

# OGGM-Edu Glaciology Lab 2

## Exploring glacier data

### Background information

Where are there glaciers on Earth today, and why? What determines how large they can grow—and therefore how much they can contribute to sea level rise? And how do glaciologists keep track of all this?

In this lab, we will investigate the global distribution of glaciers and their sea level contribution potential. We will use the World Glaciers Explorer app and data from the World Glacier Monitoring Survey to study several related questions.

### Materials

- Lab notebook
- Laptop computer
- World Glaciers Explorer app: <https://bokeh.oggm.org/explorer/app>
- World Glacier Monitoring Service—Fluctuations of Glaciers Browser: <https://wgms.ch/fogbrowser/>

### Pre-lab questions

Answer the following questions in your lab notebook, then discuss with your lab partner.

1. Think about the distribution of glaciers on Earth today.
  - a. Where do you expect there to be a large volume of glacier ice?
  - b. Where do you expect there to be no glaciers at all?
2. What do you think a glacier needs in order to survive from year to year?
3. How do you think we keep track of Earth's glaciers?

### Procedure

#### Part A: Where are glaciers?

1. Access the World Glaciers Explorer app in your browser, through the link above.

- Click and drag a rectangle on the map to select an area. Note the updated statistics at the left and distribution plots along the bottom.
- Fill in Table 1 below. For some areas, you may need to select multiple rectangles and sum them up:

Continent/Region	Number of glaciers	Glacier area [km <sup>2</sup> ]	Sea-level equivalent [mm]
<b>Greenland</b>			
<b>North America</b> (include Canadian Arctic)			
<b>South America</b>			
<b>Antarctica</b>			
<b>Africa</b>			
<b>Europe</b> (include Iceland and Norwegian Arctic)			
<b>Asia</b> (mainland + Russian Arctic, include Caucasus)			
<b>Australia</b>			
<b>Oceania</b> (include Indonesia and New Zealand)			

- Clear your previous selection. Repeat step 2 as necessary to answer questions 1-5 in your lab notebook.

## Part B: How do glaciers survive?

- Clear your previous selection.
- Click and drag a rectangle on the elevation-latitude plot to select a subset of glaciers. Note the updated plots and map visualization of those glaciers' geographic distribution. Answer Questions 6-7 in your lab notebook.
- Click and drag a rectangle on the temperature distribution plot to select a subset of glaciers. Note the updated plots and map visualization of those glaciers' geographic distribution. Answer Question 8.
- Clear your previous selection. Now click and drag a rectangle on the precipitation distribution plot. Note the updates to the remaining plots.
- Repeat steps 2 and 3 as necessary to answer Question 9.
- For question 10, you will follow a similar selection process but analyze the temperature trends histogram.

## Part C: Glacier monitoring data

1. Access the Fluctuations of Glaciers Browser through the link above.
2. Click on the orange bubble over a region you want to learn more about.
3. Page through the figures presented in the pop-up at the right hand side. Right click one and select "Open Image in New Tab". Answer Question 11.  
*Hint: Some figure types are easier to interpret than others. If the first figure you see is confusing, click the arrows to try another one.*

## Questions

1. How many glaciers are there on Earth? How much would the sea level rise if they all melted?
2. Which regions in Table 1 have the most glaciers? The most sea-level contribution potential?
3. Describe one thing that surprised you about Table 1. What were you expecting, and what did you find instead?
4. Which region has a greater sea level rise contribution potential: Alaska or the Himalayas?
5. How much glacier area is there in the United States? How does that compare with the area of Vermont? *Hint: You will need to select multiple areas and sum them up.*
6. What is the average elevation of glaciers in the Tropics (30 N - 30 S)?
7. Where are there more glaciers: north of 50 N or south of 50 S? Why do you think this is?
8. Where can you find glaciers whose average annual temperature is above freezing (0 °C)? How do you explain their survival, based on the other statistics available in the app?
9. Describe the relationship between annual temperature and average precipitation required to sustain a glacier. Draw a graph below to illustrate.
10. The average temperature trend over the globe is approx. 0.2°C per decade. Indicate the fraction of glaciers (in area) that experience a local change higher than the global average. Then indicate the fraction of glaciers that experience a very high warming (above 0.5 °C per decade) and describe where they are. Explain.
11. Write a short paragraph describing the figure you have exported from the WGMS browser. What is the glacier's name and WGMS ID? Where is it? What are the axes of the figure? What can you interpret about what is going on at this glacier?