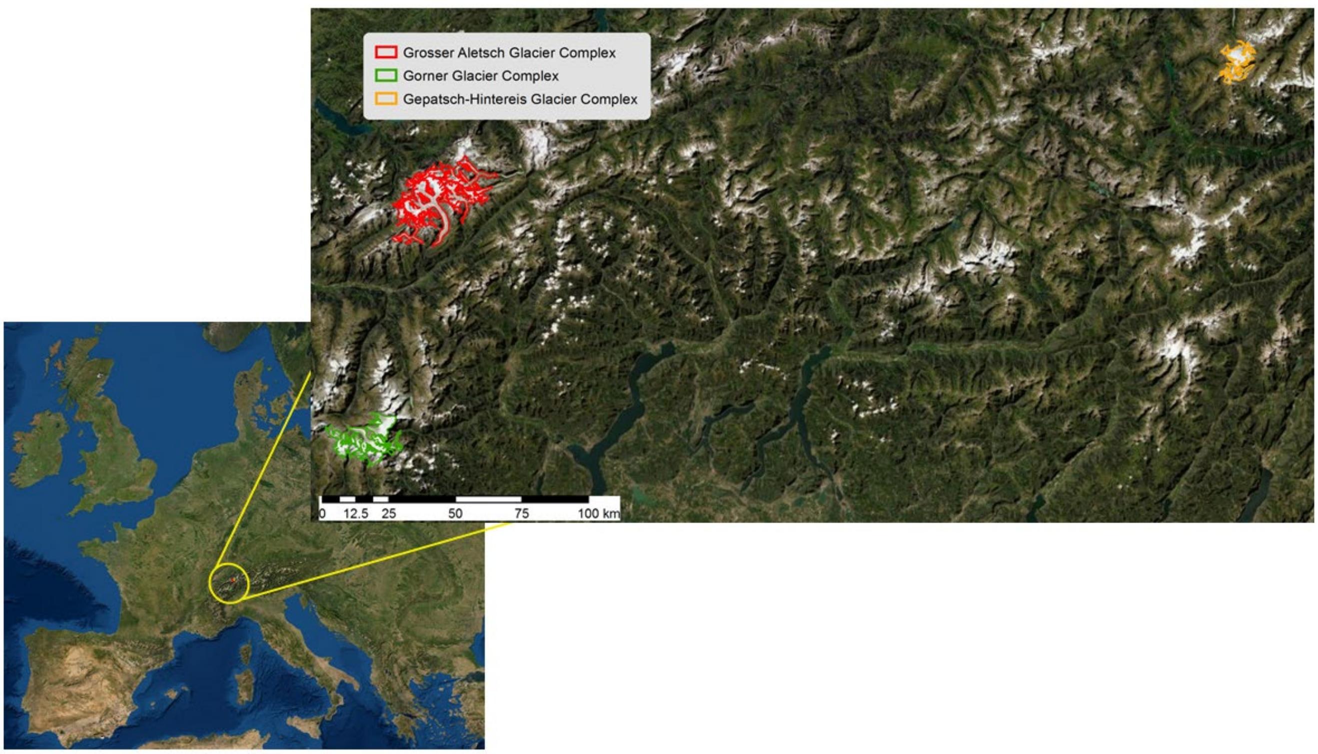


**Figure 26. Three largest glacier complexes in Region 11 – Central Europe**

## Notes on Region 11 Results

From communication with the regional correspondent, more recent outlines are forthcoming. Once these new outlines are submitted to GLIMS, a reanalysis of this section will be conducted, and an updated version of this data set will be created.

I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the largest glaciers that reside in these complexes.

### Glacier Outline Literature Citation and GLIMS Submission Information

Fischer, M., Huss, M., Barboux, C. and Hoelzle, M. (2014). The new Swiss Glacier Inventory SGI2010: Relevance of using high ‐ resolution source data in areas dominated by very small glaciers Arctic, Antarctic, and Alpine Research 46(4), 933 ‐ 945.

**Submitters**: M. Fischer, University of Fribourg

## Region 12 – Caucasus and Middle East

Region 12 of the GTN-G region classification encompasses the Caucasus and Middle East. It extends from the Caucasus Mountains in the north which includes a small portion of Russia and then extends south to cover much of Georgia, Azerbaijan, Iraq, and Iran. To the west, it extends halfway into Turkey; and to the east, it extends into Iran. The region outline extends from 31° N to 45° N latitude and 32° E to 54° E longitude (Figure 1).

The glaciers in Region 12 reside in the higher elevation mountains such as those of the Elburz Mountains in Iran, the Taurus Mountains in Turkey, and the Greater Caucasus Mountains along the border of Russia and Georgia/Azerbaijan. Only a small portion of this region is covered in glaciers. For example, the total area of glaciers in Iran is approximately 20 $km^2$ (Ferrigno, 1991); in Turkey, it is around 23 $km^2$ (Kurter, 1991); and in the Caucasus Mountains, which has the largest accumulation of glaciers for this region, it is estimated to be about 1,200 $km^2$ (Tielidze and Wheate, 2018).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Bezengi Glacier, Dikh-Kotiu-Bugoisy Glacier, and Karaugom Glacier. They all reside in Russia in the Greater Caucasus Mountains and are classified as valley glaciers. Their sizes are listed in Table 28, and their outlines can be seen in Figure 27.

**Table 28. Three largest glaciers in Region 12 - Caucasus and Middle East**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Bezengi Glacier | 37.5** | 2014-08-03 |
| Dikh-Kotiu-Bugoisy Glacier (aka Dych-sy-Ailama Glacier) | 27.5** | 2014-08-03 |
| Karaugom Glacier | 24.0** | 2014-08-03 |

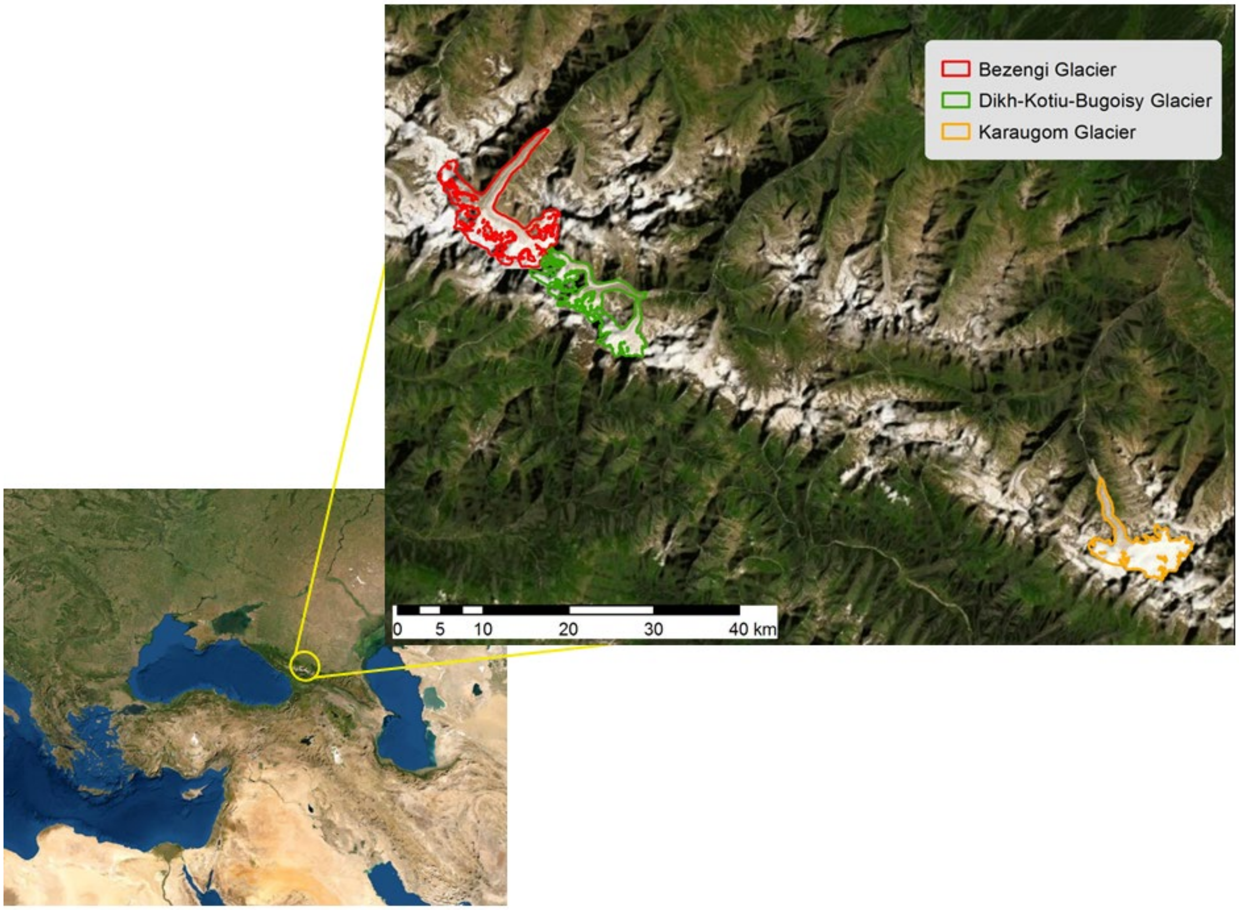


**Figure 27. Three largest glaciers in Region 12 - Caucasus and Middle East**

## Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Bezengi Glacier Complex, Elbrus Glacier Complex, and Karaugom Glacier Complex. Their sizes are listed in Table 29, and their outlines can be seen in Figure 28.

**Table 29. Three largest glacier complexes in Region 12 - Caucasus and Middle East**

| Glacier complex name | Size ($km^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Bezengi Glacier Complex | 153.4** | 1960-01-01 to 2014-08-03 |
| Elbrus Glacier Complex | 116.4** | 1960-01-01 to 2014-08-03 |
| Karaugom Glacier Complex | 59.1** | 1999-08-18 to 2014-08-28 |

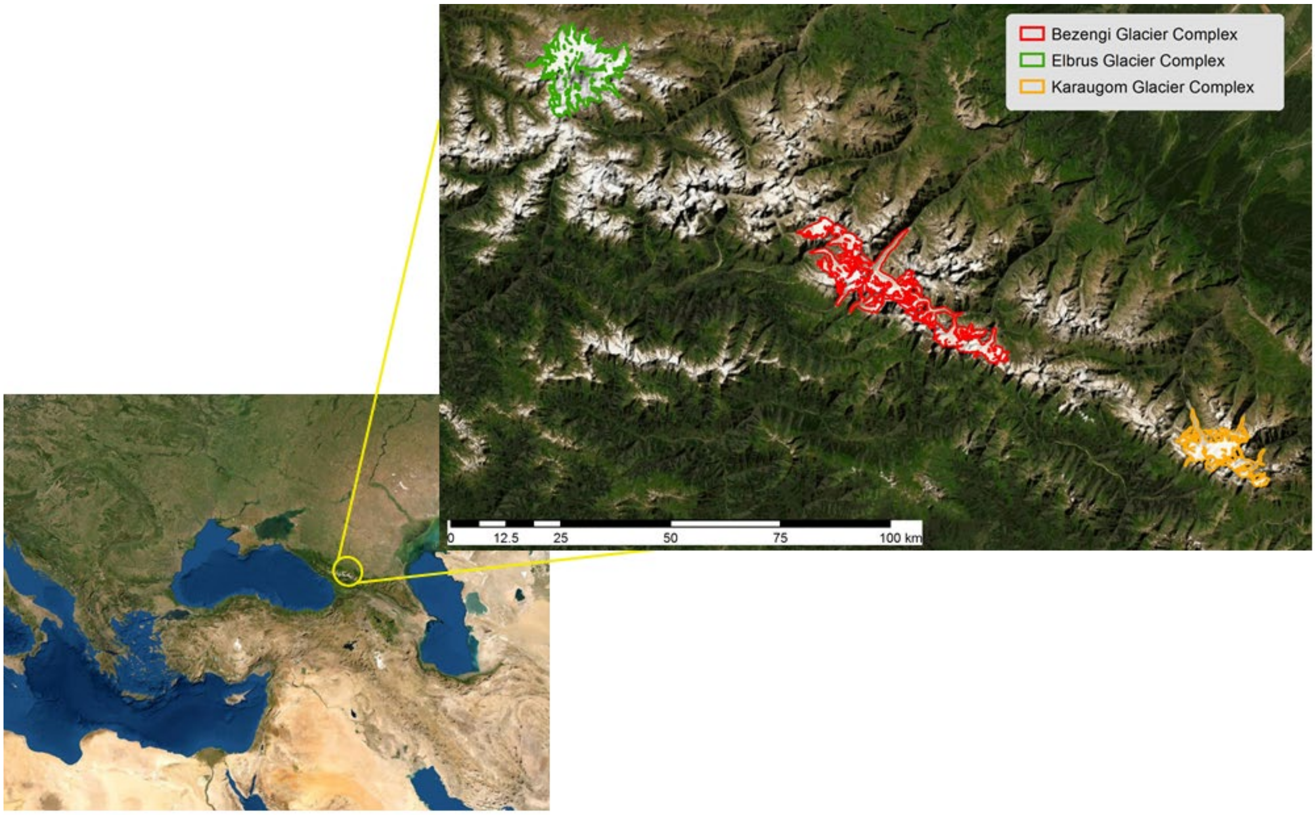


**Figure 28. Three largest glacier complexes in Region 12 - Caucasus and Middle East**

### Notes on Region 12 Results

GLIMS and RGI differ on the name given for the largest glacier. GLIMS shows it as Ulluchirak Glacier and RGI shows it as Bezengi Glacier. From a literature search, the name appears to be correct in RGI (Heid and Kaab, 2012). The second largest glacier in GLIMS is broken up into more than one glacier in RGI. From email communication with the regional correspondent and Tielidze et al. (2017), the GLIMS outline is correct and is the official second largest glacier.

I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the largest glaciers that reside in these complexes.

### Glacier Outline Literature Citation and GLIMS Submission Information

Tielidze, Levan G., Roger D. Wheate (2018). The Greater Caucasus Glacier Inventory (Russia, Georgia, and Azerbaijan). The Cryosphere 12 (1):81--94. DOI: 10.5194/tc-12-81-2018.

**Submitters**: L. Tielidze, Ivane Javakhishvili Tbilisi State University

## Region 13 – Asia, Central

Region 13 of the GTN-G region classification encompasses Central Asia. This includes southwest China along with the Tibetan Plateau. The region extends as far west to include portions of Uzbekistan and encompasses Tajikistan and Kyrgyzstan. The region outline extends from 28° N to 46° N latitude and 65° E to 105° E longitude (Figure 1).

Region 13 is widely scattered with numerous major mountain-glacier systems that cover an estimated 60,000 km$^2$ and includes a series of significant mountain ranges and plateaus such as the Karakorum, the Tian Shan, and the Tibetan Plateau (Yafeng et al., 2010).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Fedchenko Glacier in the Pamir Mountain Range in Tajikistan, South Inylchek Glacier in the Tian Shan Mountains in Kyrgyzstan, and Tuomuer Glacier in the Tian Shan Mountains in China. The primary classification of Fedchenko is mountain glacier and the other two are classified as valley glaciers. Their sizes are listed in Table 30, and their outlines can be seen in Figure 29.

**Table 30. Three largest glaciers in Region 13 – Central Asia**

| Glacier name | Size (km$^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Fedchenko Glacier | 700.5* | 2000-09-16 |
| South Inylchek Glacier | 368.0* | 2002-10-05 |
| Tuomuer Glacier | 358.2* | 2007-08-24 |

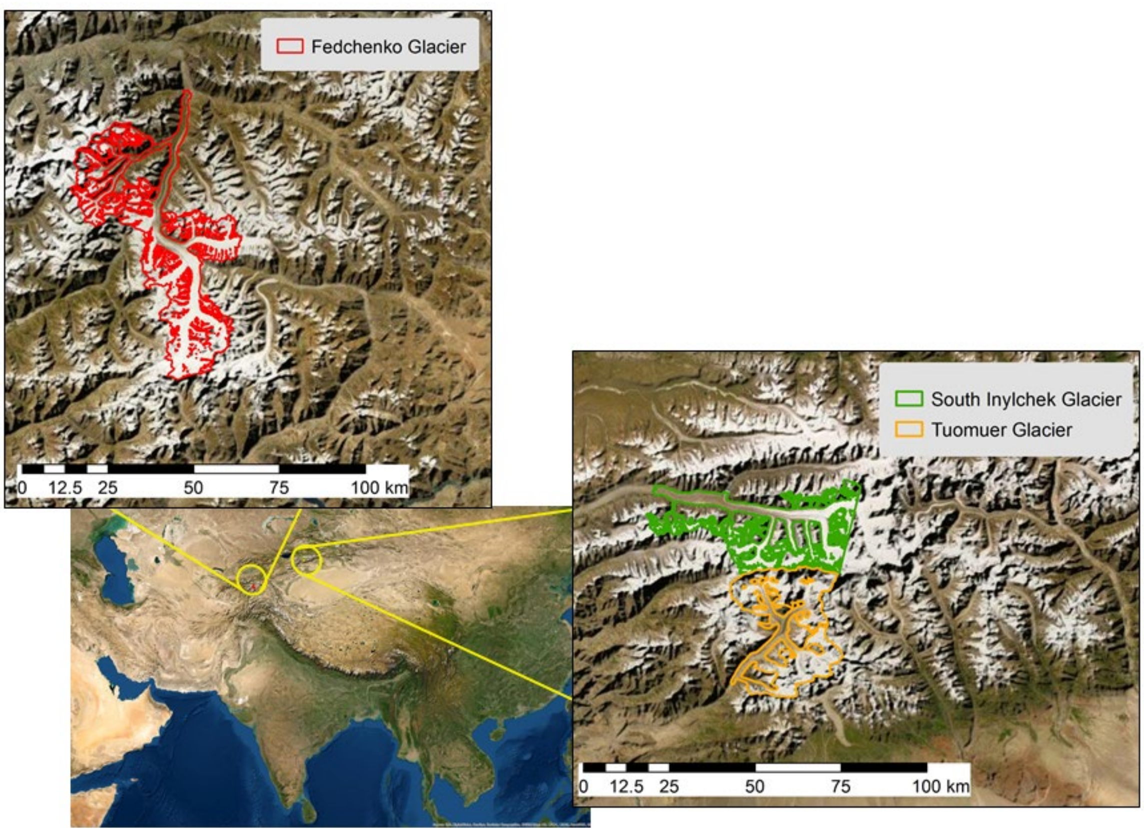


**Figure 29. Three largest glaciers in Region 13 – Central Asia**

### Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Western Kunlun Icefield, South Inylchek Glacier Complex, and Fedchenko Glacier Complex. Their sizes are listed in Table 31, and their outlines can be seen in Figure 30.

**Table 31. Three largest glacier complexes in Region 13 – Central Asia**

| Glacier complex name | Size ($km^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Western Kunlun Icefield | 2,786.4** | 2010-12-08 to 2011-08-05 |
| South Inylchek Glacier Complex | 2,743.6** | 2002-08-18 to 2007-08-24 |
| Fedchenko Glacier Complex | 1,742.6** | 2000-09-16 to 2004-09-11 |

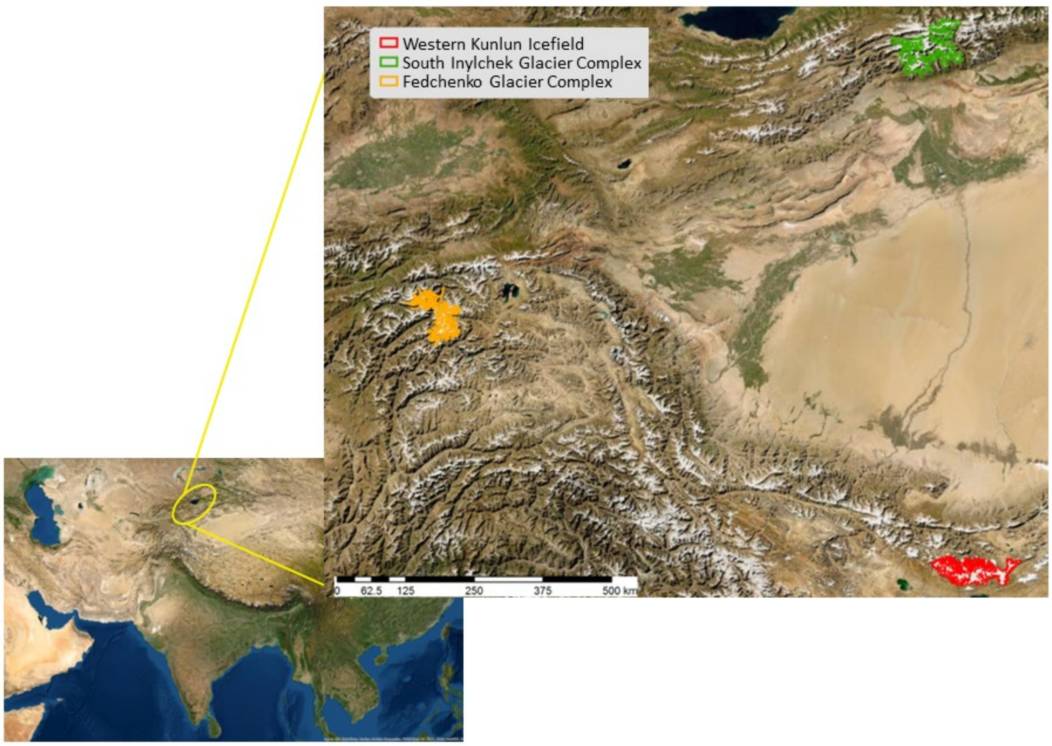


**Figure 30. Three largest glacier complexes in Region 13 – Central Asia**

### Notes on Region 13 Results

Neither GLIMS nor RGI had a name for the second largest glacier; but according to email communication with the Region 13 correspondent and Shangguan et al. (2015), this is South Inylchek Glacier.

I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the area or geographical features where the complexes are located or from the largest glaciers that reside in these complexes.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: G. Cogley, University of Colorado

## Region 14 – Southwest Asia

Region 14 of the GTN-G region classification encompasses Southwest Asia. This region includes Pakistan along with the eastern half of Afghanistan and a small portion of the northwest corner of India and the southeast part of China. It contains the Karakorum, Hindu Kush, and Sulaiman Mountain Ranges. The region outline extends from 26° N to 37.5° N latitude and 65° E to 82.5° E longitude (Figure 1). Glaciers that reside in this region are some of the largest and longest that reside in the mid-latitudes, with an approximate area of 15,000 km$^2$ (Shroder and Bishop, 2010). The total area of glaciers in this region is greater than the total area of glaciers in the European Alps (Hewitt, 2014).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Siachen Glacier, Baltoro Glacier, and Biafo Glacier. They all reside in the Karakorum Mountain Rang in Pakistan and are all classified as valley glaciers. Their sizes are listed in Table 32, and their outlines can be seen in Figure 31.

**Table 32. Three largest glaciers in Region 14 – Southwest Asia**

| Glacier name | Size (km$^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Siachen Glacier | 925.9** | 2006-11-09 |
| Baltoro Glacier | 631.7** | 2006-11-09 |
| Biafo Glacier | 482.2** | 2007-09-16 |

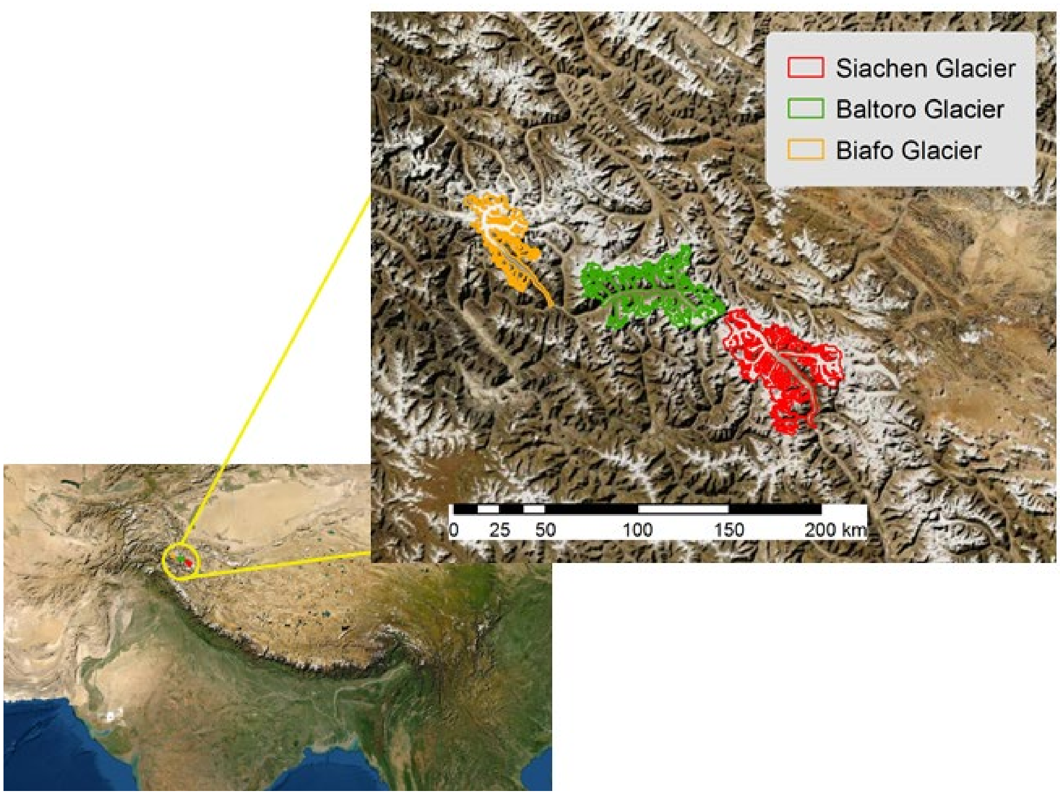


**Figure 31. Three largest glaciers in Region 14 – Southwest Asia**

## Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Siachen Glacier Complex, Batura Glacier Complex, and Lunkho e Dosare Glacier Complex. Their sizes are listed in Table 33, and their outlines can be seen in Figure 32.

**Table 33. Three largest glacier complexes in Region 14 – Southwest Asia**

| Glacier complex name | Size (km$^2$) | Range of measurement dates (YYYY-MM-DD) |
|---|---|---|
| Siachen Glacier Complex | 7,401.2** | 1998-08-13 to 2010-08-23 |
| Batura Glacier Complex | 702.7** | 1998-08-20 to 2007-09-16 |
| Lunkho e Dosare Glacier Complex | 407.7** | 2000-09-09 to 2007-08-25 |

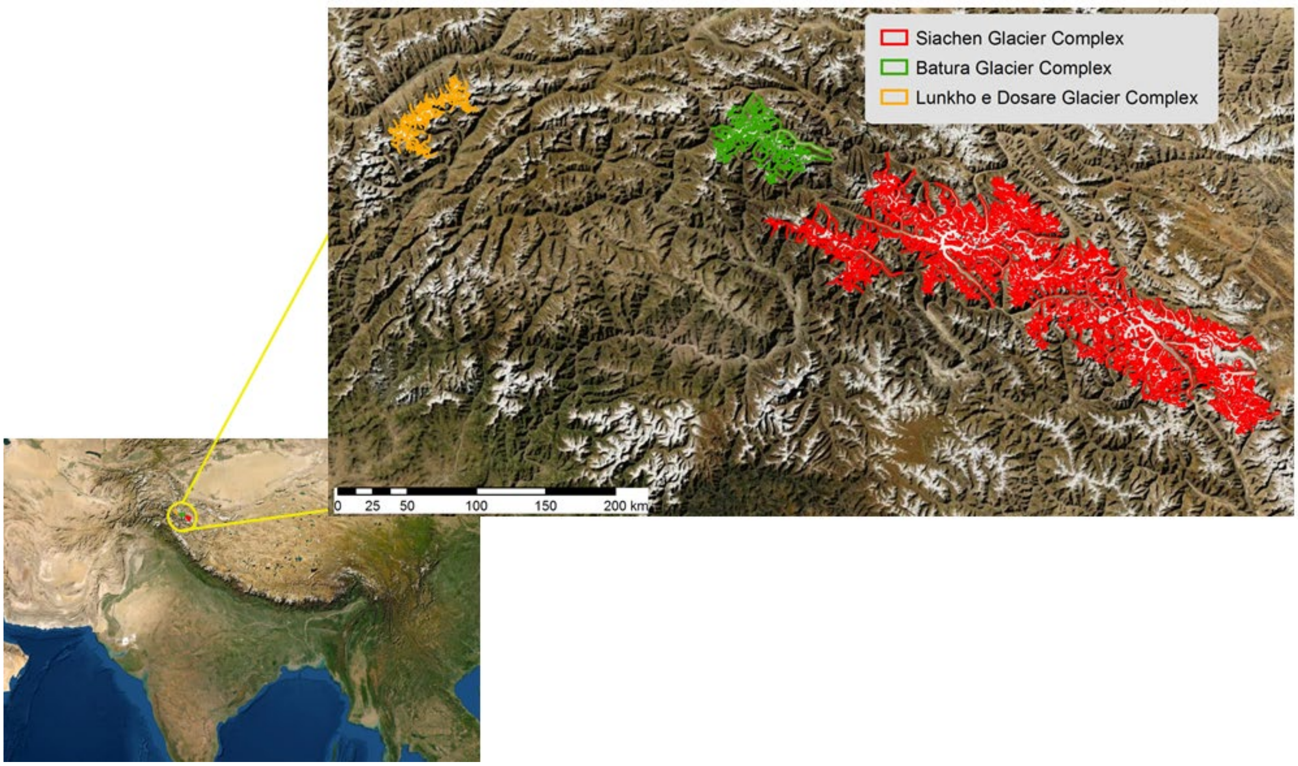


**Figure 32. Three largest glacier complexes in Region 14 – Southwest Asia**

## Notes on Region 14 Results

I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the area or geographical features where the complexes are located or from the largest glaciers that reside in these complexes.

## Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: S. Bajracharya, International Centre for Integrated Mountain Development (ICIMOD)

## Region 15 – Southeast Asia

Region 15 of the GTN-G region classification encompasses Southeast Asia. It covers much of the Himalayan Mountain Range extending from northern India, across Tibet and Bhutan, and into the southwest part of China. The region outline extends from 26° N to 32° N latitude and 75.4° E to 105° E longitude (Figure 1).

The Himalaya are Earth's tallest mountains, with an average height of 6,100 m (20,000 ft) in elevation (Higuchi et al., 2010). The range also holds one of the greatest collections of snow and ice outside the polar regions (Williams and Ferrigno, 2010).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Yanong Glacier, Gangotri Glacier, and Xirinongpu Glacier. Yanong and Xirinongpu reside in the Kangri Karpo Mountains of the Southeast Tibetan Plateau in China, and Gangotri resides in the Garhwal Himalayas in India. They are all classified as valley glaciers. Their sizes are listed in Table 34, and their outlines can be seen in Figure 33.

**Table 34. Three largest glaciers in Region 15 – Southeast Asia**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Yanong Glacier | 179.6* | 2005-09-08 |
| Gangotri Glacier | 176.8** | 2008-11-09 |
| Xirinongpu Glacier | 96.3* | 2005-09-08 |

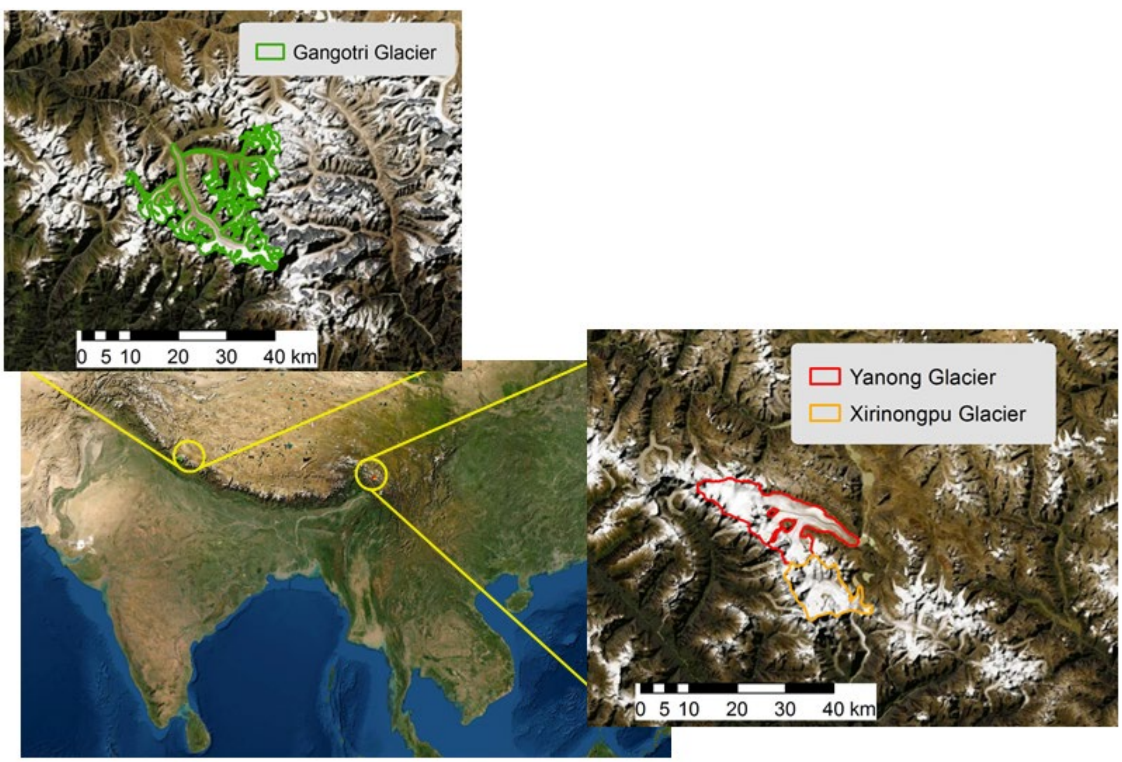


**Figure 33. Three largest glaciers in Region 15 – Southeast Asia**

### Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Yanong Glacier Complex, Rongbuk Glacier Complex, and Zemu Glacier Complex. Their sizes are listed in Table 35, and their outlines can be seen in Figure 34.

**Table 35. Three largest glacier complexes in Region 15 – Southeast Asia**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Yanong Glacier Complex | 955.4** | 1964-01-01 to 2010-04-09 |
| Rongbuk Glacier Complex | 928.3** | 2005-09-08 |
| Zemu Glacier Complex | 720.6** | 1966-01-01 to 2010-04-09 |

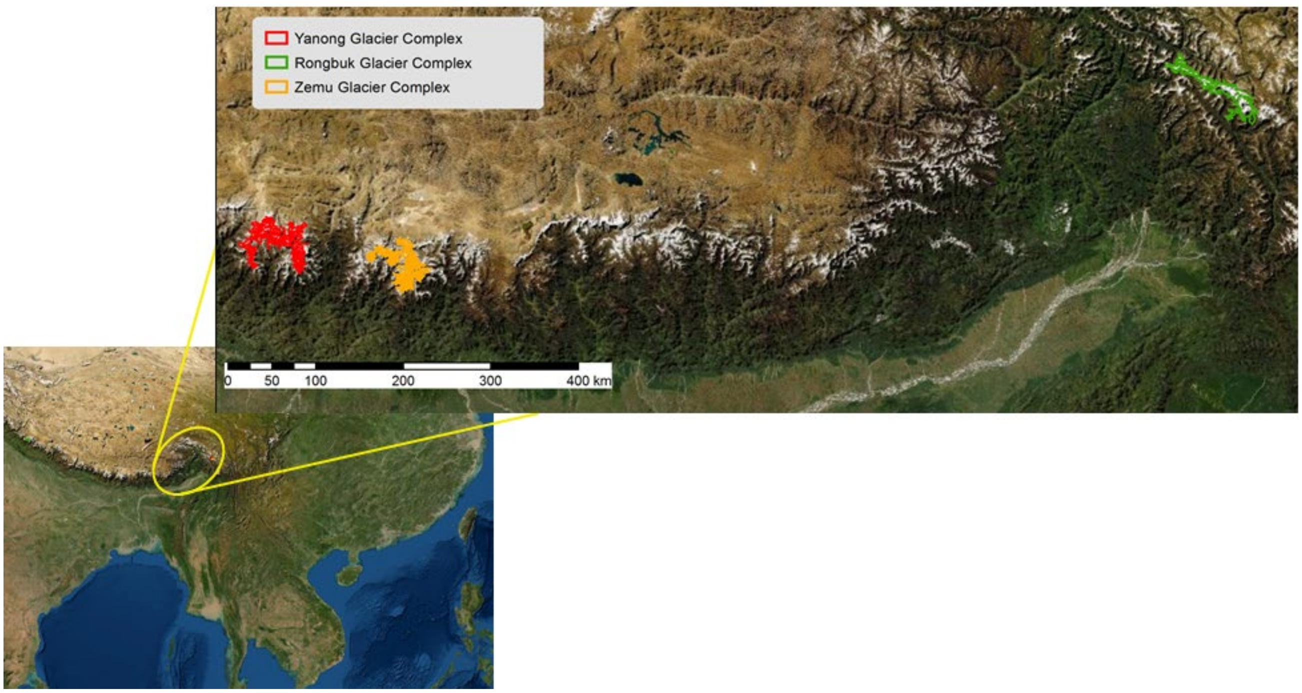

**Figure 34. Three largest glacier complexes in Region 15 – Southeast Asia**

### Notes on Region 15 Results

In the GLIMS database, Yanong and Xirinongpu were both listed three times with the same date but with different areas. It appears that each of these glaciers was submitted by three different institutions that each computed the area differently. I compared the GLIMS values with the data from RGI and chose those that most closely matched RGI.

For Yanong glacier, RGI spells it Yagnung. The most common spelling is Yanong (Zhang, 2019), so I chose that spelling. I could not find names for the glacier complexes; so, for the purposes of this study, I created ones from the largest glaciers that reside in these complexes.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: S. Bajracharya, International Centre for Integrated Mountain Development (ICIMOD); S. Liu, Chinese Academy of Sciences

## Region 16 – Low Latitudes

Region 16 of the GTN-G region classification encompasses a rectangular swath across the lower latitudes of the Earth. The region outline extends from 25° S to 20° N latitude and 100° W to 142° E longitude (Figure 1).

Region 16 is an extremely large region covering the tropical zones of the Earth. In the Western Hemisphere, it encompasses the lower half of Central America in the north and as far south as Paraguay in South America. In the Eastern Hemisphere, it encompasses most of Africa. The region continues across the southern half of India through the islands of southeast Asia and finally ending with the north west portion of Australia. Due to the latitude and warm climate, glaciers in this region occur in high mountain areas only. For this region, all the largest glaciers reside in South America because the glaciers of Africa are very small.

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Jancapampa Glacier, Pucca Orcco Glacier, and Japupunta Glacier. They all reside in Peru with Jancapampa in the Cordillera Blanca region and Pucca Orcco and Japupunta in the Cordillera Vilcanota region. The largest and third largest are classified as mountain glaciers, and the second largest is classified as an outlet glacier. Their sizes are listed in Table 36, and their outlines can be seen in Figure 35.

**Table 36. Three largest glaciers in Region 16 – Low Latitudes**

| Glacier name | Size (km2) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Jancapampa Glacier | 15.8** | 2005-08-28 |
| Pucca Orcco Glacier | 14.5* | 2000-06-15 |
| Japupunta Glacier | 14.3* | 2000-06-15 |

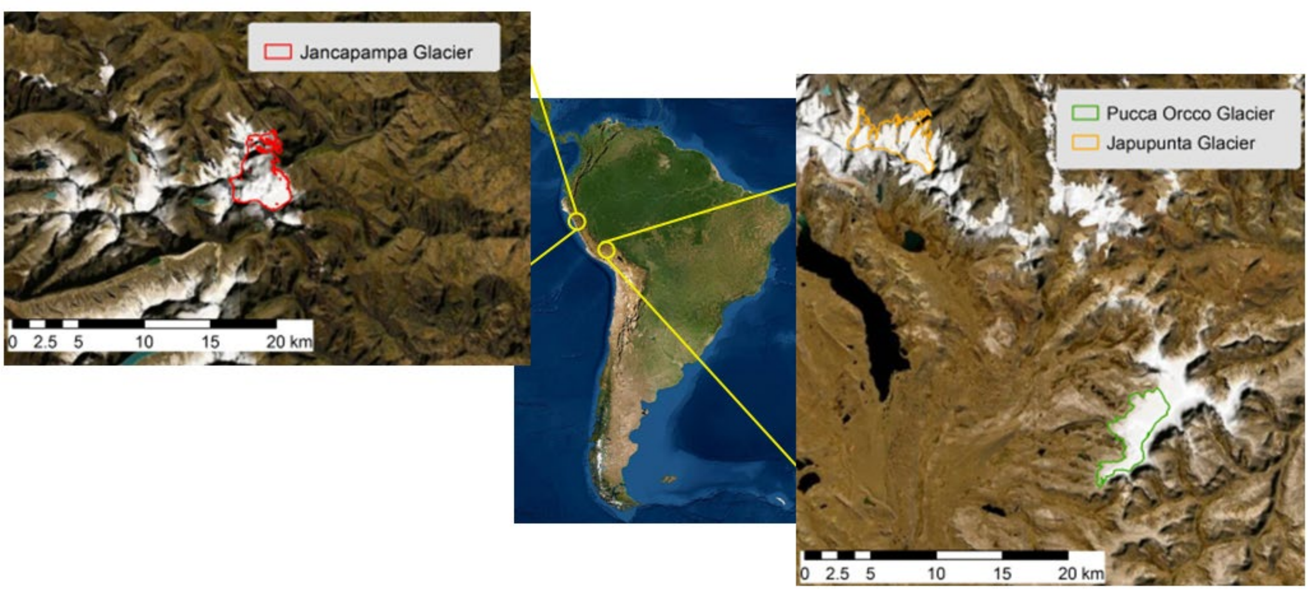


**Figure 35. Three largest glaciers in Region 16 – Low Latitudes**

### Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Vilcanota Glacier Complex, Chaupi Orco-Soral Glacier Complex, and Ancohuma Glacier Complex. Their sizes are listed in Table 37, and their outlines can be seen in Figure 36.

**Table 37. Three largest glacier complexes in Region 16 - Low Latitudes**

| Glacier complex name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Vilcanota Glacier Complex | 121.3** | 2000-06-15 |
| Chaupi Orco-Soral Glacier Complex | 111.2** | 2000-06-15 |
| Ancohuma Glacier Complex | 85.6** | 2000-06-15 |

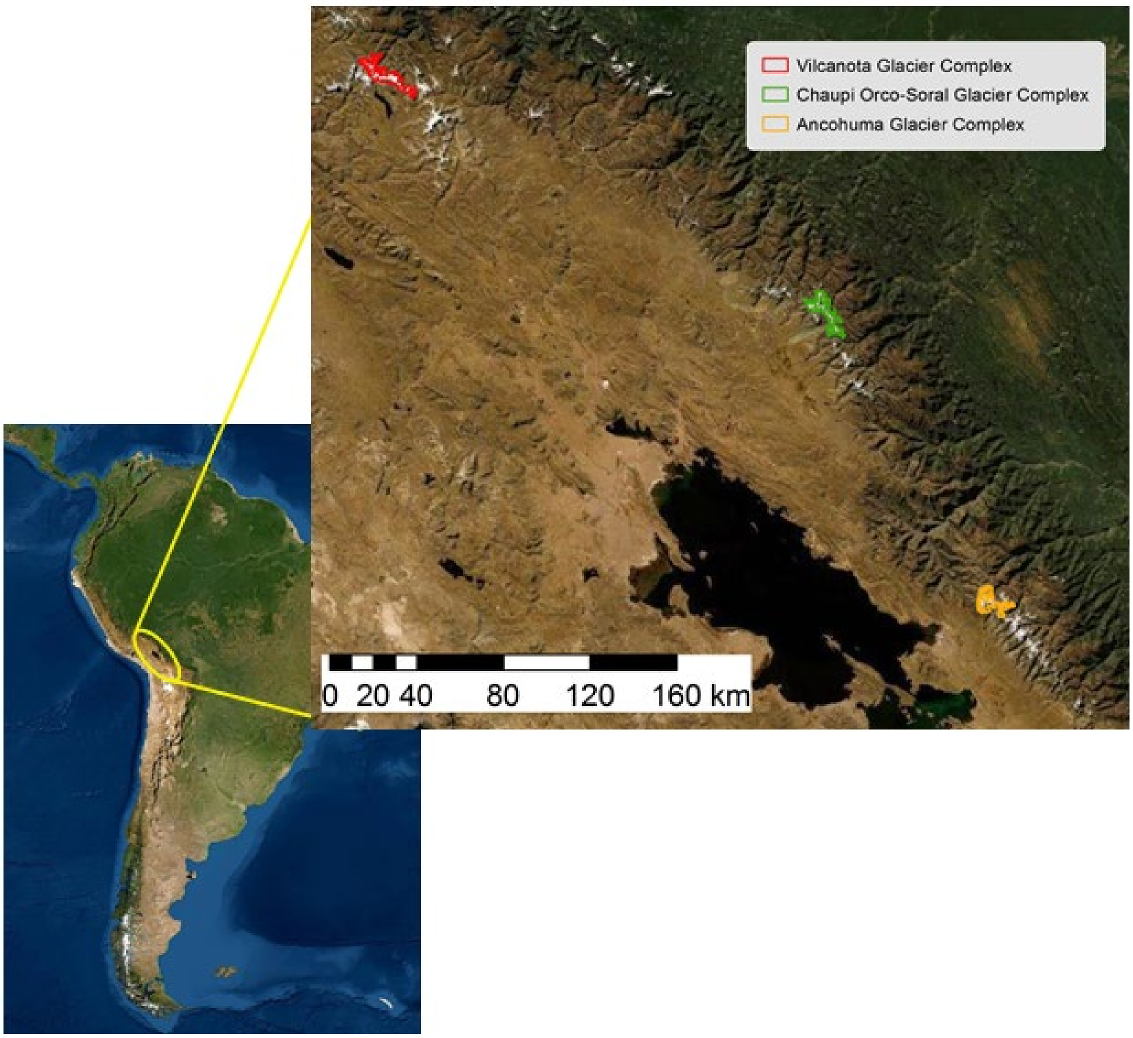


**Figure 36. Three largest glacier complexes in Region 16 - Low Latitudes**

### Notes on Region 16 Results

Neither GLIMS nor RGI had names for these glaciers. From communication with the Region 16 correspondent, it was determined that the glacier outlines are not well defined for this region.

Many of the individual glacier outlines in GLIMS and RGI for Region 16 are merged into larger glacier complexes. The correspondent informed me that they are working on new outlines that will be added in an upcoming version of GLIMS (email correspondence Nov. 2020). Future work would be to use these new outlines once they are submitted to GLIMS and provide an updated version of this data.

To complete this analysis with the current version of GLIMS, I chose the three largest outlines even if they were outlines that encompassed several glaciers. The names I chose for the glaciers with the merged outlines was the largest glacier of the set. Both Pucca Orcco and Japupunta are examples of having merged outlines. Pucca Orcco is made up of Pucca Orcco, Mojorani 1, 2, and 3, and an unnamed glacier. Japupunta is comprised of Apucuchu, Chichicasa 1 and 2, and Japupunta Glacier. I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the area or geographical features where the complexes are located or from the largest glaciers that reside in these complexes.

Note that Region 16 does contain some very small ice caps that are well known. They are listed here for completeness but are not part of the data product because they are smaller than the three largest glacier complexes defined by the merging process. They are Quelccaya Ice Cap (50.5 $km^2$) and Coropuna Ice Cap (47.6 $km^2$) both in Southern Peru.

**Glacier Outline Literature Citation and GLIMS Submission Information**

Ames, A.; G. Munoz; J. Verastegui; M. Zamora; M. Zapata (1989). Glacier Inventory of Peru. Part I. *Hidrandina S.A. Unit of Glaciology and Hydrology, Huaraz, Peru*.

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Silverio, W.; J.M. Jaquet (2005). Glacial Cover Mapping (1987--1996) of the Cordillera Blanca (Peru) Using Satellite Imagery. *Remote Sensing of Environment* 95 (3):342--350.

**Submitters**: A. Racoviteanu, Institute of Research for Development, Marseille, France (UR R032 Great Ice); G. Cogley, University of Colorado

## Region 17 – Southern Andes

Region 17 of the GTN-G region classification encompasses the Southern Andes including Chile and Argentina. The region outline extends from 57° S to 25° S latitude and 82° W to 62° W longitude (Figure 1).

The size, shape, and characteristics of glaciers in the Southern Andes region differ considerably due to the variations in the climate and topography of the Andes Mountains (Lliboutry and Corte, 1998). This area also contains the Southern Patagonia Icefield, which is one of the larger ice masses on the Earth (Warren and Sugden, 1993).

### Largest Individual Glaciers

The three largest glaciers in this region, from largest to smallest, are Pio XI Glacier in Chile, Upsala Glacier in Argentina, and O'Higgins Glacier in Chile. They are all located on the Southern Patagonia Icefield and are classified as outlet glaciers. Their sizes are listed in Table 38, and the glaciers can be seen in Figure 37. There is a fourth glacier, Viedma Glacier, that is very similar in size to Upsala and O'Higgins and is sometimes noted in the literature as being the larger of the three; see the Region 17 Notes section for further information.

**Table 38. Three largest glaciers in Region 17 – Southern Andes**

| Glacier name | Size (km$^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Pio XI Glacier | 1,344.7** | 2007-09-06 |
| Upsala Glacier | 883.4** | 2007-09-06 |
| O'Higgins Glacier | 882.8** | 2007-09-06 |

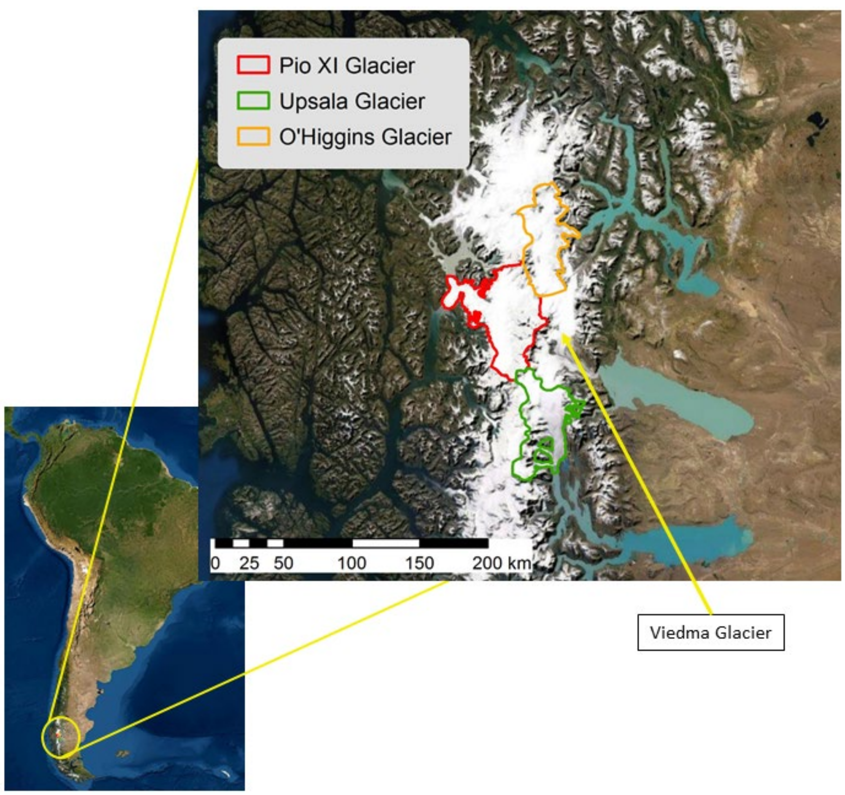


**Figure 37. Three largest glaciers in Region 17 – Southern Andes**

### Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 17, Lliboutry and Corte (1998) was consulted. The three largest glacier complexes in this region, from largest to smallest, are the Southern Patagonia Icefield straddling the border of Chile and Argentina, the Northern Patagonia Icefield in Chile, and the Cordillera Darwin Icefield in Chile. Their sizes are listed in Table 39, and their outlines can be seen in Figure 38.

**Table 39. Three largest glacier complexes in Region 17 – Southern Andes**

| Glacier complex name | Size ($km^2$) | Range of Measurement Dates (YYYY-MM-DD) |
|---|---|---|
| Southern Patagonia Icefield | 13,326.3** | 2000-06-15 to 2007-09-06 |
| Northern Patagonia Icefield | 4,017.7** | 2000-06-15 to 2007-09-06 |
| Cordillera Darwin Icefield | 1,893.6** | 2000-06-15 to 2007-09-06 |

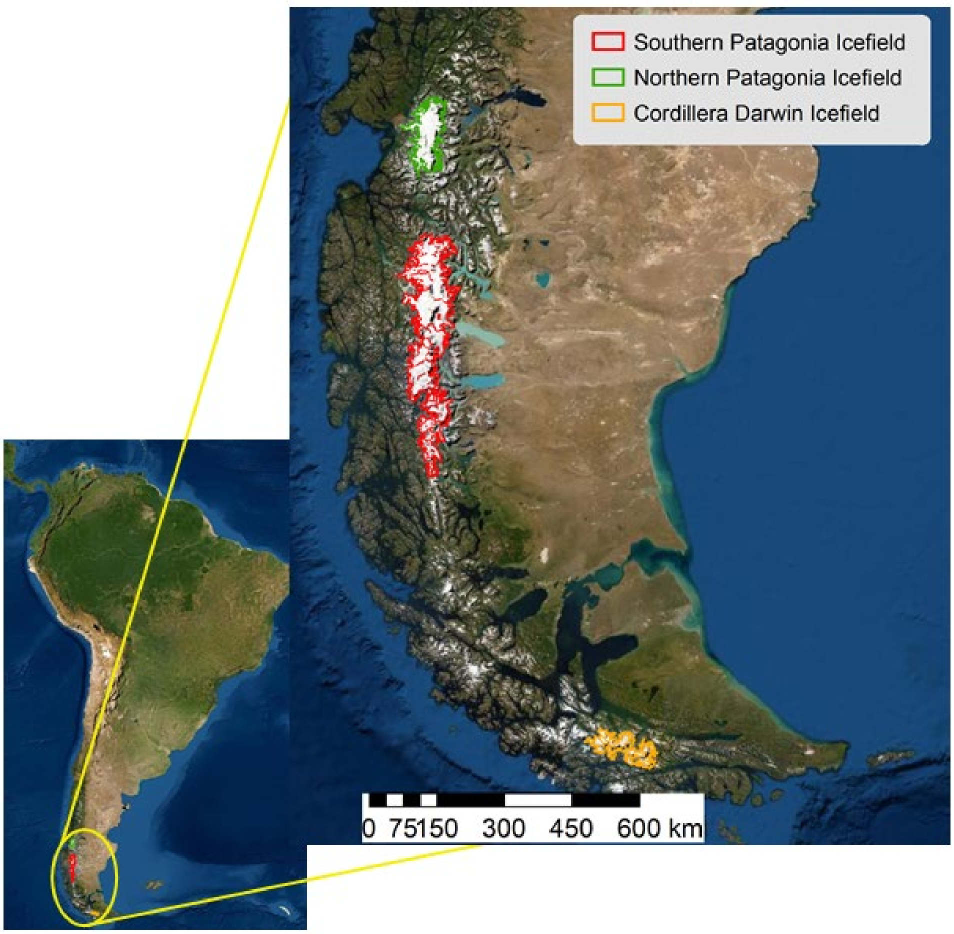


**Figure 38. Three largest glacier complexes in Region 17 – Southern Andes**

### Notes on Region 17 Results

Viedma Glacier is a fourth glacier in this region that is very similar in size to Upsala and O'Higgins. It is mentioned here for completeness since some literature (e.g. Zalazar et al., 2020;

Lliboutry and Corte, 1998), lists it as being over 900 $km^2$, which is slightly larger than Upsala. This would make Viedma the second largest in Region 17. RGI also lists Viedma with a size of 975 $km^2$, but the date of that measurement is older than the date of the GLIMS measurement, so the GLIMS area of 858 $km^2$ was used, making Viedma the fourth largest in this region.

Also, the Region 17 correspondent noted that my numbers might be slightly different depending on the base image used and the interpreted ice divide. Pio XI, Viedma, and Upsala are connected by some of the Southern Patagonian Icefield plateaus (Figure 37), which are quite challenging when looking for the exact position of the ice divide (email correspondence Nov. 2020). Because of this, Viedma glacier is mentioned here, but not included in the final data product because GLIMS lists it as fourth and has the more recent measurement date. When glaciers are of a similar size, slight disagreement in sizes may occur due to the difference in the base image used and how the division was interpreted. Thus, disagreements may occur over these similarly sized glaciers in their official ranking.

The Region 17 correspondent also notes that there are some newer inventories that are not yet in GLIMS or RGI that may provide clarity on the glacier sizes in Region 17, specifically, Zalazar et al. (2020) and Barcaza et al. (2017). Since these inventories are not currently in GLIMS or RGI, they were not included in this analysis but are mentioned for reference. Future work would be to use these new outlines once they are submitted to GLIMS and provide an updated version of this data.

**Glacier Outline Literature Citation and GLIMS Submission Information**

No literature citation available.

**Submitters**: B. Davies, Royal Holloway University

## Region 18 – New Zealand

Region 18 of GTN-G region classification encompasses New Zealand. The region outline extends from 49° S to 34° S latitude and 164° E to 179° E longitude (Figure 1).

Glaciers in New Zealand occur on both the North and South Islands with the majority of these on the South Island in the Southern Alps. On the South Island, glaciers cover approximately 1,200 $km^2$ or about .8% of the area of the island (Chinn, 1989).

**Largest Individual Glaciers**

The three largest glaciers in this region, from largest to smallest, are Tasman Glacier, Fox Glacier, and Franz Josef Glacier. They all reside in the Southern Alps of New Zealand and are all classified as valley glaciers. Their sizes are listed in Table 40, and their outlines can be seen in Figure 39.

**Table 40. Three largest glaciers in Region 18 – New Zealand**

| **Glacier name** | **Size ($km^2$)** | **Measurement date (YYYY-MM-DD)** |
|---|---|---|
| Tasman Glacier | 87.7** | 2009-02-17 |
| Fox Glacier | 34.3** | 2009-02-17 |
| Franz Josef Glacier | 33.1** | 2009-02-17 |

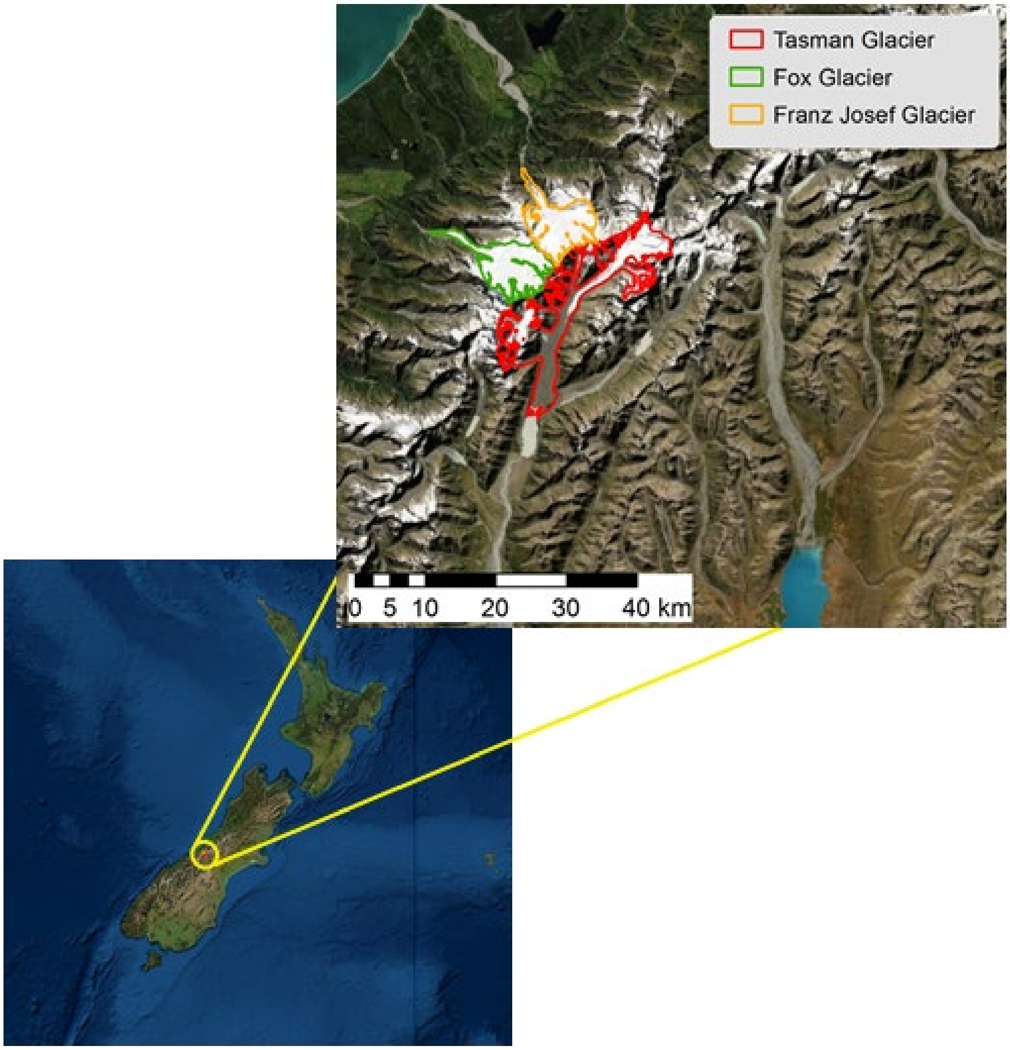

**Figure 39. Three largest glaciers in Region 18 – New Zealand**

## Largest Glacier Complexes

The three largest glacier complexes in this region, from largest to smallest, are the Tasman Glacier Complex, Adams-Lambert Glacier Complex, and Lyell-Ramsay Glacier Complex. Their sizes are listed in Table 41, and their outlines can be seen in Figure 40.

**Table 41. Three largest glacier complexes in Region 18 - New Zealand**

| Glacier complex name | Size ($km^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Tasman Glacier Complex | 248.8** | 1978-01-01 to 2009-02-17 |
| Adams-Lambert Glacier Complex | 43.0** | 1978-01-01 |
| Lyell-Ramsay Glacier Complex | 31.2** | 1978-01-01 |

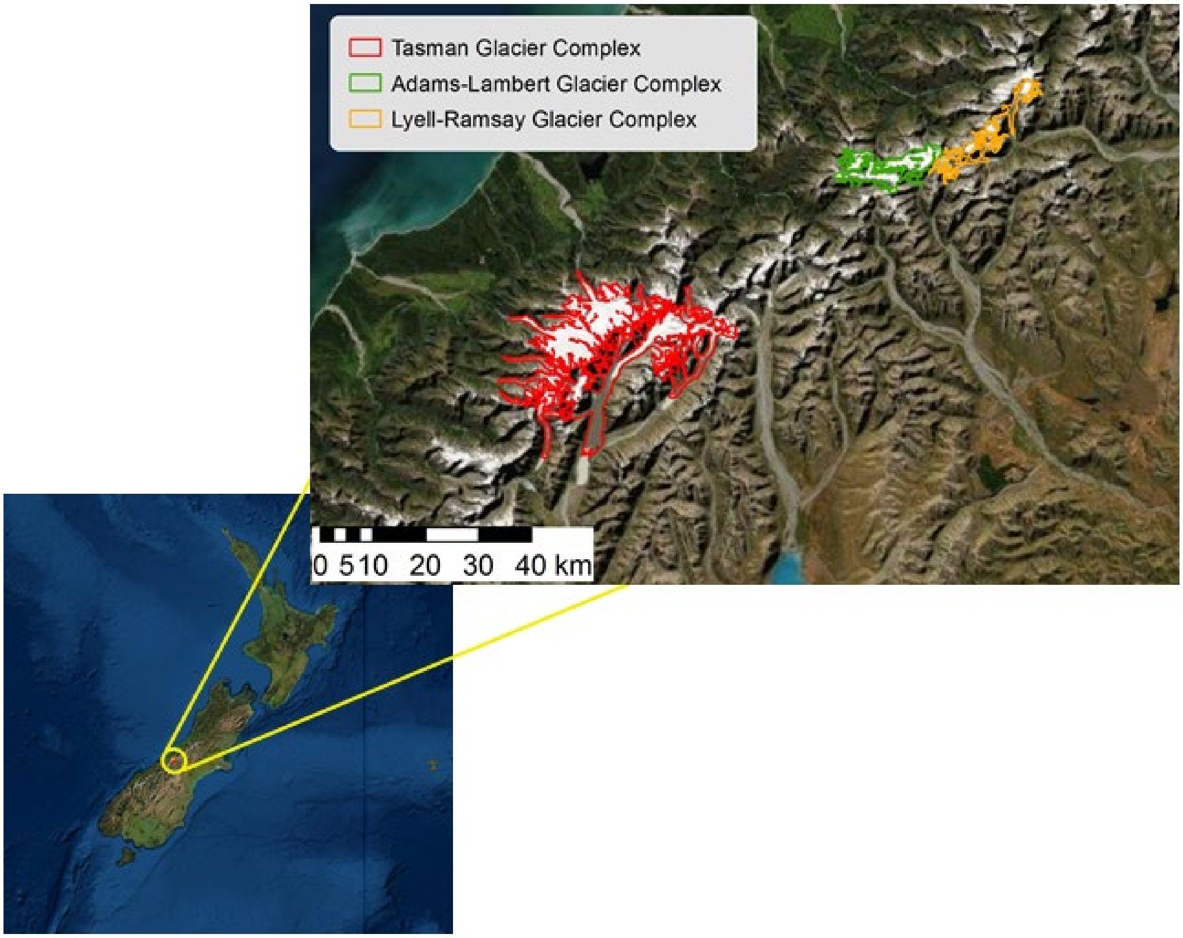


**Figure 40. Three largest glacier complexes in Region 18 - New Zealand**

### Notes on Region 18 Results

Neither GLIMS nor RGI had names for the second and third largest glaciers. These names came from Herman et al. (2011). I could not find names for the glacier complexes in the literature; so, for the purposes of this study, I created ones from the area or geographical features where the complexes are located or from the largest glaciers that reside in these complexes.

The Region 18 correspondent noted that the GLIMS data is out of date and that there are newer outlines being prepared for GLIMS that have the same largest glaciers but with more up-to-date area values (Bauman et al., 2021). Future work would be to use these new outlines once they are submitted to GLIMS and provide an updated version of this data.

### Glacier Outline Literature Citation and GLIMS Submission Information

No literature citation available.

**Submitters**: P. Sirguey, Canterbury University

## Region 19 – Antarctic Mainland and Antarctic and Subantarctic Islands

Region 19 of the GTN-G region classification encompasses mainland Antarctic and the Antarctic and Subantarctic Islands. The region outline extends from 90° S to 45° S latitude and 180° W to 180° E longitude (Figure 1).

Of the Earth's seven geographical continents, Antarctica is the most southerly and is the 5th largest with an area approximately one and half times that of the United States. However, it contains approximately 90 percent of all the ice on the Earth because it is covered almost entirely by an ice sheet (Swithinbank, 1988). Because Antarctica is so ice covered, it can be more difficult to delineate glacier boundaries than it is in other parts of the world. For this reason, only glaciers with connectivity levels 0 or 1 are included in the results.

Because of the different nature of the glaciers (many without ablation area) between the glaciers on the Antarctic Mainland Ice Sheet and those on the surrounding islands, I split this region into two sub-regions: the Antarctic mainland (subregion 19-31 in GTN-G, 2017) and the Antarctic and Subantarctic islands (subregions 19-01 to 19-24 in GTN-G, 2017).

## Antarctic Mainland

### Largest Individual Glaciers

The three largest glaciers on mainland Antarctica, from largest to smallest, are Seller Glacier, Mercator Ice Piedmont, and Anthony Glacier on the Antarctic Peninsula. They are all classified as outlet glaciers. Their sizes are listed in Table 42, and their outlines can be seen in Figure 41.

**Table 42. Three largest glaciers in Region 19 - Antarctic and Subantarctic – Mainland Antarctica**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Seller Glacier | 7,018.3** | 2002-12-31 |
| Mercator Ice Piedmont | 3,499.4** | 2002-12-31 |
| Anthony Glacier | 2,155.4** | 2002-12-31 |

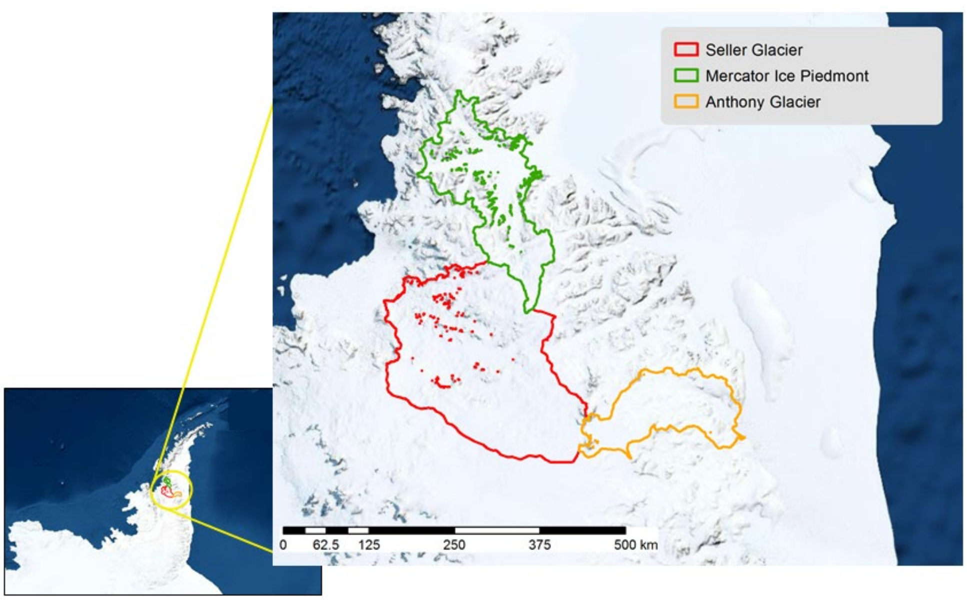


**Figure 41. Three largest glaciers in Region 19 – Antarctic Mainland**

### Largest Glacier Complexes

The largest complex on mainland Antarctica is the Antarctic Peninsula Glacier Complex with a size of 80,852.0 km2. The complex is shown in Figure 42.

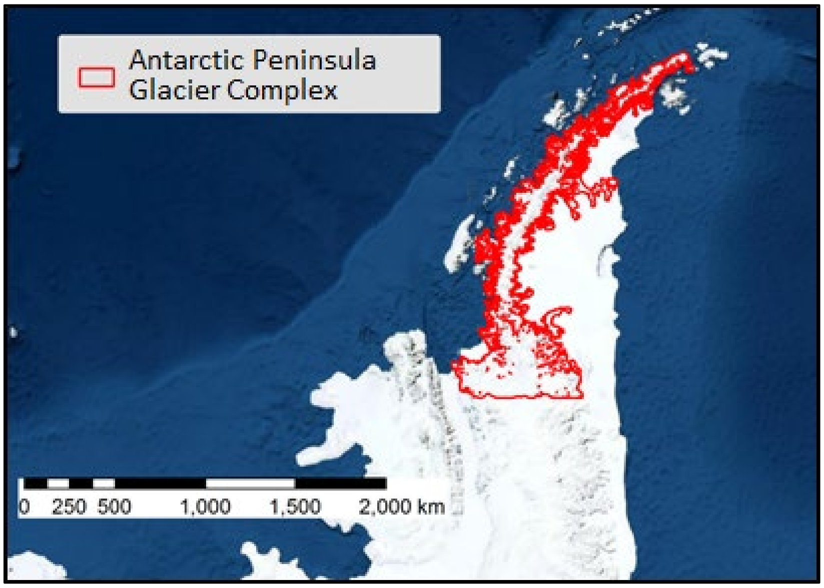


**Figure 42. Largest glacier complex in Region 19 – Antarctic Mainland**

## Antarctic and Subantarctic Islands

### Largest Individual Glaciers

The three largest glaciers on the Antarctic and Subantarctic islands, from largest to smallest, are Thurston Island Glacier No. 1 on Thurston Island and Alexander Island Glaciers No.1 and No. 2 on Alexander Island. They are all classified as outlet glaciers. Their sizes are listed in Table 43, and their outlines can be seen in Figure 43.

**Table 43. Three largest glaciers in Region 19 – Antarctic and Subantarctic Islands**

| Glacier name | Size ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|
| Thurston Island 001 Glacier | 5,260.7*** | 1972-12-04 |
| Alexander Island Glacier No. 1 | 4766.1*** | 1997-09-01 |
| Alexander Island Glacier No. 2 | 3980.4*** | 1997-09-01 |

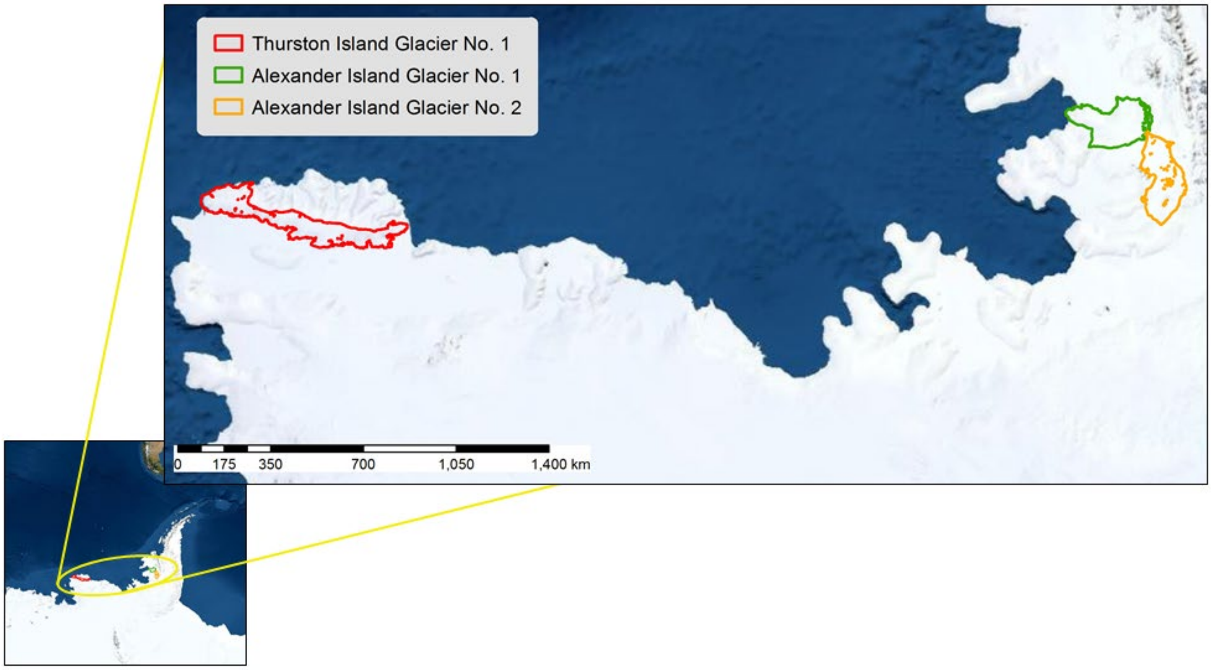


**Figure 43. Three largest glaciers in Region 19 - Antarctic and Subantarctic Islands**

## Largest Glacier Complexes

To help in the analysis of the largest glacier complexes in Region 19, Bliss et al. (2013) was consulted. The three largest glacier complexes on the Antarctic and Subantarctic islands, from largest to smallest, are Alexander Island Glacier Complex, Thurston Island Ice Cap, and Carney Island Ice Cap. They are all in the Subantarctic islands. Their sizes are listed in Table 44, and their outlines can be seen in Figure 44.

**Table 44. Three largest glacier complexes in Region 19 - Antarctic and Subantarctic Islands**

| Glacier complex name | Size (km$^2$) | Measurement date or range of dates (YYYY-MM-DD) |
|---|---|---|
| Alexander Island Glacier Complex | 47,486.2*** | 1979-02-99 to 2001-12-20 |
| Thurston Island Ice Cap | 11,133.0*** | 1972-12-04 |
| Carney Island Ice Cap | 6004.8*** | 1956-02-01 |

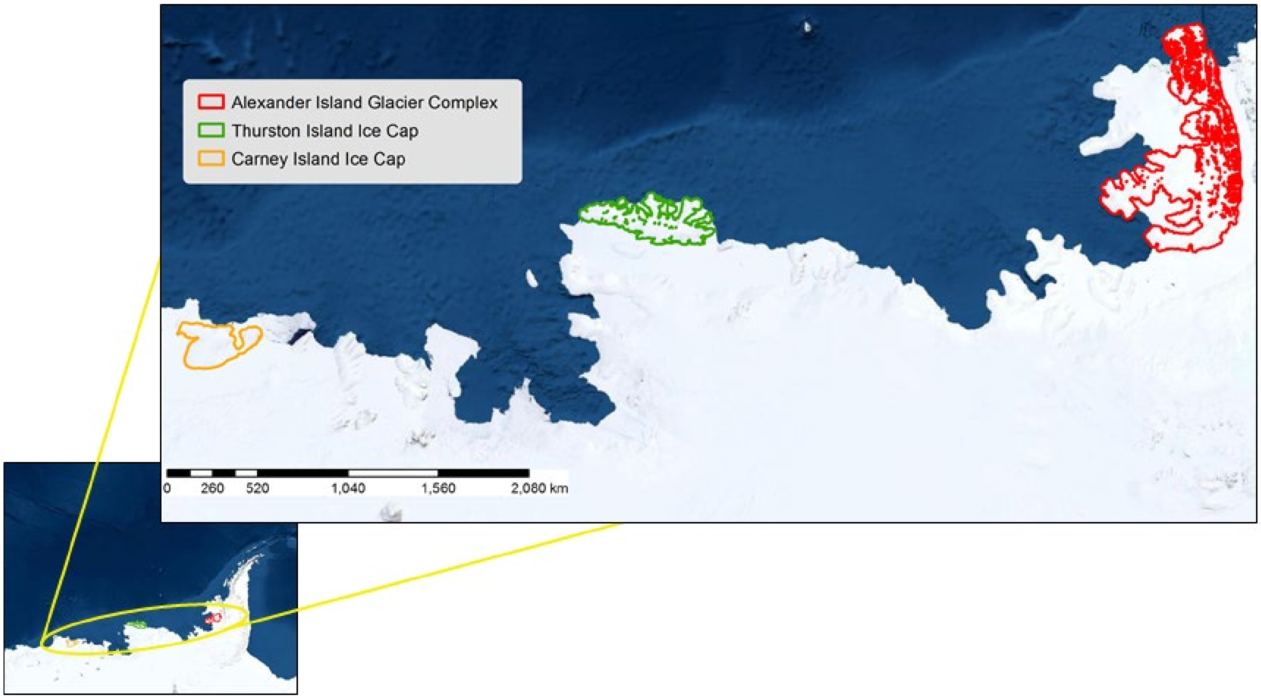


**Figure 44. Three largest glacier complexes in Region 19 – Antarctic and Subantarctic Islands**

### Notes on Region 19 Results

The analysis for the Antarctic mainland used data from GLIMS from Huber et al. (2017) only. This was done because the Huber data only include glaciers with connectivity level of 0 or 1 (Table 2), which is what is wanted for this analysis. Glaciers with connectivity level 2 (Table 2) to the ice sheet do not fit the definition of a glacier used in this project. For this reason, two glaciers that are often considered the largest in the world, Lambert Glacier and Pine Island Glacier, are not included in this analysis because they are strongly connected to the Antarctic ice sheet. Further, according to the definitions in Cogley et al. (2011), Lambert and Pine Island could be classified as ice streams.

For the analysis of the Antarctic and Subantarctic Islands, the data came solely from RGI because RGI does not contain data from the mainland, this made it easy to extract the sub region I was interested in.

### Glacier Outline Literature Citation and GLIMS Submission Information

Huber, J., Cook, A. J., Paul, F., Zemp, M. (2017). A complete glacier inventory of the Antarctic Peninsula based on Landsat 7 images from 2000 to 2002 and other preexisting data sets. *Earth System Science Data* 9:115--131.

**Submitters**: J. Huber, Durham University; A. Bliss, University of Colorado

# DISCUSSION

While this analysis produced results that are generally consistent with the literature, several limitations and challenges should be noted. I cover some of them briefly here, but a further treatment of these can be found in Windnagel et al. (in Review).

## Challenges and Limitations Using Area for Ranking

A major limitation is that using area as the metric to analyze the largest glaciers is not necessarily the best measurement method. Some glaciers may cover a large area but not be particularly thick, thus their ice volume is low; while others may have a small area but still contain a lot of ice volume. Many glaciers across the globe are retreating and thus thinning. However, there are exceptions where glaciers are surging. These surges may well be in response to increased melt due to climate change whereby the surging is effectively reducing the mass of the glaciers (Dunse et al., 2015). Thus, the glaciers may look like they are growing in area but are likely retreating in volume. Therefore, volume might be a more suitable choice. However, at the time when this analysis began, a global database of glacier volume did not exist. As this project progressed, a global database of glacier thickness did become available (Farinotti et al., 2019) from which volume can be extrapolated. The decision was made to continue with this analysis using area. However, a literature search does support that my results using area produce realistic results, so area is a reasonable proxy for determining glacier size. For completeness, however, a short analysis of Region 11 using volume was completed; and the results of that are compared to the results obtained using area.

To calculate the glacier ice volume, I used glacier thickness data from Farinotti et al. (2019) and then calculated the ice volume of the four largest (by area) glaciers in Region 11: Grosser Aletsch Glacier, Gorner Glacier, Fiescher Glacier, and Unteraar Glacier. The method for computing the volume was to calculate the average ice thickness and then multiply that by the glacier area. The results are in Table 45.

**Table 45. Area and volume comparison for the four largest glaciers in region 11**

| Glacier Name | Area from GLIMS ($km^2$) | Volume ($km^3$) |
|---|---|---|
| Grosser Aletsch Glacier | 82.2 | 13.8 |
| Gorner Glacier | 56.4 | 5.5 |
| Fiescher Glacier | 31.3 | 3.7 |
| Unteraar Glacier | 23.8 | 3.1 |

My volume results lie within the error of the results from Farinotti et al. (2009) of 15.36±4.52, 5.85±1.53, 3.84±0.96, and 3.75±0.87, respectively. The important factor to note is that although Fiescher Glacier and Unteraar Glacier have an area difference of approximately 7.5 $km^2$, their volume difference is only 0.6 $km^3$. Although Fiescher Glacier still ranks third using the volume method, assessing the largest glaciers based on volume makes these two glaciers much more similar in size. The results from Farinotti et al. (2009) show the two glaciers to be effectively the same size when the error in the estimates is considered. It is easily conceivable that the rankings of Fiescher Glacier and Unteraar Glacier could be swapped in the future if Fiescher

Glacier were to lose more mass. In addition, it is also easily conceivable that, if the volume method is used in all regions, other glaciers could certainly change rankings.

### Challenges with Glacier Complex Merging Method

Another challenge in my analysis is the method used to merge glaciers to find glacier complexes. This method seems to consistently produce glacier complexes that are slightly larger than what is found in the literature. However, with one of the goals being to process this data in a reproducible, automatic, and programmatic way, this is an unavoidable consequence. The strength of the method is that one can use already existing glacier outlines to estimate glacier complex size. The weakness is that it may not be as precise as using satellite imagery to manually draw a glacier complex outline. Users of this data set should be aware of this limitation and use caution when comparing the results here with more manual estimates of glacier complex size.

### Challenges in Data Availability and Quality

A further challenge is one found in the input data from GLIMS and RGI. Different researchers who submitted data to GLIMS and RGI did not always choose similar ice divides. When glaciers are of a similar size, slight disagreement in sizes may occur due to the difference in the base image used and how the division was interpreted. Thus, disagreements may occur over these similarly sized glaciers in their official ranking. These ice divides will be interpreted differently by different researchers and is a natural consequence of the challenges faced when deciding where one glacier ends and another begins.

One final limitation is the asynchronous dates of glacier outlines in GLIMS and RGI. The glacier outlines range in dates from 1956 to 2014. Because most glaciers have been retreating over the last half century, outlines with older dates may show more ice than those of newer outlines. The best way to compare glacier sizes is with measurements taken at approximately the same time. Unfortunately, that is a difficult task to accomplish globally.

## FUTURE WORK

A main task for the future of this data set would be to reprocess using a newer version of GLIMS and RGI that incorporate the forthcoming updated outlines noted by the regional correspondents for regions 6, 7, 8, 11, 16, 17, and 18. More recent outlines that use better ice divides would serve to improve the results of the rankings.

Another future study would be to use the glacier thickness data from Farinotti et al. (2019) and do a comparison of largest glaciers by volume and by area for each region. In addition, using length as the metric from Machguth and Huss (2014) would be an interesting comparison.

## CONCLUSION

Given the answers to the initial questions of “Which metric should be used?”, “How do we define glacier?”, and “What global data sets are available?”, this analysis produced results that are consistent with the literature. In addition, the Python code written to analyze the GLIMS and RGI databases leads to reproducible science that can easily be adapted to run with newer versions of the GLIMS and RGI databases. This allows the results to remain current and up to date. This is an important feature as glaciers continue to retreat due to climate change.

## DATA ACCESS

The data described in this report can be accessed from https://doi.org/10.7265/0k6h-yn09.


## ACKNOWLEDGMENTS

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The basemap used was the ESRI World Imagery basemap (ESRI, 2022).

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# APPENDIX A – LIST OF LARGEST GLACIERS BY REGION

| Region number | Region name | Glacier name | Area ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|---|---|
| 1 | Alaska | Malaspina-Seward Glacier | 3,362.7 | 2010-09-12 |
| | | Bering Glacier | 3,025.1 | 2010-09-10 |
| | | Hubbard Glacier | 2,834.5 | 2010-09-14 |
| 2 | Western Canada and USA | Klinaklini Glacier | 469.8 | 2004-07-22 |
| | | Franklin Glacier | 153.4 | 2004-07-22 |
| | | Heakamie Glacier | 136.9 | 2004-99-99 |
| 3 | Arctic Canada North | Wykeham Glacier South | 3,175.8 | 1999-07-09 |
| | | Devon Ice Cap Southeast Glacier No. 2 | 2,622.8 | 1999-06-15 |
| | | Croker Bay Glacier | 2,170.5 | 1999-06-15 |
| 4 | Arctic Canada South | Barnes Ice Cap South Dome North Slope Glacier | 2,771.4 | 2002-08-02 |
| | | Barnes Ice Cap Loeken Glacier No. 2 | 1051.3 | 2000-07-27 |
| | | Barnes Ice Cap South-East Slope Glacier | 959.9 | 2000-07-27 |
| 5 | Greenland Periphery | Tjalfe Glacier | 739.0 | 1999-09-01 |
| | | Qaarajuttok Ice Cap South-East Glacier | 603.8 | 2000-08-23 |
| | | Knud Rasmussen Glacier | 583.1 | 2000-09-09 |
| 6 | Iceland | Skeidararjökull | 1,561.2 | 2000-99-99 |
| | | Bruarjökull | 1,428.7 | 2000-99-99 |
| | | Breidamerkurjökull | 1,067.7 | 2000-99-99 |
| 7 | Svalbard and Jan Mayen | Storstraumbreen | 1,226.4 | 2001-07-10 |
| | | Bråsvellbreen | 1,095.9 | 2001-07-10 |
| | | Negribreen | 963.9 | 2008-09-01 |
| 8 | Scandinavia | Austerdalsisen | 55.4 | 1999-09-07 |
| | | Tunsbergdalsbreen | 47.5 | 2006-09-16 |
| | | Nigardsbreen | 41.9 | 2006-09-16 |

| Region number | Region name | Glacier name | Area ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|---|---|
| 9 | Russian Arctic | Moshnyj Glacier | 1,256.8 | 2013-08-19 |
| | | Academy of Sciences Ice Cap Basin North Glacier | 1,243.5 | 2006-07-13 |
| | | Academy of Sciences Ice Cap Basin West Glacier | 1,032.8 | 2006-07-13 |
| 10 | Asia, North | Potanin Glacier | 37.4 | 2011-08-23 |
| | | Slunina Glacier | 33.7 | 2011-08-03 |
| | | Erman Glacier | 33.5 | 2011-08-03 |
| 11 | Central Europe | Grosser Aletsch Glacier | 78.4 | 2009-09-15 |
| | | Gorner Glacier | 40.2 | 2009-09-15 |
| | | Fiescher Glacier | 29.5 | 2009-09-15 |
| 12 | Caucasus and Middle East | Bezengi Glacier | 37.5 | 2014-08-03 |
| | | Dikh-Kotiu-Bugoisy Glacier | 27.5 | 2014-08-03 |
| | | Karaugom Glacier | 24.0 | 2014-08-03 |
| 13 | Asia, Central | Fedchenko Glacier | 700.5 | 2000-09-16 |
| | | South Inylchek Glacier | 368.0 | 2002-10-05 |
| | | Tuomuer Glacier | 358.2 | 2007-08-24 |
| 14 | Asia, South West | Siachen Glacier | 925.9 | 2006-11-09 |
| | | Baltoro Glacier | 631.7 | 2006-11-09 |
| | | Biafo Glacier | 482.2 | 2007-09-16 |
| 15 | Asia, South East | Yanong Glacier | 179.6 | 2005-09-08 |
| | | Gangotri Glacier | 176.8 | 2008-11-09 |
| | | Xirinongpu Glacier | 96.3 | 2005-09-08 |
| 16 | Low Latitudes | Jancapampa Glacier | 15.8 | 2005-08-28 |
| | | Pucca Orcco Glacier | 14.5 | 2000-06-15 |
| | | Japupunta Glacier | 14.3 | 2000-06-15 |

| Region number | Region name | Glacier name | Area ($km^2$) | Measurement date (YYYY-MM-DD) |
|---|---|---|---|---|
| 17 | Southern Andes | Pio XI Glacier | 1,344.7 | 2007-09-06 |
| | | Upsala Glacier | 883.4 | 2007-09-06 |
| | | O'Higgins Glacier | 882.8 | 2007-09-06 |
| 18 | New Zealand | Tasman Glacier | 87.7 | 2009-02-17 |
| | | Fox Glacier | 34.3 | 2009-02-17 |
| | | Franz Josef Glacier | 33.1 | 2009-02-17 |
| 19 | Antarctic Mainland | Seller Glacier | 7,018.3 | 2002-12-31 |
| | | Mercator Ice Piedmont | 3,499.4 | 2002-12-31 |
| | | Anthony Glacier | 2,155.4 | 2002-12-31 |
| 19 | Antarctic and Subantarctic Islands | Thurston Island Glacier No. 1 | 5,260.7 | 1972-12-04 |
| | | Alexander Island Glacier No. 1 | 4,766.1 | 1997-09-01 |
| | | Alexander Island Glacier No. 2 | 3,980.4 | 1997-09-01 |

# APPENDIX B – LIST OF LARGEST GLACIER COMPLEXES BY REGION

| Region number | Region name | Glacier Complex Name | Area (km²) | Minimum date (YYYY-MM-DD) | Maximum date (YYYY-MM-DD) |
|---|---|---|---|---|---|
| 1 | Alaska | Malaspina-Seward Glacier Complex | 30,194.9 | 1999-08-12 | 2010-09-23 |
| | | Brady-Carroll Glacier Complex | 5,816.7 | 2005-08-09 | 2010-09-23 |
| | | Knik-Harvard-Columbia Glacier Complex | 5,182.8 | 2007-07-16 | 2009-09-06 |
| 2 | Western Canada and USA | Klinaklini Glacier Complex | 905.1 | 2004-07-22 | 2004-07-22 |
| | | Franklin Glacier Complex | 703.7 | 2004-07-22 | 2004-08-16 |
| | | Bishop Glacier Complex | 509.3 | 2004-08-09 | 2004-08-09 |
| 3 | Arctic Canada North | Northern Ellesmere Icefield | 19,521.3 | 1999-06-15 | 1999-06-15 |
| | | Prince of Wales Icefield | 19,009.2 | 1999-06-15 | 1999-07-09 |
| | | Agassiz Ice Cap | 18,038.0 | 1999-06-15 | 1999-06-15 |
| 4 | Arctic Canada South | Penny Ice Cap | 6,508.1 | 2000-08-13 | 2002-08-01 |
| | | Barnes Ice Cap | 5,862.7 | 2000-07-27 | 2002-08-02 |
| | | Bylot Island Icefield | 4,711.9 | 2000-08-10 | 2001-08-09 |
| 5 | Greenland Periphery | Flade Isblink Glacier Complex | 9,025.3 | 2001-07-03 | 2001-07-03 |
| | | Hans Tausen-Bure Glacier Complex | 4,114.0 | 1999-99-99 | 1999-99-99 |
| | | Stauning Alps Glacier Complex | 3,466.0 | 2000-08-19 | 2001-08-20 |
| 6 | Iceland | Vatnajökull Ice Cap | 8,091.7 | 1999-01-01 | 1999-01-01 |
| | | Langjökull Ice Cap | 920.6 | 2000-08-20 | 2000-08-20 |
| | | Hofsjökull Ice Cap | 889.5 | 1999-08-01 | 1999-08-01 |
| 7 | Svalbard and Jan Mayen | Asgardfonna-Balderfonna-Olaf V Glacier Complex | 8,370.5 | 1961-01-01 | 2008-09-01 |
| | | Austfonna Ice Cap | 8,066.9 | 2001-07-10 | 2008-08-14 |
| | | Holtedalfonna-Isachsenfonna Glacier Complex | 5,376.8 | 1966-01-01 | 2010-07-15 |
| 8 | Scandinavia | Jostedalsbreen Ice Cap | 499.9 | 2006-09-16 | 2006-09-16 |
| | | Western Svartisen Ice Cap | 219.3 | 1999-09-07 | 1999-09-07 |
| | | Southern Folgefonna Ice Cap | 163.4 | 2002-09-13 | 2002-09-13 |

| Region number | Region name | Glacier Complex Name | Area ($km^2$) | Minimum date (YYYY-MM-DD) | Maximum date (YYYY-MM-DD) |
|---|---|---|---|---|---|
| 9 | Russian Arctic | Severny Island Northern Ice Cap | 20,666.8 | 2002-02-08 | 2015-08-05 |
| | | Academy of Sciences Ice Cap | 5,573.5 | 2006-07-13 | 2006-07-13 |
| | | Karpinsky-University Glacier Complex | 4,033.2 | 2001-06-21 | 2001-06-21 |
| 10 | Asia, North | Tavan Bogd Icefield | 137.0 | 1989-09-03 | 2011-08-23 |
| | | Ushkovsky Volcano Icefield | 123.0 | 2011-08-03 | 2011-08-03 |
| | | Snegovoy-Ostry Icefield | 114.4 | 2000-07-18 | 2000-07-18 |
| 11 | Central Europe | Grosser Aletsch Glacier Complex | 213.9 | 1973-09-01 | 2009-09-15 |
| | | Gorner Glacier Complex | 112.9 | 1998-08-31 | 2011-09-30 |
| | | Gepatsch-Hintereis Glacier Complex | 46.7 | 1969-06-30 | 2015-08-26 |
| 12 | Caucasus and Middle East | Bezengi Glacier Complex | 153.4 | 1960-01-01 | 2014-08-03 |
| | | Elbrus Glacier Complex | 116.4 | 1960-01-01 | 2014-08-03 |
| | | Karaugom Glacier Complex | 59.1 | 1999-08-18 | 2014-08-28 |
| 13 | Asia, Central | Western Kunlun Icefield | 2,786.4 | 2010-12-08 | 2011-08-05 |
| | | South Inylchek Glacier Complex | 2,743.6 | 2002-08-18 | 2007-08-24 |
| | | Fedchenko Glacier Complex | 1,742.6 | 2000-09-16 | 2004-09-11 |
| 14 | Asia, South West | Siachen Glacier Complex | 7,401.2 | 1998-08-13 | 2010-08-23 |
| | | Batura Glacier Complex | 702.7 | 1998-08-20 | 2007-09-16 |
| | | Lunkho e Dosare Glacier Complex | 407.7 | 2000-09-09 | 2007-08-25 |
| 15 | Asia, South East | Yanong Glacier Complex | 955.4 | 1964-01-01 | 2010-04-09 |
| | | Rongbuk Glacier Complex | 928.3 | 2005-09-08 | 2005-09-08 |
| | | Zemu Glacier Complex | 720.6 | 1966-01-01 | 2010-04-09 |
| 16 | Low Latitudes | Vilcanota Glacier Complex | 121.3 | 2000-06-15 | 2000-06-15 |
| | | Chaupi Orco-Soral Glacier Complex | 111.2 | 2000-06-15 | 2000-06-15 |
| | | Ancohuma Glacier Complex | 85.6 | 2000-06-15 | 2000-06-15 |

| Region number | Region name | Glacier Complex Name | Area (km$^2$) | Minimum date (YYYY-MM-DD) | Maximum date (YYYY-MM-DD) |
|---|---|---|---|---|---|
| 17 | Southern Andes | Southern Patagonia Icefield | 13,326.3 | 2000-06-15 | 2007-09-06 |
| | | Northern Patagonia Icefield | 4,017.7 | 2000-06-15 | 2007-09-06 |
| | | Cordillera Darwin Icefield | 1,893.6 | 2000-06-15 | 2007-09-06 |
| 18 | New Zealand | Tasman Glacier Complex | 248.8 | 1978-01-01 | 2009-02-17 |
| | | Adams-Lambert Glacier Complex | 43.0 | 1978-01-01 | 1978-01-01 |
| | | Lyell-Ramsay Glacier Complex | 31.2 | 1978-01-01 | 1978-01-01 |
| 19 | Antarctic Mainland | Antarctic Peninsula Glacier Complex | 80,851.9 | 2002-12-31 | 2002-12-31 |
| 19 | Antarctic and Subantarctic Islands | Alexander Island Glacier Complex | 47,486.2 | 1979-02-99 | 2001-12-20 |
| | | Thurston Island Ice Cap | 11,133.0 | 1972-12-04 | 1972-12-04 |
| | | Carney Island Ice Cap | 6,004.8 | 1956-02-01 | 1956-02-01 |

# APPENDIX C – GLACIER AND COMPLEX NAMES THAT WERE GENERATED FOR THIS PROJECT

In the Results section for each region, see the Notes for details on how the names were determined.

| Region name (number) | Name |
|---|---|
| Alaska (01) | Malaspina-Seward Glacier Complex |
| | Brady-Carroll Glacier Complex |
| | Knik-Harvard-Columbia Glacier Complex |
| Western Canada and USA (02) | Klinaklini Glacier Complex |
| | Franklin Glacier Complex |
| | Bishop Glacier Complex |
| Arctic Canada South (04) | Barnes Ice Cap Southeast Slope Glacier |
| Greenland Periphery (05) | Qaarajuttok Ice Cap South-East Glacier |
| Asia, North (10) | Tavan Bogd Icefield |
| | Ushkovsky Volcano Icefield |
| | Snegovoy-Ostry Icefield |
| Central Europe (11) | Grosser Aletsch Glacier Complex |
| | Gorner Glacier Complex |
| | Gepatsch-Hintereis Glacier Complex |
| Caucasus and Middle East (12) | Bezengi Glacier Complex |
| | Elbrus Glacier Complex |
| | Karaugom Glacier Complex |
| Asia, Central (13) | Western Kunlun Icefield |
| | South Inylchek Glacier Complex |
| | Fedchenko Glacier Complex |

| Region name (number) | Name |
|---|---|
| Asia, Southwest (14) | Siachen Glacier Complex |
| | Batura Glacier Complex |
| | Lunkho e Dosare Glacier Complex |
| Asia, Southeast (15) | Yanong Glacier Complex |
| | Rongbuk Glacier Complex |
| | Zemu Glacier Complex |
| Low Latitudes (16) | Pucca Orcco Glacier |
| | Japupunta Glacier |
| | Vilcanota Glacier Complex |
| | Chaupi Orco-Soral Glacier Complex |
| | Ancohuma Glacier Complex |
| New Zealand (18) | Tasman Glacier Complex |
| | Adams-Lambert Glacier Complex |
| | Lyell-Ramsay Glacier Complex |
| Antarctic and Subantarctic Islands (19) | Alexander Island Glacier No. 1 |
| | Alexander Island Glacier No. 2 |
| | Alexander Island Glacier Complex |
| Antarctic Mainland (19) | Antarctic Peninsula Glacier Complex |