Ice Mass & Sea Level Change Unit 3: GROUP A Snowmelt Group

Becca Walker and Leigh Stearns

You have been provided with two Greenland air temperature maps. Satellites equipped with radiometers (instruments that measure surface radiation) collect the data used in these maps. The map on the left shows the average air temperature in °C for January–August 2001. The map on the right shows the average air temperature in °C for January–August 2010. The four study sites on which you will focus your attention are circled on both maps.

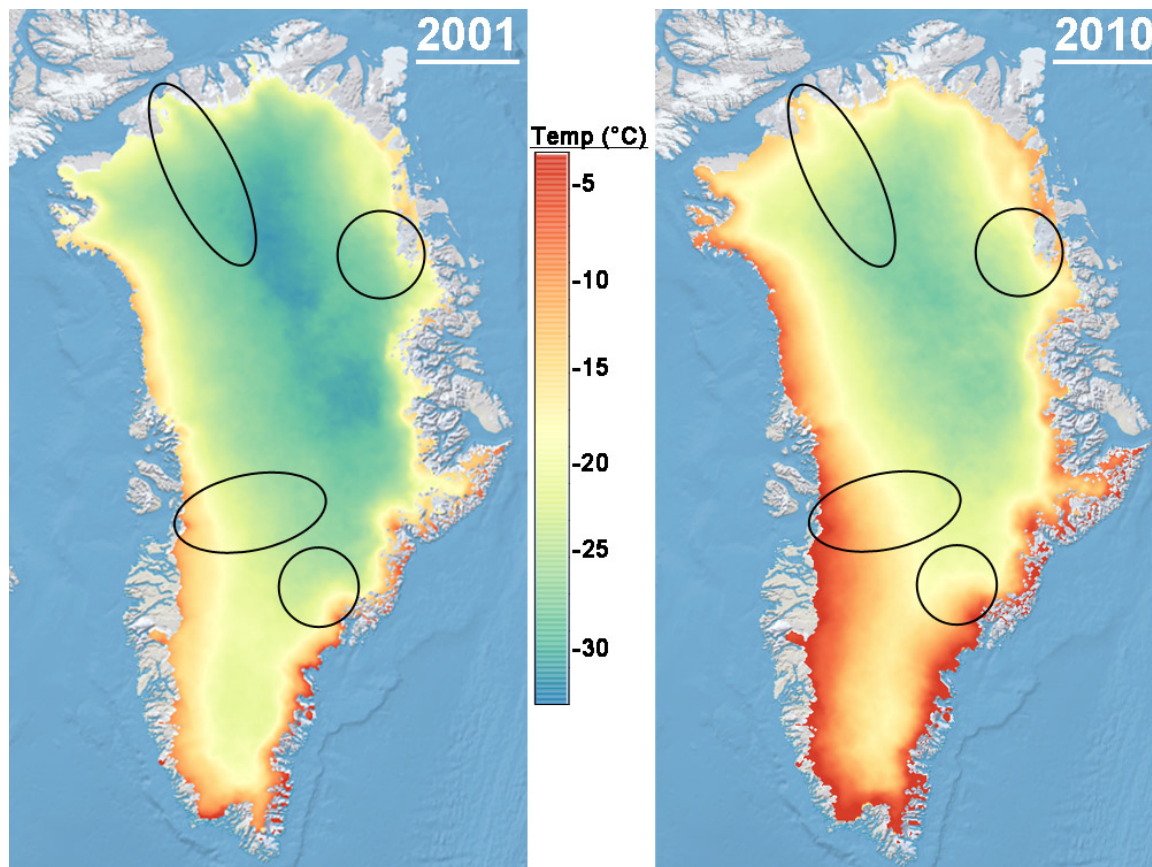## Part 1: Greenland air temperature

Figure 1: Above: Average air temperatures over Greenland from January–August in 2001 and 2010. Data are compiled from AVHRR and processed by J. Comiso (pers. comm.) We selected this monthly range due to data availability. Note that 2010 was an anomalously warm summer in Greenland.

(1) Does average air temperature seem to be uniform everywhere in Greenland? If not, come up with two to three ideas about why air temperature differs from place to place.

(2) When you glance at the 2001 and 2010 maps for a few seconds, what is the most significant difference that you see between the two years?

(3) Which study site(s), if any, appear to exhibit greater (warmer) average air temperatures in 2010 than 2001? Approximately how much greater?

(4) Which study site(s), if any, appear to exhibit lower (colder) average air temperatures in 2010 than 2001? Approximately how much lower?

(5) Which study site(s), if any, appear to exhibit the same average air temperatures in 2010 and 2001?

Figure 2: Greenland map with four study area names.

Part 2: Greenland snow melt

You have also been provided with two Greenland snowmelt maps. These maps are created using passive microwave satellite data to identify locations where there is wet (i.e., melting) snow on top of the Greenland Ice Sheet. When looking at these maps, it is important to understand that "cumulative melt days" means the total number of days that satellites measured snow melting during a particular year. The map on the left shows the average number of cumulative melt days that occurred from 1979–2007. The map on the right shows the number of cumulative melt days that occurred in 2012. The four study sites on which you will focus your attention are circled on both maps.
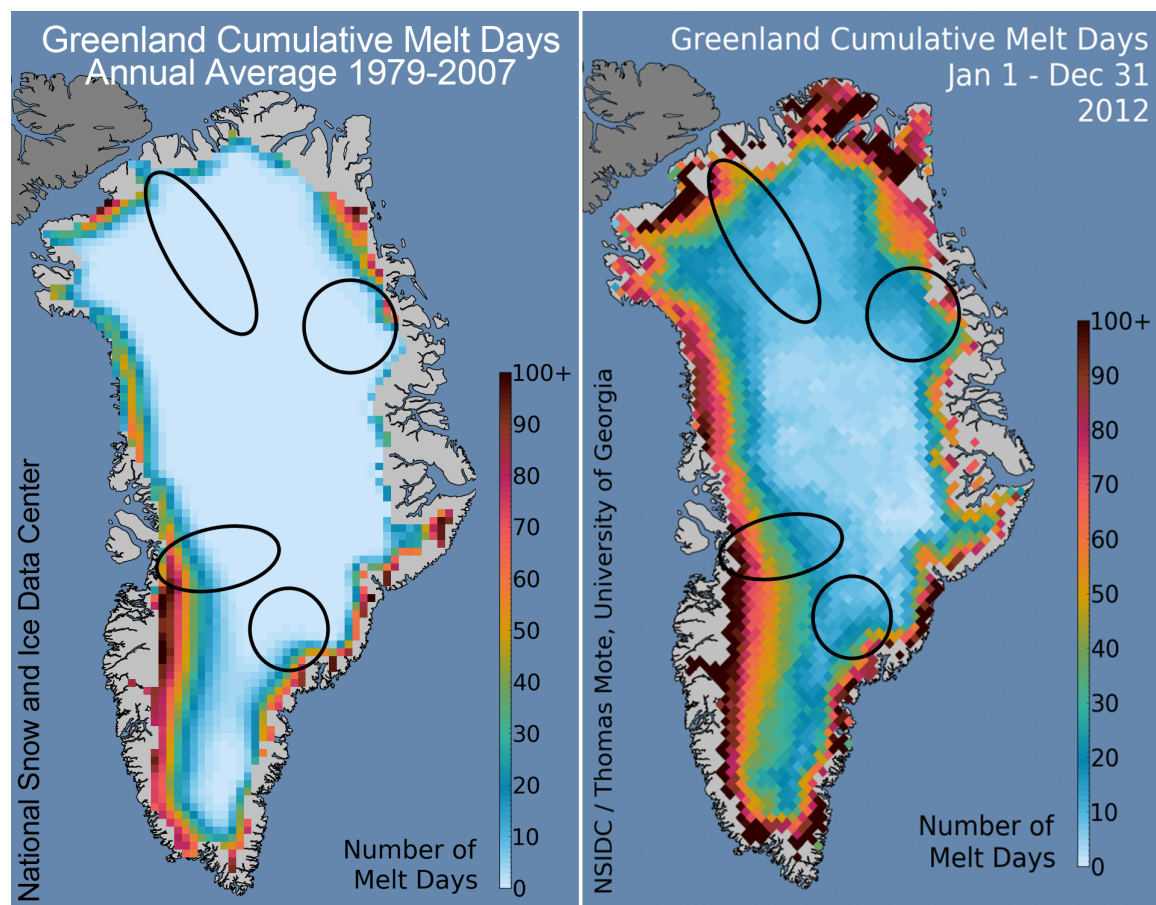

Figure 3: Snowmelt data for each 25 km pixel is calculated from the Special Sensor Microwave Imager/Sounder (SSMIS) passive microwave radiometer, which acquires daily brightness temperatures. The National Snow and Ice Data Center provides daily updates of Greenland surface melt at *http://nsidc.org/greenland-today/*.

(6) When you glance at the average number of melting days from 1979–2007 and the number of melting days for 2012 maps for a few seconds, what is the most significant difference that you see between the two maps?

(7) Overall, are there more melting days in the interior of Greenland or closer to the coast? Suggest a reason for this observation.

(8) Which study site(s) exhibited greater than 100 melting days in 2012?

(9) Which study site(s) exhibited between 50 and 100 melting days in 2012?

(10) Which study site(s) exhibited fewer than 50 melting days in 2012?

Part 3: Greenland mass loss predictions

Now that you have looked at some Greenland air temperature and surface snowmelt data, it is time to predict where you would expect the greatest changes in ice mass *to occur. An increase in ice mass indicates that a particular glacier is growing. In contrast, a glacier that exhibits a decrease in ice mass is shrinking.*

Instructions:

- Notice that on your blank map labeled "prediction," you have been given a scale bar with different colors representing large decrease in ice mass, slight decrease in ice mass, no change in ice mass, slight increase in ice mass, and large increase in ice mass. Using this scale, please shade the four study sites circled on the map to reflect your predictions about how much relative ice mass change has occurred in these areas between (approximately) 2000 and 2012.
- You have an identical blank map labeled "evidence." On this map, please make some written notes near the four study sites about the *evidence* that you used to make your predictions. You can use words like warming, melting, accumulating, cooling, etc. This map should support/justify the predictions that you made.

- When you are finished with these two maps, you should be able to present them to someone in another group and explain to him/her your predictions for changes in ice mass and how you came up with your predictions.

(11) How certain are you in your predictions? If you are uncertain, which additional pieces of information would be useful in making your predictions?

(12) Which data set—air temperature or snowmelt—did you rely on more in making your predictions? Why?

Prediction   **Evidence**

Ice mass change

- large increase
- slight increase
- no change
- slight decrease
- large decrease