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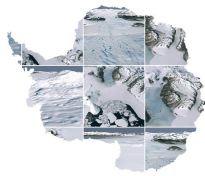
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Why does the ice melt on the “Frozen Continent”? - Student Handout

Part 1: Why does the ice melt on the “Frozen Continent”?

In earlier lessons, we learned that albedo is an important driver of snow and ice melt in Antarctica. However, it is not the only thing causing surface melting on the “frozen continent!” In this lesson, you will use real data to investigate multiple hypotheses for what might be contributing to surface melt in Antarctica.

Word Bank	
Reanalysis	



1. Below is a map of where melt is occurring in Antarctica (from Bell et al., 2018). What do you notice? What do you wonder?

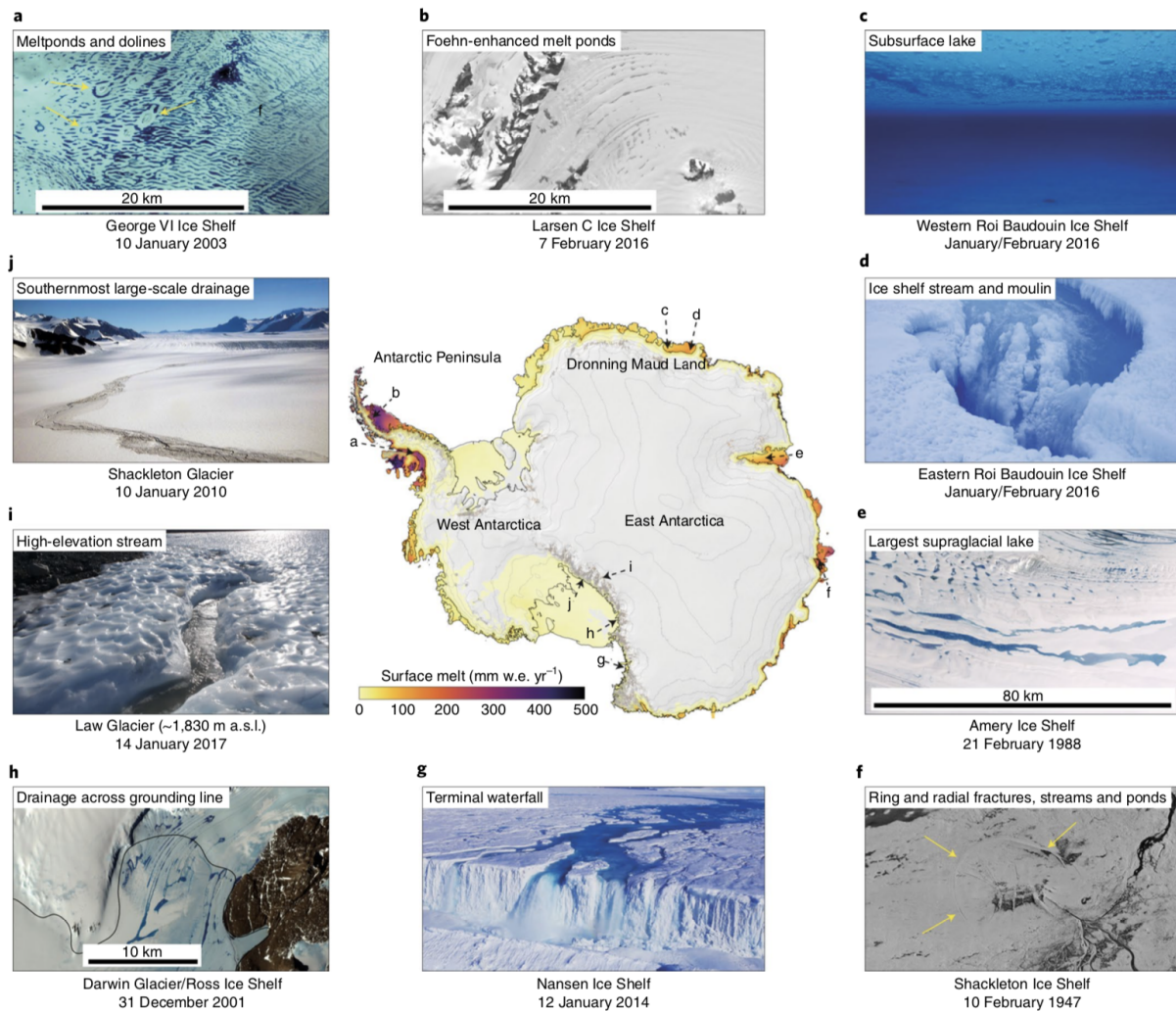
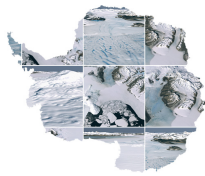
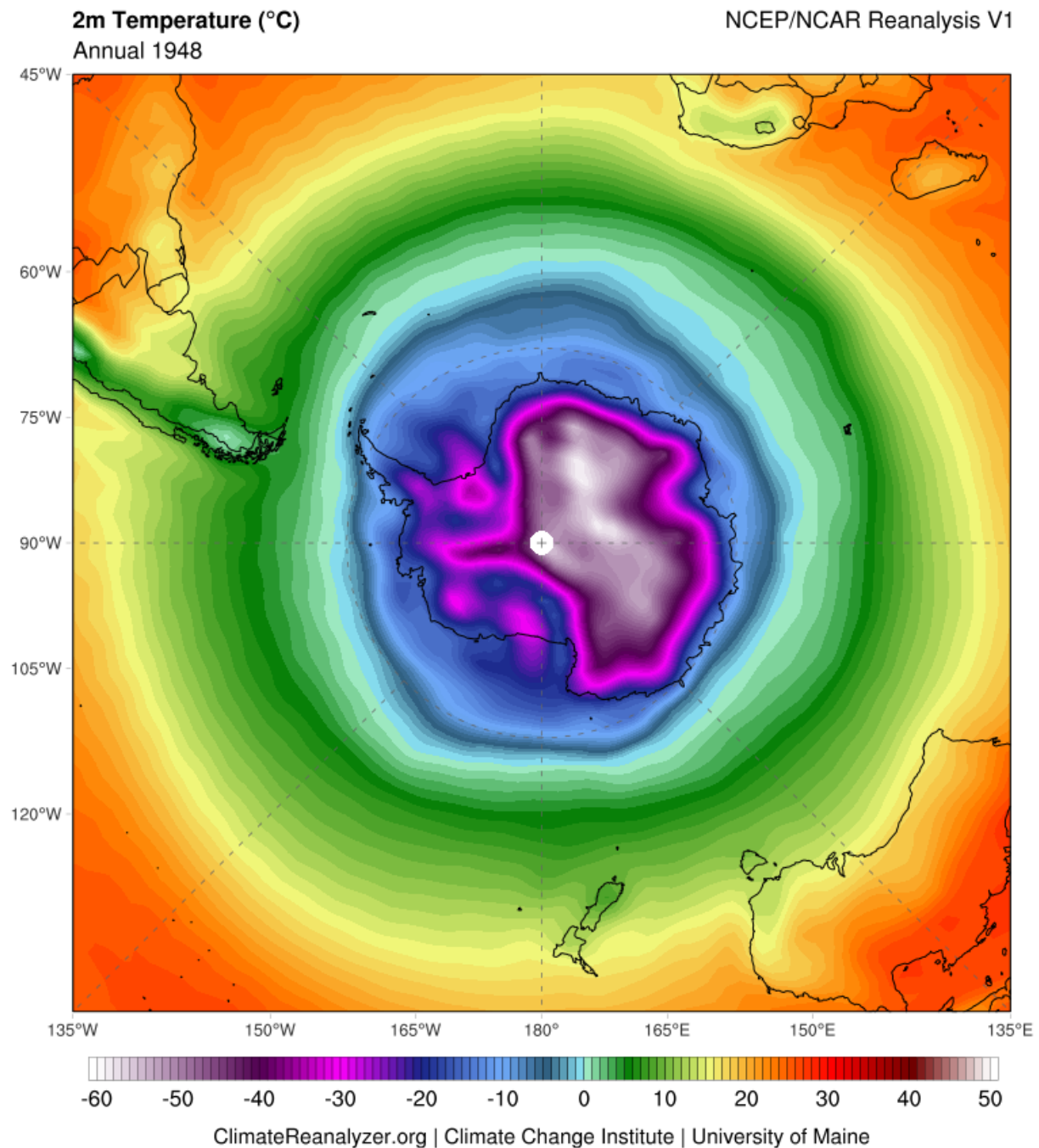
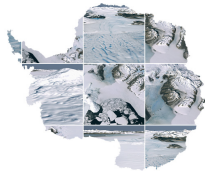


Fig. 1 | Examples of major components of surface hydrological systems located on a present-day Antarctic surface melt map. The central map shows 2000–2009 Antarctica surface melt from QuikSCAT satellite observation 7; the locations of the images in **a–j** are indicated. **a**, Meltwater lakes and dolines (arrows), **b**, Foehn wind-enhanced meltwater ponding. **c**, Buried lake. **d**, Moulin draining surface stream. **e**, Elongate supraglacial lake. **f**, Fractures around a drained lake. Scale unknown. **g**, Persistent waterfall draining water. **h**, Supraglacial streams transporting water across grounding line of the Darwin Glacier onto the Ross Ice Shelf. **i**, High-elevation (1,830 m) meltwater stream. **j**, Meltwater stream crossing the grounding line. Images reproduced from: US Geological Survey (**a,b,e,h**); ref. ⁸, Springer Nature Limited (**c**); Sanne Bosteels (**d**); USGS/EROS and the Polar Geospatial Center (**f**); Won Sang Lee (**g**); Mike Kaplan (**i**); John Stone (**j**).



2. Here is a map of average annual temperatures in Antarctica from January 1948 through August 2018 (from climatereanalyzer.org). What do you notice and wonder? Do you see any connections between this figure and the one you just looked at on the previous page?





Part 2: Research

We know that albedo is important in driving melt. You will now investigate data and make a claim about where melt is occurring and what other processes are driving melt.

You will be split into groups to study the following variables. Each person in your group will be responsible for two of the variables. The goal is to figure out which of these variables might be driving melting in Antarctica, and which ones do not seem to be connected to melt:

- 2m Temperature (important for melt)
- 2m Max Temperature (important for melt - could be combined with 2m Temperature)
- 10m Wind Speed (important for melt - but low data resolution)
- Total Cloud Cover (not really important for melt)
- Precipitation (not really important for melt)
- Precipitable Water (not really important for melt - could be combined with Precipitation)

1. First, as a group, form a hypothesis indicating which variables you think are important for melt in Antarctica and which are not, and why or why not.

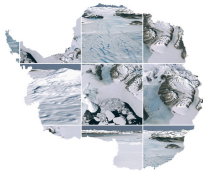
2. Use the Climate Reanalyzer tool to plot the variables listed above:

- 1) Go to <https://climatoreanalyzer.org/>
- 2) Click on Monthly Reanalysis Maps
- 3) Choose Region: Antarctic and click "Plot"
- 4) Choose the Variable you will be exploring and click "Plot"

3. Compare the plots you make with the Climate Reanalyzer tool with the map of Antarctic melt on page 2, or see a larger version of the map on the following page.

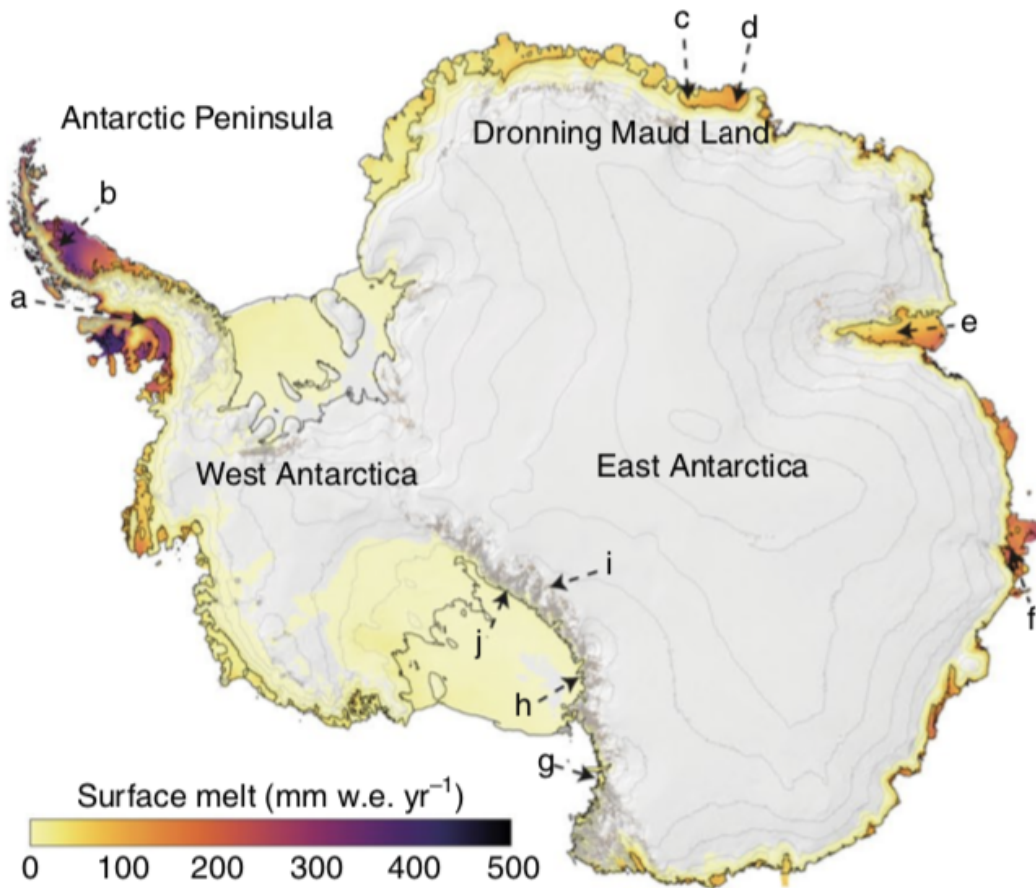
Things to remember and consider in guiding data collection / analysis:

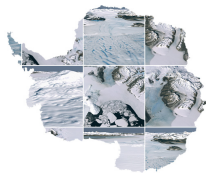
- Always take a note of the units and color scale.
- From the images in Lesson 1, we know melt occurs most in the austral summer (months "DJF" for December / January / February), and often peaks in January. So, we expect to focus our inquiry in those months. You can choose how wide (or narrow) a time window to look at and across how many years (by varying start year and single/multiple).
- Each time you change parameters, you need to click "plot" again.
- You can click on the plot to get an image of it which you can zoom in on.



- You can play with the dataset: Which model is used to create the reanalysis. (NCEP/NCAR is the US one, ECMWF is the European one, and there are even models that go into the future.)
- Look which areas have melt and compare those areas (and the low/no melt areas) on the plots of the variables. What similarities / differences are there?

Map showing melt in Antarctica





Part 3: Argumentation Session

Creating an Argument

Your teacher will explain how to use the Claim - Evidence - Reasoning format to answer the Guiding Question: *Why does the ice melt on the “Frozen Continent”?*