



# Exploring NASA's Operation IceBridge Data Sets Through National Snow and Ice Data Center's Data Portal to Visualize Changes in Polar Ice






## Overview

NASA's Operation IceBridge (OIB) flies airborne missions each year over both Polar Regions, collecting ice thickness and extent data on glaciers, ice caps, ice shelves and sea ice. This data is useful to many disciplines studying climate, weather, ocean circulation, sea level and many related fields. The National Snow and Ice Data Center (NSIDC) houses and organizes the data collected and has a portal to this data which is free and available to the public. By exploring this data, students can gain an understanding of how scientists gather data, get some experience graphing and interpreting information from large data sets, observe changes over time and compare the northern and southern Polar Regions. This lesson will guide both teacher and student through the steps necessary to access the NSIDC OIB Portal and offers suggestions on ways to utilize the data to meet a variety of objectives.

## Objectives

In this 2-3 day lesson, students will explore NASA's Operation IceBridge data collected through annual airborne missions over both poles. Using a sophisticated suite of instruments, scientists onboard several NASA aircraft gather data used by many scientists to understand our changing poles. While the datasets are extremely large and complex, small sections can be studied allowing students to glimpse

### Details

-  Lesson
-  Antarctic
-  Less than a week
-  Download and Share
-  Middle School and Up

### Materials

#### Notebooks

Laptop computers with Internet  
Media projector

### Standards

#### NGSS Standards:

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.  
HS-ESS2-2. Analyze geoscience data to make the

into the world of climate science. Further studies of the instruments, the mission and the findings can be arranged through connecting with scientists through NASA Connect and platforms such as Skype, through reading professional papers that use the data, or by visiting universities using this data.

**Long Term Target:**

To use authentic data sets collected by NASA’s Operation IceBridge scientists to gain insight into physical conditions in the Polar Regions

**Supporting Targets:**

- To access datasets and maneuver within the OIB Portal at NSIDC
- To manipulate data sets and produce graphs and images
- To compare and contrast information over time or from the northern and southern polar regions
- To produce a presentation about my learning that shows my ability to use the portal to gather information

claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.  
HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.  
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

**Lesson Preparation**

Gather materials needed and download Lesson Materials PDF.

**Procedure**

**ENGAGE (5-10 mins)**

Write on board, project or verbally ask:

- How could we calculate the volume of a mountain?
- What would you have to know and how could you gather that information?
- Use the word “relief” and reference mathematical operations in your answer.
- Write your ideas in your note catcher (attached) and prepare to share out to the class.

**GRAPPLE (10-15 mins)**

Imagine that there are 2 instruments embedded in the ceiling of the classroom that are able to measure the height of your body and of all your classmates. One instrument sends a beam that

penetrates air and bounces back when the beam senses the top of your heads. The other instrument penetrates both air and your body but bounces back when the beam senses the concrete or floor tiles.

How could you make a map of your classroom showing all the heights of the students in it where they are sitting or standing.? Design a way to do this with these two instruments. Include thoughts on how bodies would be located (the X and Y axis), how their height would be calculated (the Z axis) and build a small example data set. Share several student ideas.

### **FOCUS (25-35 mins)**

These instructions are included for your students on their note catcher (attached).

- Instruct students to go to: NSIDC OIB portal at <https://nsidc.org/icebridge/portal/quickstart>
  - On the welcome screen you will see an option to watch a video. Click on the video to start. Take notes, pause and start as needed.
  - Now click on the second video “Instructions on the Map Interface” and record more notes as needed.
1. On the top right corner, find “Earth Data Login”. Click on this and go through a simple free process of establishing a login. Use a school email and password you will remember.
  2. Now explore the site. You may move around as you wish or follow some suggestions:
    - Click on the N for northern hemisphere and the S for southern hemisphere
    - Play with the Available Layers and see what changes on the map
    - Click on the Temporal Filter, select different dates and see what changes
    - Use the Bounding Box somewhere within view, and clear it
    - Use the Keyword Search and type in “Thickness” and see what comes up
    - Reset all filters
    - Notice the coordinates scrolling.
  3. Go to the very northern tip of Greenland - what are the coordinates? \_\_\_\_\_  
(Students should write down 83°32’43”N 29°19’42”W)
  4. Go to the very tip of the Antarctic Peninsula - what are the coordinates? \_\_\_\_\_  
(Students should write down 63°14’30”S 54°56’34”W)
  5. Opening and running Google Earth along side the OIB portal page can be useful.

### **APPLY (40-50 mins.)**

Teachers working with middle school or younger high school students who prefer more structure to this lesson, please use the pre-selected location, Thwaites Glacier, for your students to investigate. Thwaites Glacier resides in western Antarctica (75°30’S 106°45’W). It is an interesting, rapidly changing and carefully monitored glacier. By studying this glacier, students will be looking at some of

the most compelling data we have on Antarctic data today. There is a brief summary of Thwaites, written by NASA scientists below, and others can be found easily online if you wish to add more literacy into the lesson.

“The West Antarctic Ice Sheet (WAIS) is particularly vulnerable to ocean warming-induced collapse. The Thwaites Glacier of West Antarctica is one of the largest WAIS regional contributors to sea level rise, and has been considered to be potentially unstable for many years. Joughin et al. (p. 735) used a combination of a numerical model and observations of its recent geometry and movement to investigate the stability of the Thwaites Glacier. The glacier has already entered the early stages of collapse, and rapid and irreversible collapse is likely in the next 200 to 1000 years.”

Joughin, I., B. E. Smith, and B. Medley. "Marine Ice Sheet Collapse Potentially Under Way for the Thwaites Glacier Basin, West Antarctica." *Science* 344.6185 (2014): 735-38. Web.

Abstract and full article can be found through <http://science.sciencemag.org/content/344/6185/735>

You can decide if you want to lead students through this exercise, or let them explore on their own. Here are the steps:

- Toggle on the map until you reach the coordinates 75°30'S 106°45'W, then form a bounding box around part of Thwaites Glacier. Try different size bounding boxes.
- On the left, you will see data sets that are available. Depending on the exact location of the bounding box, you will see different data sets. Click on one of the sets.
- Go to “View Workspace” and then “Get Data”, and open “Link to your Data”. You can download it as a zip file, or save to Drive. Data sets can be saved as an excel sheet, which in turn can be graphed easily.
- Explore the different data sets. There is no “right answer” here, but you can explore different types of data sets, and see some are just numbers (try to graph something!) others are photographs, and others are secondary maps.
- A second location of your choice will be looked at next. Switch hemispheres and explore the other Polar Region.

Alternatively, for upper level high school students interested in selecting an area of their own to investigate, instruct them to select a location either in the northern or southern hemisphere with flight lines. Their task will be to isolate one data set, download the data they need to Google drive and open it in Excel. They will use excel tools to build one graph showing some of the data they selected.

**SYNTHESIZE (60-100 mins. - depends on number of students and presentation method)**

Students will prepare a brief presentation of their graph or what they learned about Thwaites Glacier or the area they selected. This should include:

- The coordinates and date of the data
- Description of the building of the graph, why they chose the data, and graph type
- What the data tells them
- What they learned through this exercise

The presentations can be 1 student at a time presenting in front of the class, or done as a gallery style, with 5 or 6 students presenting from computers at their desks, while the others visit several presentations, and then swap roles until all students have shared.

While watching the other presentations, students should gain a basic understanding of how their data compares with others' data. This might be as general as “the transects across Greenland showed a similar ice thickness to the transects I looked at across Antarctica” or as specific as “Crane Glacier and Jakobshavn Glacier seem to have a lot of similarities, such as...” etc. These comparisons could be pole to pole, or within the same Polar Region.

Students should be able to write a summary of their learning at the end of this lesson, addressing the following prompts in a smooth, 3 paragraph essay format. This paper will be assessed in accordance to your classroom policies for written work, so no rubric is included for this. Students will find this on their handouts, and they should address the following:

1. List 3 things you learned about through playing with the OIB Portal
2. Based on the data, how are the 2 poles similar and different from each other
3. Describe one new understanding about the shape of ice at the poles (sea ice, land ice, ice shelves, etc)

## Extension Options

Download a free 90 day trial of ArcGIS and import a small data set to the “New Map” area. Play with the program to produce topographic maps of the “Thickness” data.

Study some of the various instruments used in data collection, tying in well to engineering interests. Some of these are mentioned as part of the data collection titles. The instruments used are:

- ATM laser altimeters (NASA/GSFC/WFF)
- Infrared Imager (NASA/GSFC/WFF)
- MCoRDS radar sounder (CReSIS/KU)
- Snow radar (CReSIS/KU), Gravimeter
- Ku-band radar altimeter (CReSIS/KU)
- Ka-band radar altimeter (CReSIS/KU)
- Digital Mapping System (NASA/Ames)
- Mini-Rad (CU)

By doing a simple Google search for several of these instruments, students can gain a basic

understanding of how each piece of the data is collected.

Have students read the abstract and full article “*Marine Ice Sheet Collapse Potentially Under Way for the Thwaites Glacier Basin, West Antarctica*” in the Journal Science at <http://science.sciencemag.org/content/344/6185/735>, or for younger students “*The Doomsday Glacier*” in Rolling Stones Magazine at <http://www.rollingstone.com/politics/features/the-doomsday-glacier-w481260> and write a summary.

## **Resources**

<https://nsidc.org/icebridge/portal/quickstart> <https://earth.google.com>

[https://www.nasa.gov/mission\\_pages/icebridge/index.html](https://www.nasa.gov/mission_pages/icebridge/index.html) <https://www.arcgis.com>

## **Assessment**

A rubric has been made to evaluate the student work and presentation and is included in the pdf attachment.

## **Author/Credits**

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ArcGIS concept and part of lesson idea from collaborative work with PolarTREC teacher Kelly McCarthy (OIB Greenland 2016)

<https://nsidc.org/icebridge/portal/quickstart> <https://earth.google.com>

[https://www.nasa.gov/mission\\_pages/icebridge/index.html](https://www.nasa.gov/mission_pages/icebridge/index.html) <https://www.arcgis.com>

## Using NASA's Operation IceBridge Data: Note Catcher

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

Lesson Component	Student Ideas
<p><b>Engage:</b></p> <p>How could we calculate the volume of a mountain?</p> <p>What would you have to know and how could you gather that information? Use the word "relief" and reference to mathematical operations in your answer.</p>	
<p><b>Grapple:</b></p> <p>How will you design a way of collecting student height data?</p> <p>What method will you use to organize the data?</p> <p>What will the resulting image/map look like? Describe or sketch.</p>	
<p><b>Focus:</b></p> <p>Notes from Video 1</p>	
<p>Notes from Video 2</p>	
<p>Create a login: What username and password did you use?</p>	

<p>Click on the <b>N</b> for northern hemisphere and the <b>S</b> for southern hemisphere. What do you see?</p> <p>Play with the <b>Available Layers</b>. What changes on the map? Be specific.</p> <p>Click on the <b>Temporal Filter</b>, select different dates. Give 2 examples.</p> <p>Use the <b>Bounding Box</b> somewhere within view, and then clear it. What did you choose to “bound”? Describe.</p> <p>Use the <b>Keyword Search</b> and type in “Thickness” and see what comes up. <b>Reset</b> all filters</p> <p>Notice the coordinates scrolling as you move from one location to another. Write down a coordinate to go to, and navigate there with your mouse.</p>	
<p>Go to the very northern tip of Greenland - what are the coordinates?</p> <p>Go to the very tip of the Antarctic Peninsula - what are the coordinates?</p> <p>(optional) Opening and running Google Earth along side the OIB portal page can be useful if it is downloaded on your computer. Check with your teacher.</p>	
<p><b>Apply:</b></p> <p>Navigate to Thwaites Glacier (or your own location if your teacher asks you to do that). What are some immediate observations of your location?</p>	



<p>Build a bounding box around a small part of your location.</p> <p>Select a data set that is lit up white on the left. What did you choose?</p>	
<p>Go to “View Workspace”, “Get Data” and either download to zip or save to Drive. Open your data and take a look. What do you see?</p> <p>Is there anything you think you can graph? This could be a small section of one column of data, for example. If so, save the data to an excel file from Drive. Then, go into the spreadsheet and delete unnecessary columns, and use graphing wizard to make a graph for you.</p> <p>What style of graph did you make? How did it look?</p> <p>Explore the different data sets. There is no “right answer” here, but you can explore different types of data sets, and see some are just numbers, others are photographs, and others are secondary maps. Describe what you see.</p> <p>A second location of your choice will be looked at next. Switch hemispheres and explore the Northern Polar Region.</p>	
<p>As you observe other data from your classmates, write down some notices and wonders you have</p>	<p>I Noticed:</p> <p>I Wondered:</p>

## Presentation Activity

You will prepare a brief presentation of your experience and your product (a graph or map) relating to Thwaites Glacier (or the area that you selected). This should include:

- The coordinates of your data
- The date of the data
- Description of the data - what it includes, what instrument collected it
- Describe the building of your graph, why you chose the data you did, and the graph type
- Explain what the data tells you
- Summarize what you learned through this exercise

Your teacher (or the class) needs to decide on the style of the presentation. One possible presentation style could be 1 student at a time presenting in front of the class. You might rather use a gallery presentation style, with 4-5 students presenting from computers at their desks, while the other students visit several presentations, and then swap roles until all students have shared.

While watching the other presentations, you should gain a basic understanding of how other data compares with your data by noting one thing you NOTICE and 1 thing you WONDER. This might be as general as “I noticed the transects across Greenland showed a similar ice thickness to the transects I looked at across Antarctica” and “I wonder why Crane Glacier and Jakobshavn Glacier seem to have a lot of differences” etc. These comparisons could be pole to pole, or within the same Polar Region. You will write this near the bottom of your note catcher.

## Lesson Scoring Rubric

(Collect and grade Note Catcher for the first 4 elements, and judge the “Synthesize” element as the student presents)

Lesson Element	3 - Meets Expected Level of Proficiency	2 - Beginning Level of Proficiency	1 - Limited Evidence of Proficiency
Engage	Calculation of the volume of a mountain was discussed with clarity using the term “relief”, referencing method of mathematics and measurements	Calculation of the volume of a mountain was discussed with basic ideas that may lack information or the term “relief” and only suggest methods of measurements but shows a starting understanding	The approach to and method of calculating the volume of a mountain was unclear and the student did not offer thoughtful ideas.
Grapple	The steps of the grapple were taken, producing a clear description or image/map that could show the heights of students in the room from two different instruments. The outcome of playing with the concept showed good understanding of how to portion the room and use the data	The steps of the grapple were generally taken but the resulting outcome showed gaps in understanding. The final description or image showed part of the understanding but did not completely satisfy the objective.	Student did not find clarity within the grapple, showing a lack of understanding of how to use the two instruments, portion the room and does not show a dedication to work through the challenge.
Focus	Student moved through the tutorial collecting notes from videos, playing with all the different tools on the portal successfully. At the end of this, the student is ready to use the tools to discover some data.	Student moved through parts of the tutorial playing with some of the different tools on the portal with some success. The student will be able to approach the portal but can not work independently at this point	Student moved through the tutorial in a limited or less than focused manner, resulting in a poor understanding. The student will not be successful within the portal until s/he has completed this first
Apply	Student was able to find Thwaites Glacier and produce a bounding box, locate and select some data, download it and open it. Student is ready to look at the data	Student had difficulty using the tools on the portal to locate and box Thwaites Glacier, or they had trouble selecting and downloading data successfully	Student was not able to work independently through the steps of the lesson
Synthesize	Presentation showed engagement into the lesson, with clarity about the two locations studied and a synthesis of the similarities and differences found between them.	Presentation showed a basic level of understanding of how to maneuver through the portal but an understanding of the locations was lacking	Presentation showed understanding of a basic level of use of the portal but application was lacking.
Extend (optional)	Extended steps were taken, such as the use of ArcGIS or studying the instruments which brought a deeper level of understanding (add in extra points)		

### Written Summary: Final Product

You will write a summary of your learning at the end of this lesson, addressing the following prompts in a smooth, 3+ paragraph essay format. The first draft will be written in class and peer-edited, and the final draft should be prepared for homework and turned in on \_\_\_\_\_. This paper will be graded separately from the lesson's scoring rubric in the manner that suites your teacher.

Include these 3 prompts in your essay:

1. List 3 things you learned about through playing with the OIB Portal
2. Based on the data, how are the 2 poles similar and different from each other?
3. Describe one new understanding about the shape of ice at the poles (sea ice, land ice, ice shelves, etc)

Be sure to use MLA formatting, check for all writing conventions and use proper citation in MLA format.