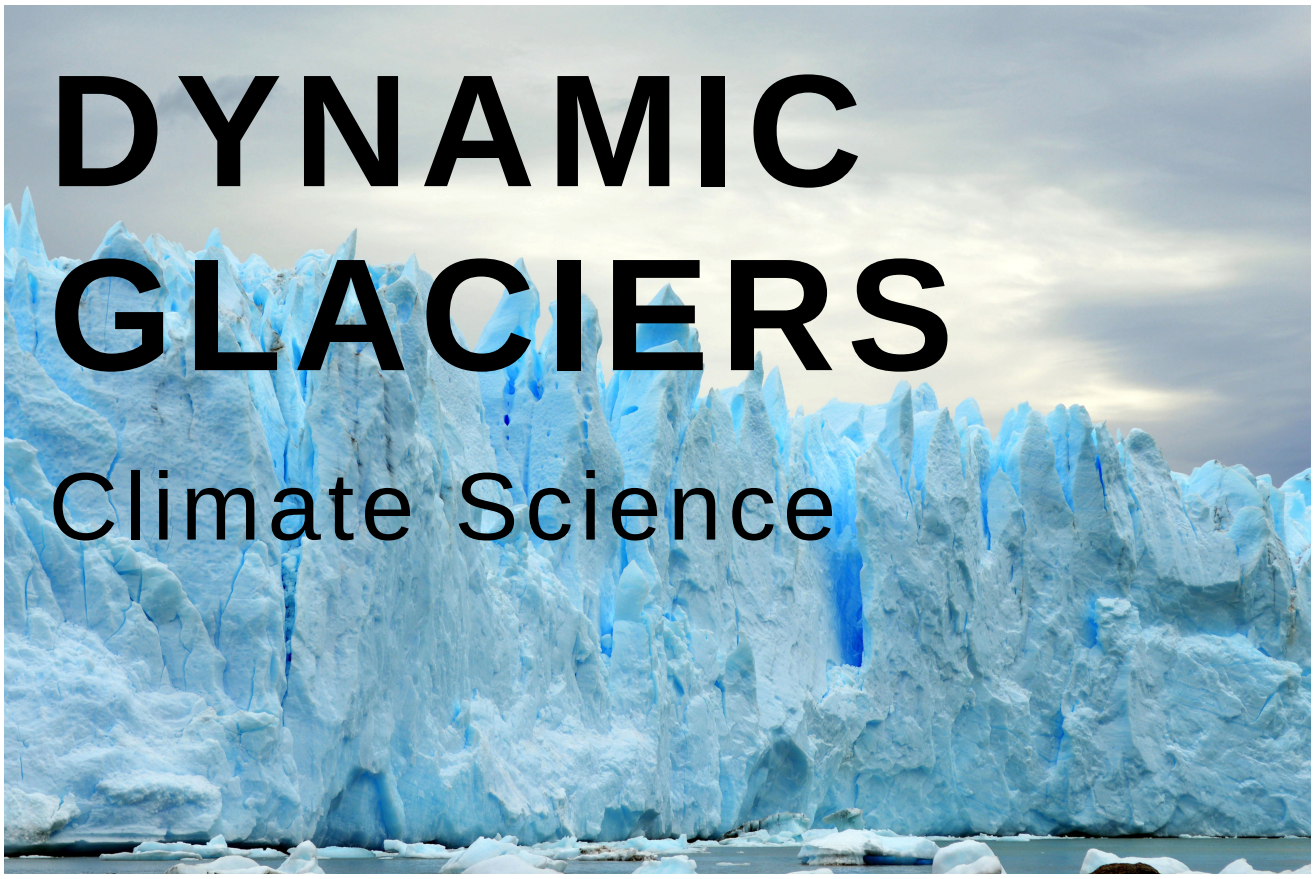

DYNAMIC GLACIERS

Climate Science

Grades

4-6

Objectives

Students compare photographs of glaciers to observe how Alaskan glaciers have changed over the last century.

What's Inside?

- Lesson plan
- Glacier image pairs

Source: https://scied.ucar.edu/activity/glaciers-then-and-now.
Retrieved 02.23.22

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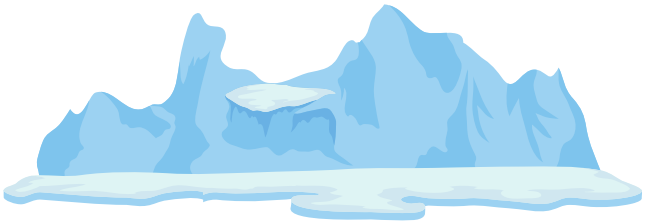
LEARNING OBJECTIVES

- Students will understand how alpine glaciers have changed rapidly over the past century.
- Students will understand possible reasons for glacier retreat over long and short periods of time.
- Students will learn about possible impacts of global glacier retreat.

TIME

- Preparation: 15 minutes
- Activity: 25 minutes
- Discussion: 25 minutes



Educational Standards (Next Generation Science Standards)

- Analyze and interpret data from maps to describe patterns of Earth's features.
- Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- Weather and Climate
- Global Climate Change
- Analyzing and Interpreting Data, Constructing Explanations and Designing Solutions
- Stability and Change, Patterns

MATERIALS

- For each group of 2-4 students: An envelope containing the 16 glacier photos printed from the Glaciers: Then and Now - Image Pairs

PREPARATION

1. Print enough copies of Glaciers Then and Now Image Pairs to have one for each student group.
2. Cut each sheet of paper in half to separate the glacier photos.
3. Optional: Laminate all photos to make the sets more durable for repeated use.
4. Note: Do not share the first page with students until they have matched the pairs of photographs.

Source: https://scied.ucar.edu/activity/glaciers-then-and-now.
Retrieved 02.23.22

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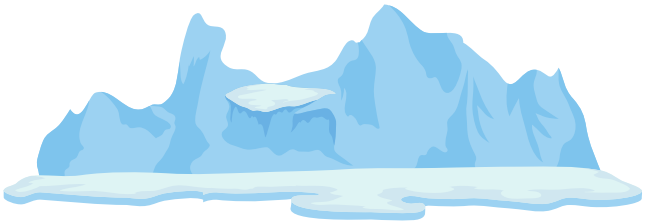
DIRECTIONS

1. Explain what glaciers are, how glaciers grow and retreat, and the two types of glaciers: continental and valley (or alpine) glaciers. Discuss the climate conditions that are necessary for a glacier to grow (snowy winters and cool summers). Discuss the climate conditions that are necessary for a glacier to shrink (warmer).
2. In groups of three or four, have students try to match the glacier images from the past and present. Give them approximately 10 minutes to accomplish the task. (Note: Do not share the key with students until they have matched pairs.)
3. Give students 5 minutes to compare their matches to those made by the other groups.
4. Discuss the images and reveal the correct matches.
5. Have students take notes about what is similar and different about pair of images.
6. Discuss as a class how the "then" and "now" photos were similar and different, and hypothesize about the reason for change in glaciers.
    - What stayed the same? What changed?
    - Do all the glaciers in this sample follow the same pattern? Are they growing, retreating, or staying the same?
    - What climate conditions encourage glacier growth and glacier retreat?
    - What might account for glacier retreat today?
    - As glaciers get smaller, how might this affect the Earth? How might it affect humans?



BACKGROUND

Glaciers are either one of two types: a continental glacier, also called an ice sheet, such as those that occur on Antarctica, or an alpine or valley glacier found in mountain valleys. The photographs in this activity are all alpine glaciers from Alaska, US. Alpine glaciers occur all over the world, yet require specific climate conditions to survive. This usually includes a location that has high snowfall in the winter and cool temperatures in the summer to prevent snow from melting.

Source: https://scied.ucar.edu/activity/glaciers-then-and-now.
Retrieved 02.23.22

If a glacier is to form in a given location, snow must accumulate over time, turn to ice, and begin to flow under the pressure caused by its own weight and gravity. As more and more snow accumulates over years, decades, centuries, and longer periods of time, the glacier continues to move. In areas with little snowfall or low slope conditions, the glacier will flow downward and outward very slowly. If the ice is on a steep slope if basal conditions are smooth and soft, and if there is high snowfall, then the glacier will flow faster. Often this rapid motion creates crevasses on the glacier's surface.

Glacier retreat occurs as a result of sublimation (transition of ice to vapor), snow evaporation (evaporation of liquid water in the snow), strong scouring winds, and ice melt. The process of a glacier getting smaller is called ablation. Over the past 60 to 100 years, almost all glaciers worldwide have been getting smaller and in most cases, there is strong evidence that current glacier retreat is due to Earth's warming climate. This is most evident for alpine glaciers in the Arctic, which is warming quickly compared with other regions, and for alpine glaciers at high elevations in tropical latitudes.

More international glacier image pairs are available from the USGS and at the National Snow and Ice Data Center (NSIDC) website.

An article about the activity's use to engage participants at the 2016 Arctic Summit workshop is also available online at GlacierHub.

Source: https://scied.ucar.edu/activity/glaciers-then-and-now.
Retrieved 02.23.22

Image Pairs for the Glaciers Then and Now Classroom Activity

Print the following pages, cut apart the glacier images, and laminate for classroom use. For your reference, the information about each photo pair is below.

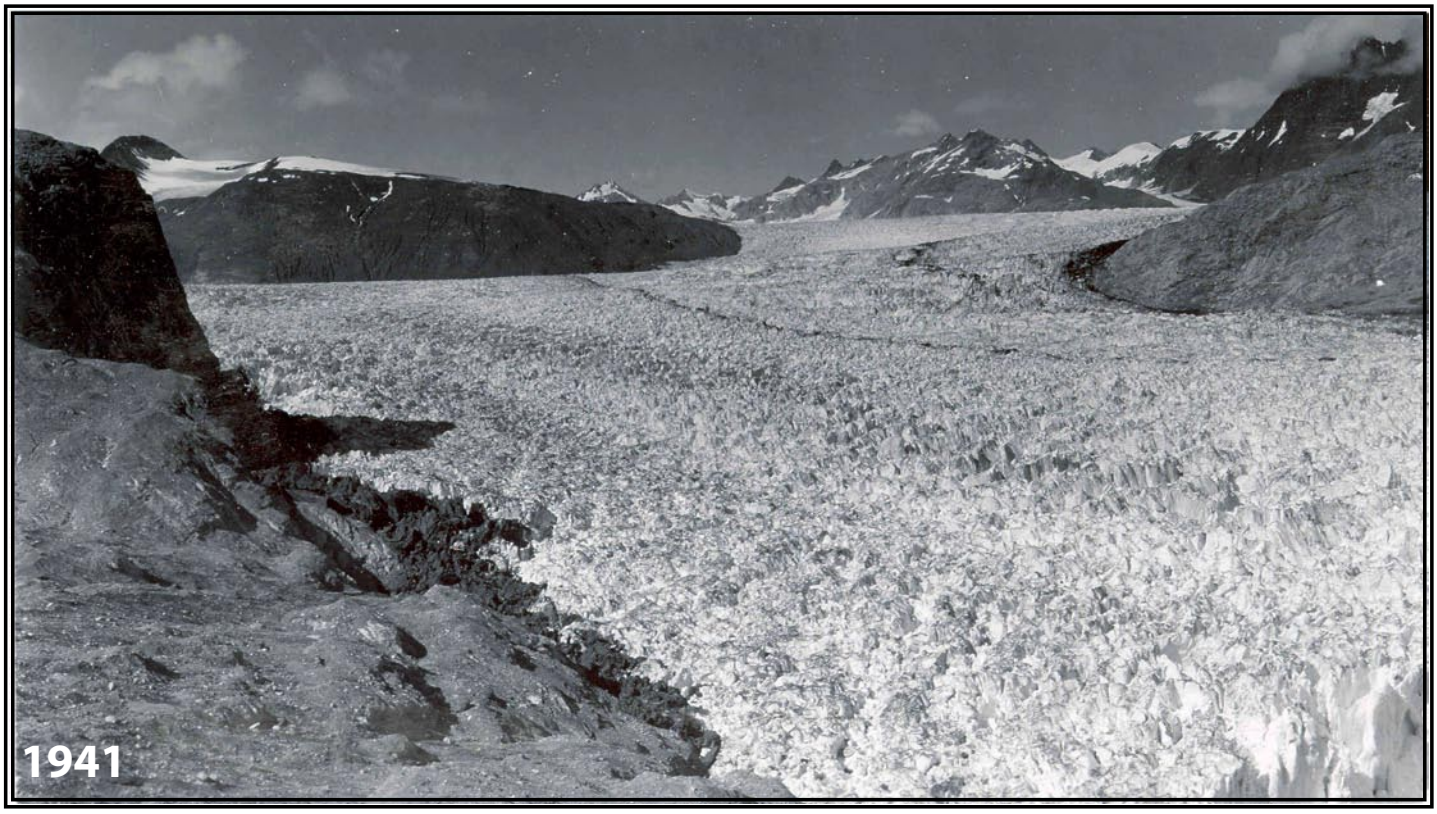
Please refer to activity directions on *Windows to the Universe* for more information about classroom implementation of this activity. The web page that describes this activity is: http://www.windows2universe.org/teacher_resources/teach_glacier.html

Pair	Year	Photographer	Source	Page
1 Muir Glacier Lat: 59.0783 Long: -136.3606	1941	William O. Field	American Geographical Society	2 top
	2004	Bruce F. Molina	USGS	2 bottom
2 Carroll Glacier Lat: 59.0842 Long: -136.6449	1906	Charles Will Wright	USGS	3 top
	2003	Bruce F. Molina	USGS	3 bottom
3 Holgate Glacier Lat: 59.8711 Long: -149.9186	1909	Ulysses S. Grant	USGS	4 top
	2004	Bruce F. Molina	USGS	4 bottom
4 McCarty Glacier Lat: 59.7700 Long: -150.2208	1909	Ulysses S. Grant	USGS	5 top
	2004	Bruce F. Molina	USGS	5 bottom
5 Muir Glacier Lat: 59.0783 Long: -136.3606	1899	Grove Karl Gilbert	USGS	6 top
	2003	Ron Karpilo	National Park Service	6 bottom
6 Toboggan Glacier Lat: 61.0217 Long: -148.2769	1909	Sidney Paige	USGS	7 top
	2000	Bruce F. Molina	USGS	7 bottom
7 Muir Glacier Lat: 59.0783 Long: -136.3606	1976	Bruce F. Molina	USGS	8 top
	2003	Bruce F. Molina	USGS	8 bottom
8 Penderson Glacier Lat: 59.8928 Long: -149.7805	1909	Ulysses S. Grant	USGS	9 top
	2004	Bruce F. Molina	USGS	9 bottom

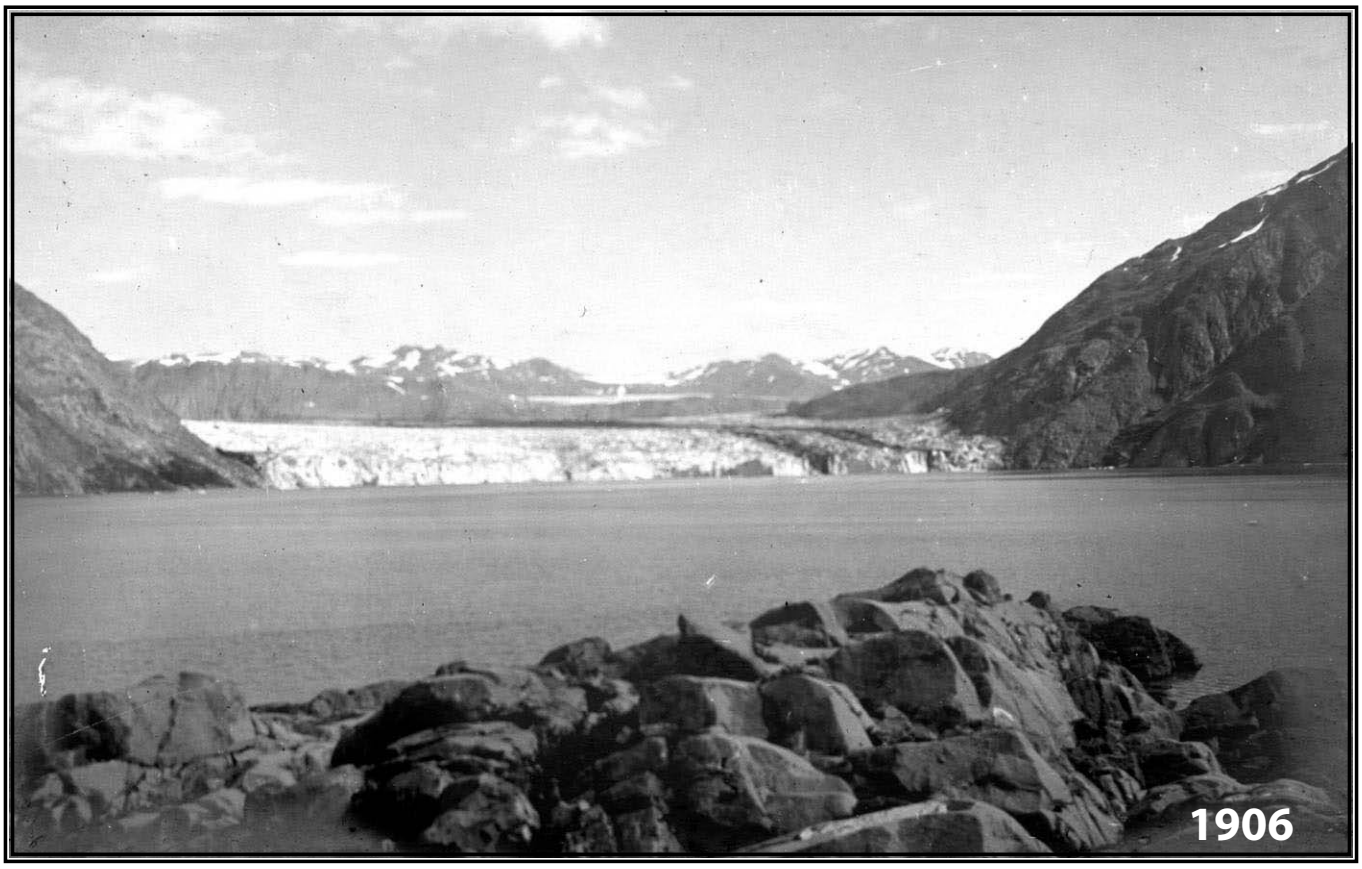
All glacier images are all from Alaska, U.S. and were published by the National Snow and Ice Data Center - World Data Center for Glaciology (www.nsidc.org)

Page numbers listed above correspond to the numbers on the following pages.

Muir Glacier

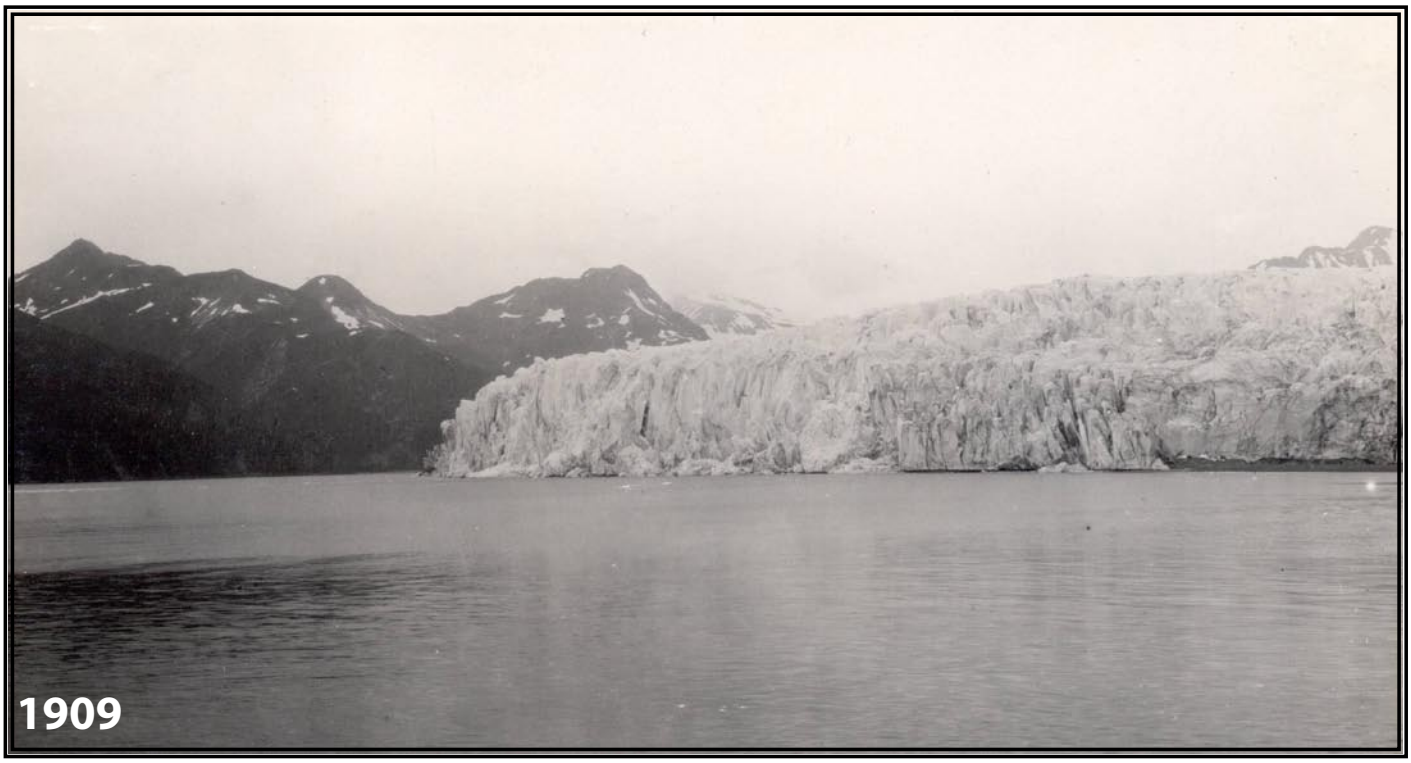


Carroll Glacier

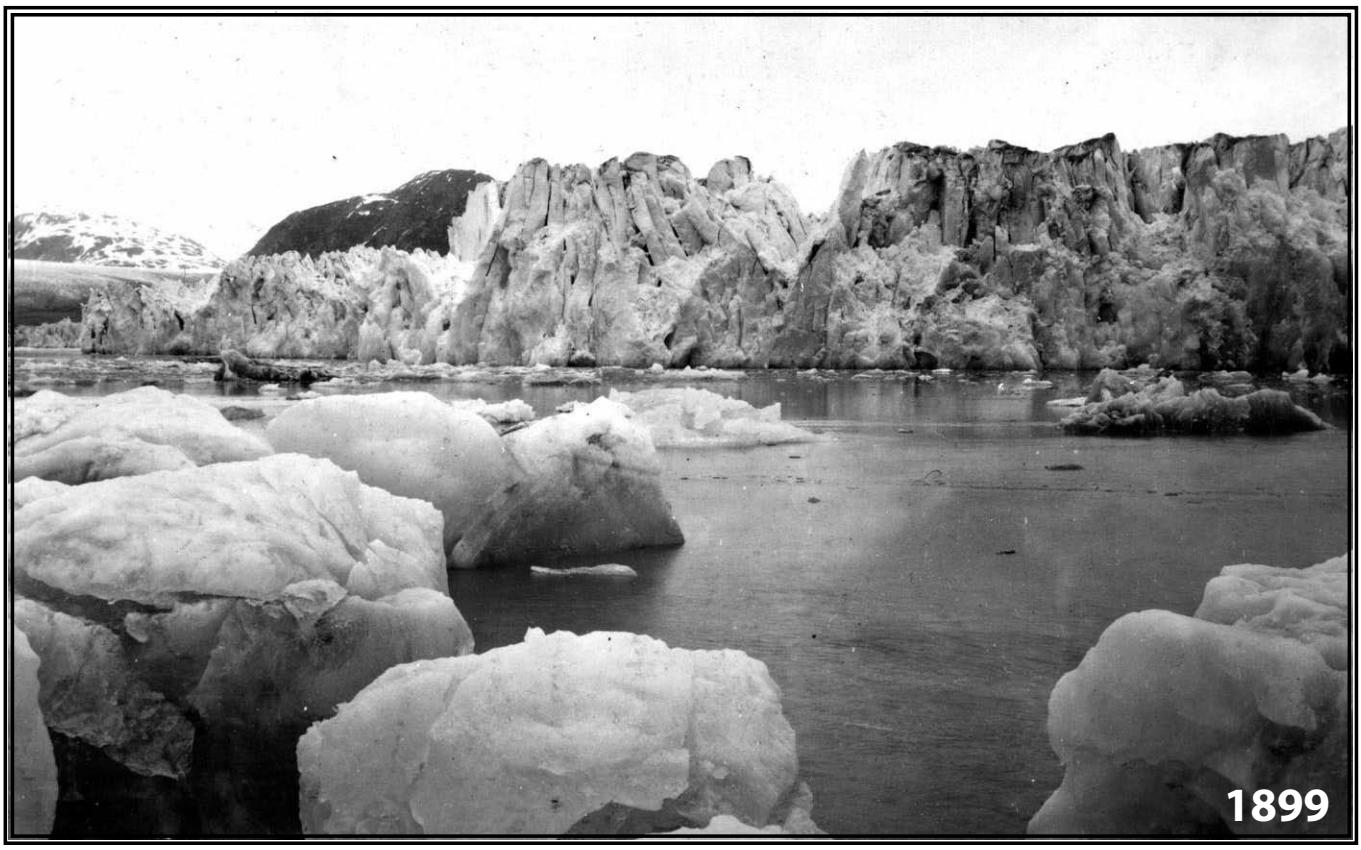


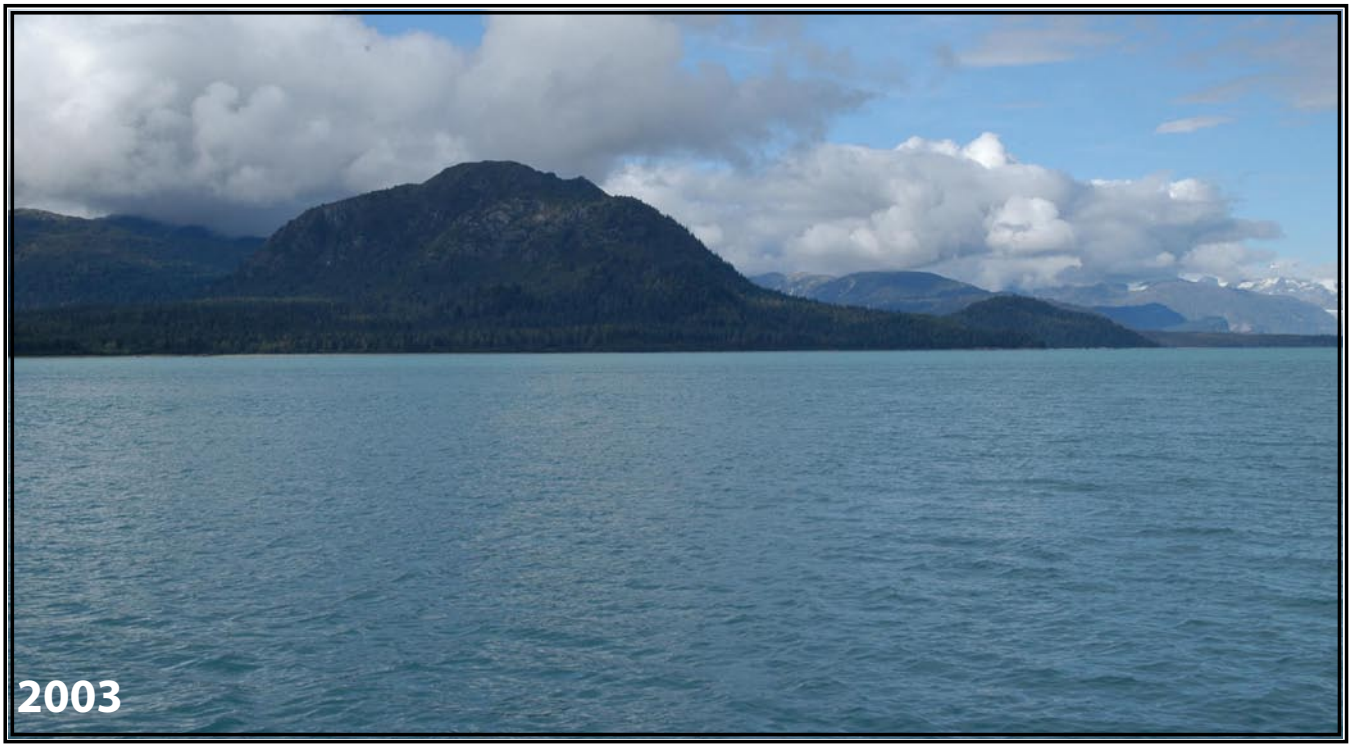
Holgate Glacier

McCarty Glacier



Muir Glacier





Toboggan Glacier

Muir Glacier

Penderson Glacier