
My NASA Data - Lesson Plans

Glacial Retreat: Quantifying Changes in Glacier Cover Over Time

Grade Band

- 6-8
- 9-12

Lesson Duration

- 50 minutes

Sphere(s)

- [Cryosphere](#)

Phenomenon

- [Changes in Snow and Ice Extent](#)

NGSS Disciplinary Core Ideas

- [ESS2A: Earth Materials and Systems](#)
- [ESS2C: The Role of Water in Earth's Surface Processes](#)
- [ESS2D: Weather and Climate](#)
- [ESS3D: Global Climate Change](#)

Science and Engineering Practices

- [Asking Questions and Defining Problems](#)
- [Developing and Using Models](#)
- [Planning and Carrying out Investigations](#)
- [Analyzing and Interpreting Data](#)
- [Using Mathematics and Computational Thinking](#)
- [Engaging in Argument from Evidence](#)
- [Obtaining, Evaluating and Communicating Information](#)

NGSS Crosscutting Concepts

- [Cause and Effect](#)
- [Scale, Proportion, and Quantity](#)
- [Systems and System Models](#)

NGSS Performance Expectation

- [4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features.](#)
- [5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.](#)
- [MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.](#)
- [MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.](#)
- [HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.](#)

Related Resources

- [Glacial retreat quantifying changes in glacier cover over time](#)
- [Views of the National Parks](#)
- [Landsat](#)

Student Handout(s)

- [Student Glacial Retreat.pdf](#)

Teacher Resource(s)

- [Day 7 Glacial Retreat.pdf](#)

NASA Data Types

- [Landsat](#)



GLACIAL RETREAT

QUANTIFYING CHANGES IN GLACIER COVER OVER TIME



Purpose

In this activity, you will use satellite images from the NASA Landsat team to quantify changes in glacier cover over time. This lesson utilizes change pair images of Bear Glacier in Kenai Fjords National Park, located on the southeastern portion of Alaska's Kenai (pronounced: Key-nigh) Peninsula, bordering the Gulf of Alaska.

Learning Objectives

To enable students to analyze changes in glacier cover over time using satellite images.

NASA Phenomenon Connection

Satellite images provide scientists aerial views of glaciers, and a major source of these images has been provided by the Landsat Program. The Landsat Program is a series of Earth-observing satellite missions jointly managed by NASA and the U.S. Geological Survey. Since 1972, Landsat satellites have collected information about Earth from space by taking specialized digital photographs of Earth's continents and surrounding coastal regions. The Landsat program has been collecting images for over three decades, enabling people to see and study the dynamic changes caused by both natural processes and human practices. One way to evaluate these changes is to compare images of a single area over an extended period of time. Two satellite images taken at different times of the same location are called change pairs and are frequently used by glaciologists to evaluate changes in a glacier.

Materials Required

The following materials are available to download and print:

- Glacier Retreat worksheet for each student
- Cover change grid for each pair of students - You will need to transfer the ready-made grid to a transparency sheet.
- NASA Landsat images for each pair of students

The following materials need to be acquired:

- Transparency sheets
- Markers with fine points for writing on transparencies

We highly suggest that the NASA Landsat Images of Bear Glacier be printed out in color and laminated. Color images facilitate the differentiation of glacier cover from land cover, and laminating the satellite images allows them to be used more than once.

Procedure

1. Together with your partner, visually identify the areas in each image that are covered by Bear glacier.

a. Be careful not to include the icebergs floating in the lake or snow that has collected in the mountains that is not part of the glacier itself.

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2. Place the transparency with the cover change grid over the image from 1986, and tape the corners of the transparency to the image. EXAMPLE
 3. One partner will hold the image while the other partner outlines the glacier cover on to the transparency with a colored marker.
 - a. It is very important to distinguish between the glacier and the clouds, therefore, an option for this activity is to trace around only the long extension of the glacier (see outline example on the right).
 4. Make a legend for your transparency cover change grid, which is now becoming a glacier cover map (see example map and legend to the right).
 5. Place the transparent glacier cover map you just made over the 2002 image of Bear Glacier and tape the corners to hold it in place.
 6. Using a different color of marker than you used in step 3, trace the outline of the 2002 glacier on the transparency grid.
 7. Count and record the number of grid squares representing a change in glacier cover. It will take both partners to do this:
 - a. One partner will compare the transparency map to the 2002 satellite image and identify the grid squares that show glacier change. You may notice that some squares contain land that is only partially covered by the glacier. In this case, the most dominant cover type should be used.
 - b. The other partner will mark the equivalent changed squares using the Cover Change Grid. Work from the upper left to the upper right across each row, putting a dot in each square that represents a change in glacier cover.
 8. Once you have determined how many grid squares represent a change in glacier cover, you will use this information to calculate the percent cover change in the satellite images provided of Bear Glacier.
 9. Your teacher will ask for everyone's results and then list them on the board. Write them down and then use them to calculate the class average.