**Reflecting on what is happening to Greenland’s ice**

Scientists use a variety of methods to investigate ice sheet changes. In this exercise you will look at graph and map data to think about how, if at all, the Greenland ice sheet seems to be changing.

**Data set #1: Reflectivity graphs**

Albedo is the measure of a surface’s reflectivity. An example of a material with a high albedo (high reflectivity) is fresh snow, whose albedo is approximately 0.84. In other words, fresh snow reflects approximately 84% of the incoming sunlight that strikes it. In contrast, glacial ice that is not covered with snow exhibits an albedo range of 0.2 to 0.6 (20%-60%).

In small groups, spend a few minutes answering the following questions:

1. Brainstorm some reasons why glacial ice can exhibit such a wide albedo range.
2. During which parts of the year would you expect the Greenland ice sheet to exhibit the highest and lowest albedo values? Why?
3. During a given month, would you expect all regions of Greenland to exhibit the same albedo? Explain your answer.

**What do the data show?**

1. Satellite observations of Greenland’s albedo are available from March 2000 to the present. Before you look at the data, let’s make some predictions about how albedo varies annually. Which of the graphs sketched below best represents the variation in albedo over the course of a typical year in Greenland?
	* 1. A b) B c) C

Albedo

Jan 🡪 Dec

**A**

Albedo

Jan 🡪 Dec

**B**

Albedo

Jan 🡪 Dec

**C**

1. Each person will be provided with some real albedo data from Greenland with time on the X axis and albedo on the Y axis. You will have a different graph than others in your group because albedo measurements were made at different elevations on the ice sheet. Study your graph and write a summary paragraph describing what your graph illustrates that includes answers to the following questions. *What elevation range does your data represent? What do the different colors on the graph indicate? What albedo range is illustrated on your graph? In general, which months have the highest and lowest albedo?*

1. Can you discern any trends in albedo values when you compare data from the initial few years with data from the most recent years?

1. Compare your albedo graph with the graphs of the other members of your group. First, as a group, make sure that everyone is clear on the questions that you already answered on your own. Share observations about the different graphs and summarize what you interpret the albedo graphs data suggests could be happening to the Greenland ice sheet. *Based on the overall data, do the higher OR lower elevation areas in Greenland have the greatest albedo? Offer an explanation for WHY. Which elevations show the greatest/least contrast in albedo values over the period represented by the data?*
2. How confident would you be in predicting what the data for the rest of 2012 would look like on the basis of the graph? How certain would you be predicting what the data for 2013 would look like? Write 2012 and 2103 along the “confidence line” below to indicate your response and briefly explain your answer.

Very confident

Not at all confident

**Data set #2: Reflectivity anomaly maps**

Next, you will work with a partner and look at a Greenland reflectivity anomaly map.

Simply, an anomaly refers to a change from “normal”. To obtain a reflectivity anomaly, the long term average reflectivity is subtracted from the current reflectivity. In other words:

**Reflectivity anomaly = current reflectivity – long term average reflectivity**

The map illustrates the reflectivity anomaly in Greenland in 2012 vs. 2000-2011. In this map, the June 2012 reflectivity is being compared with the average June reflectivity from 2000

2011. Pinks, reds, and yellows indicate areas that exhibited a higher reflectivity in June 2012 than during previous years. Blues and purples indicate areas that exhibited a lower reflectivity in June 2012 than during the previous 12 Junes. The measurements on the map are dimensionless but can be converted to albedo percentages (like you looked at on the graphs in data set #1) by multiplying by 100.

1. What does an anomaly of zero mean? (circle the best answer)
2. The reflectivity in June 2012 was the same as the average June 2000-2011 reflectivity.
3. The reflectivity in June 2012 was greater than the average June 2000-2011 reflectivity.
4. The reflectivity in June 2012 was less than the average June 2000-2011 reflectivity.
5. Why do you think that this map only includes data from June? Do you think that the data would be different if a different month of the year had been chosen? Explain.
6. Briefly summarize what the reflectivity anomaly map suggests is happening to the Greenland ice sheet. Use evidence from the map in your answer. What other information would you want to be more certain that you are interpreting the map correctly?