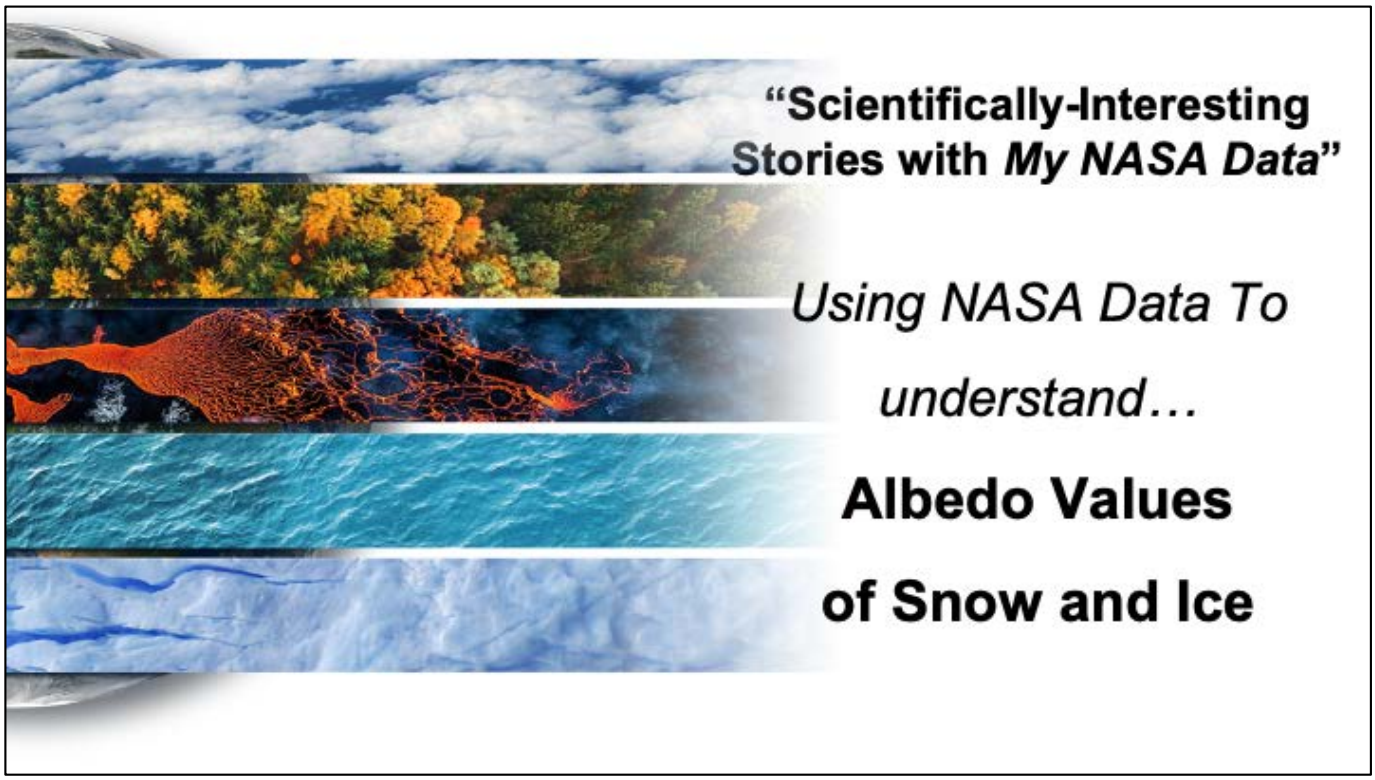

"Scientifically-Interesting
Stories with My NASA Data"
Using NASA Data To
understand…
Albedo Values
of Snow and Ice

Teacher Talking Points:

Bear Glacier is an outlet glacier of the Harding Icefield located in the Kenai Peninsula along the Gulf of Alaska, Alaska. It is the largest glacier in Kenai Fjords National Park.

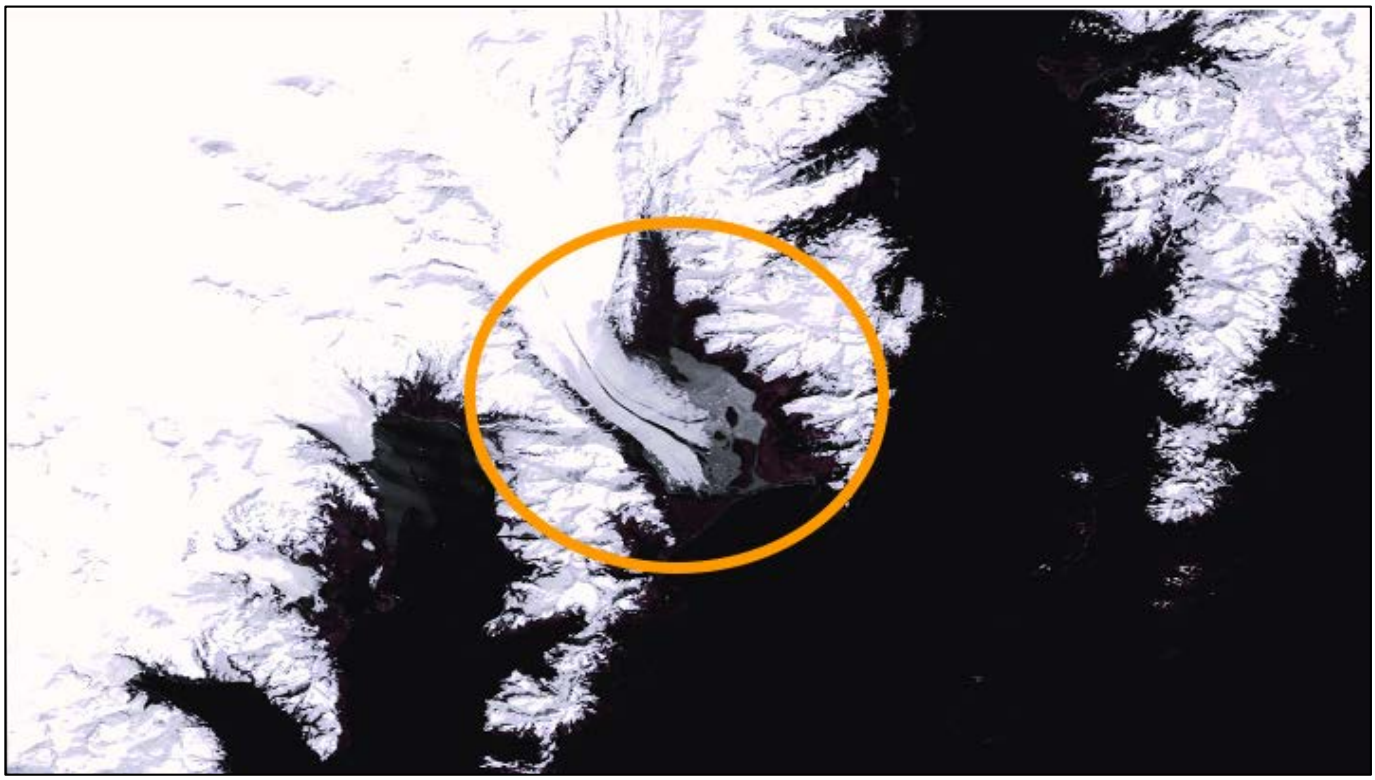
Focus Question:

1. How do glaciers form? *Glaciers form when fallen snow compresses into an ice mass over many years; the process usually takes centuries. The ice then flows to lower elevations.*
2. How do you think glaciers change over the

course of a year? *A stable glacier advances a little in the winter and retreats the same amount in the summer.*

a. Predict the effect that warming air temperatures may have on glaciers.
    b. *Temperature increases can change the regular pattern of glacial advance and retreat.*
    c. *Warmer than normal temperatures may also thin the glacier.*
    d. *The size of lake at the bottom of the glacier (also referred to as lagoon) will increase.*

Image Credits: Google Maps



Teacher Talking Points:

Satellite images of Earth help us observe locations that can be difficult to reach in person. Glaciers are sensitive to changes in regional and global climate, so scientists want to monitor them regularly. While some scientists study glaciers in the field, the Landsat satellites allow many others to monitor glacial change from the comfort of their office.

Students will analyze a series of Landsat images of Bear Glacier from 1980 to 2011 in this and subsequent slide. This image shows a satellite view

taken in 1980.

Focus Questions:

1. What do you observe about the photograph? Describe what you see.
    a. *Down the middle of the glacier run dark gray "racing stripes." As a glacier moves, it picks up dirt and debris (called "moraine") from the rocks it passes. A lateral moraine is the material on the sides of a glacier. When two glaciers merge, as they have here, the dirt and debris they carry form parallel stripes, or medial moraines, on the ice surface.*
    b. *The end of the glacier runs adjacent to the end of the peninsula.*
    c. *There is also evidence of sea ice at the bottom of the glacier shown in a gray color.*
    d. *The land on the peninsulas north and south of the glacier appear to be covered with snow.*
2. If we are to compare this image a more recent image, what features would you use to make your comparisons? Questions will vary.

a. *The median moraines in the glacier's tongue*
b. *The length of the glacier*
c. *The area/shape of the sea ice at the glacier's end (terminus)*
d. *The color of the showpack*

1. What questions can you ask about this image? Questions will vary.

    A. How does…?

    B. I wonder if…

    C. How is _____ the same as? Different than?

    D. How many...? How long...? How often...?

Image Credits: Landsat

Teacher Talking Points:

Students will now analyze the image taken of the Bear Glacier from 2011 and make their comparisons with the previous satellite image.

<u>Focus Questions:</u>

1. What do you observe about the photograph? Describe what you see.
    a. *The image shows glacier that the two median moraines running down its center are wider and darker.*
    b. *The end of the glacier no longer extends*

adjacent to the end of the peninsula and is now much further back.

c. *The gray colored sea ice is gone and there are large icebergs floating in the lagoon shown in a white color.*
d. *The water is also a teal color.*
e. *Also the land on the two peninsula's north and south of the glacier show more brown land cover, as compared to the snow cover in the first one.*

1. What else do you notice about the features of the image, compared to the first one? Observations will vary.
    a. *The median moraines in the glacier's tongue - see above for information on this feature, if students did not observe this in #1.*
    b. *The length of the glacier - see above for information on this feature, if students did not observe this in #1*
    c. *The area/shape of the sea ice at the glacier's end (terminus) - see above for information on this feature, if students did not observe this in #1*

d. *The color of the showpack - see above for information on this feature, if students did not observe this in #1*

1. What questions can you ask about this image? Questions will vary.

    A. How does…?

    B. I wonder if…

    C. How is _____ the same as? Different than?

    D. How many...? How long...? How often...?

4. Students will likely comment on the lines on this image. They are not natural features. These were created at the time when the Landsat 7 satellite scanned the landscape. Unfortunately, a piece of technology, The Scan Line Corrector, failed resulting in strips of data gaps in all imagery collected after May 31, 2003. This problem was addressed with the later model Landsat 8.

Image Credits: Landsat

Teacher Talking Points:

How do scientists make observations about the sea ice other than using Landsat? They use a relationship called the ice-albedo feedback. Watch this animation showing how polar ice reflects light from the sun.

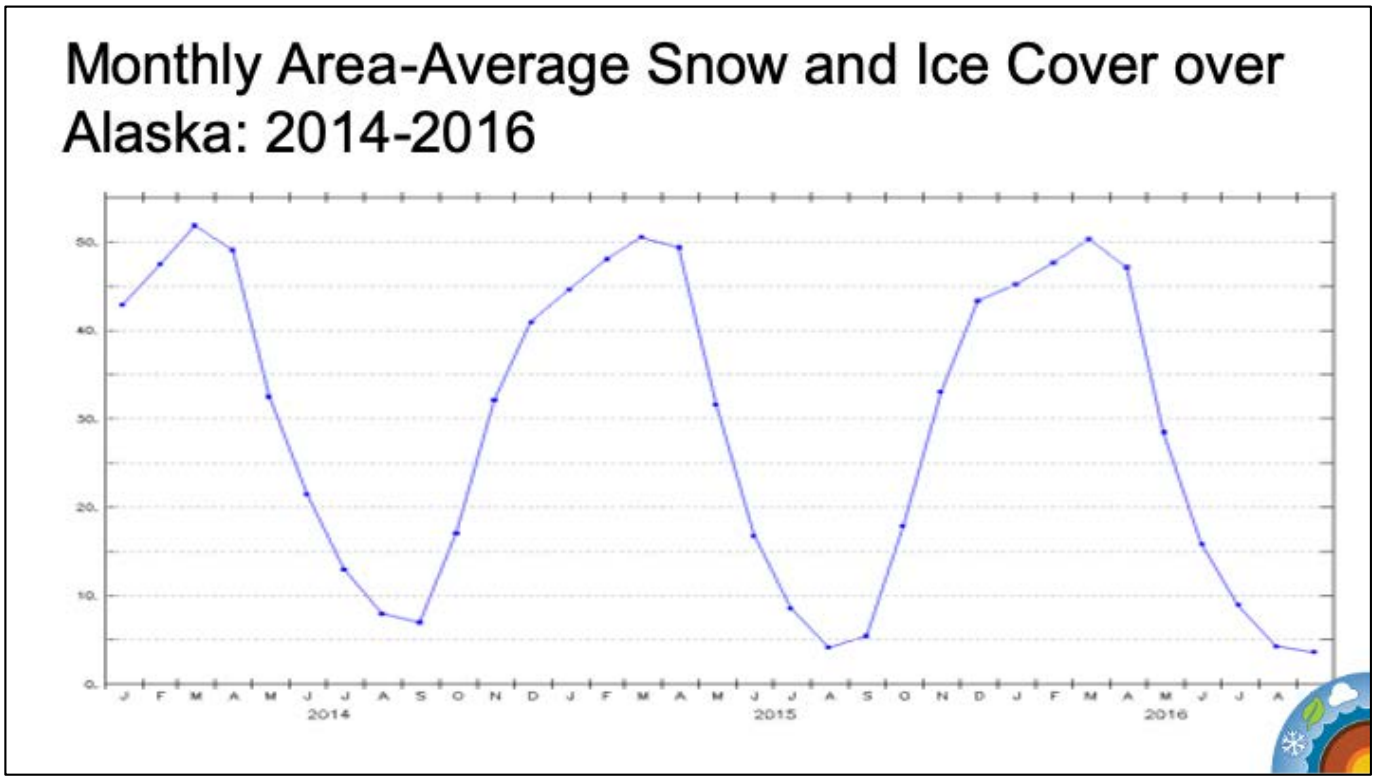
<u>Focus Questions:</u>

1. Explain what happens when the sunlight hits ice. What do you think causes this? *Ice reflects more sunlight than many other types of surfaces. This phenomenon has a lot to do with*

the color of the surface.

2. In the animation, what is happening to the solar radiation as the ice continues to melt? *As this ice begins to melt, less sunlight gets reflected into space.*
3. What effect does this have on the oceans and land? *Sunlight is absorbed into the oceans and land, raising the overall temperature, and fueling further melting.*

Have you ever noticed that you get hotter outside in the summer when you wear black and you feel cooler when you wear white? This is the effect of albedo. Albedo indicates what percentage of the incoming solar radiation (sunlight) is reflected by a surface. The less albedo a surface has, the more energy contained in solar radiation (sunlight) is getting absorbed.



Teacher Talking Points:

Analyze the line plots of the Monthly Area-Average Snow and Ice Cover over Alaska (taken from 50.63 N-77.34 N; 174.38 E-135 W) from 2014-2016.

<u>Focus Questions:</u>

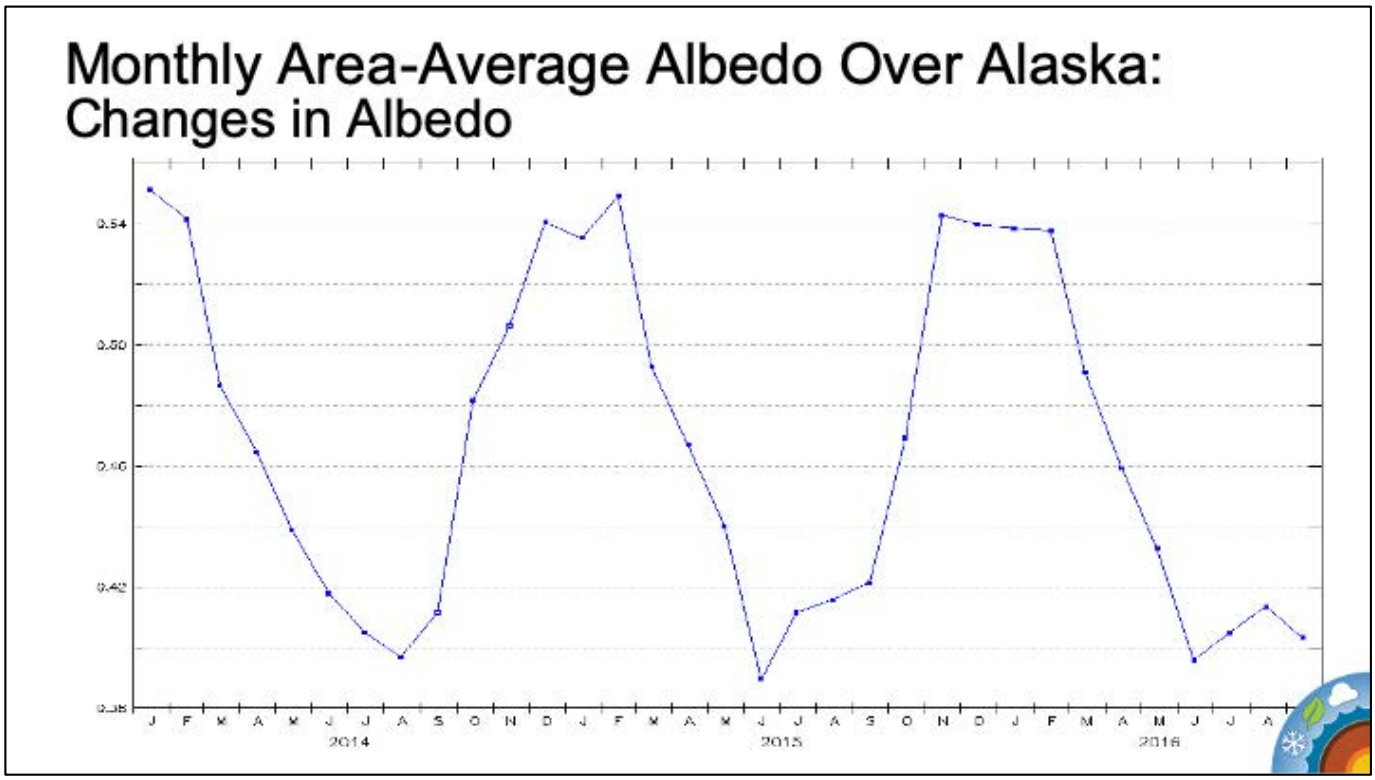
1. What kinds of patterns or trends do you see in the distribution of the data?
   The trend shows that snow and ice over values increase in the fall to spring; from spring to summer, snow and ice cover decrease. This

pattern repeats annually.

2. How do the patterns you see in the graph relate to other things you know?
   Increases in solar radiation increase in the spring and summer; decreases in the fall and winter so snow and ice melting are inversely related.

Related Resources: Consider using the *My NASA Data* Graph Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer



Teacher Talking Points:

Analyze the line plots of the Monthly Area-Average Albedo over Alaska (taken from 50.63 N-77.34 N; 174.38 E-135 W) from 2014-2016.

<u>Focus Questions:</u>

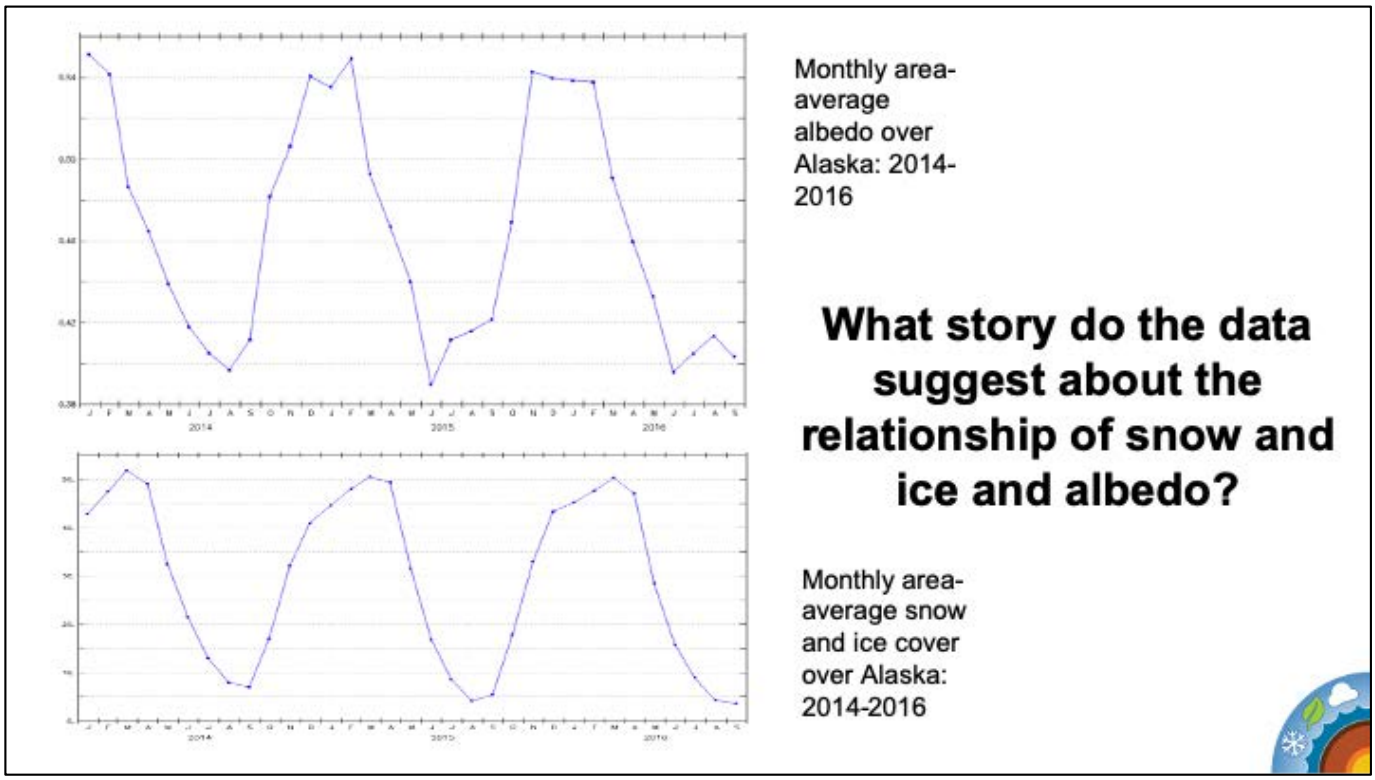
1. What kinds of patterns or trends do you see in the distribution of the data?
   The trend shows that albedo values decrease in the winter to summer; summer to winter, albedo increases. The increase stops and

begins to stabilize in approximately November until it begins to decline in approximately February. This pattern repeats annually.

2. How do the patterns you see in the graph relate to other things you know?
   As the snow and ice cover increases, so too do albedo values. Also, solar radiation increases in the spring and summer and decreases in the fall and winter so Monthly Area-Average Albedo are inversely related.

Related Resources: Consider using the *My NASA Data* Graph Cube and Question Sheet with this map. See link for details.

Image Credit: Earth System Data Explorer



Teacher Talking Points:

Focus Question:

What story do the data suggest about the relationship of snow and ice and albedo?
There is a correlation between high albedo and high percentage of coverage of snow and ice

Image Credit: Earth System Data Explorer