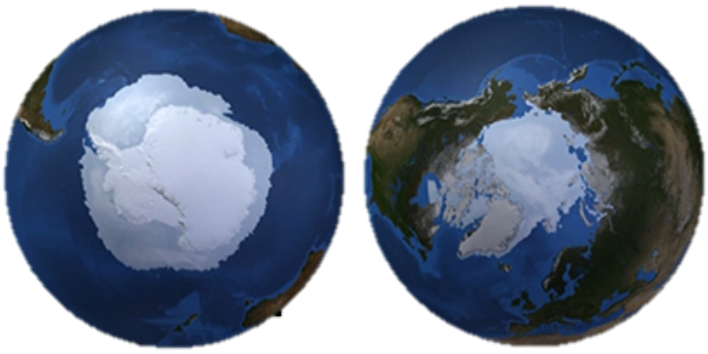
ICE SHELVES ACTIVITY 1: DECODING THE ROLE OF ANTARCTIC ICE IN GLOBAL CLIMATE

Ice Shelves play a critical role in Antarctica, serving as a buffer between the ocean and the continental ice sheet covering the land.



NASA Images of **Antarctica** and the **Arctic** covered in both land and sea ice

Above are images of Antarctica and the Arctic from space. These regions are opposite in several important ways as you will read below, yet both poles have different types of ice that work together to cool temperatures around the globe.

The Arctic is an ocean covered by a 'cap' of both annual and multi-year sea ice and surrounded by countries like Canada, the U.S. (Alaska), Greenland, Scandinavia and Russia. These countries have areas of seasonal and year round ice cover, but only Greenland has enough permanent ice to qualify as an ice sheet.

Antarctica is a large block of land 1.5 times the size of the continental U.S., and covered by a **massive ice sheet seven times** the size of Greenland's. The land is surrounded by an ocean with circulation that effectively separates the continent from the rest of the globe.

ANTARCTIC ICE appears in a range of types and sizes, including sea ice (both the newly formed surface skim of sea ice called grease ice and the older meter or more thick sea ice), icebergs, ice shelves, and finally the massive land based ice sheet. Each part of this ice inventory plays a critical role in protecting both the icy climate of Antarctica and cooling the larger climate system.

GOALS:
In this activity you will work as a team to:

1. Learn about the different types of ice in Antarctica
2. Evaluate the importance of the role each type of ice plays in the stability of the Antarctic Climate
3. Evaluate the importance of the role of each type of ice plays in the stability of the Global Climate

ACTIVITY:

1. **Become an Expert**: You will be placed in teams of 4. Each person in the team draws one Ice Card and learns as much as they can about the type of ice on their card and its role in Antarctica, becoming an 'ice specialist'. Consider the following in your information review but note that these questions are not answered directly on the cards. You will need to make inferences from the information provided:

- What role does this type of ice serve for the Antarctic ice system?
- Does it contribute to the stability of the Antarctica climate? If so how?
- Does the ice provide a positive service for the stability of the Global Climate? If so how?
- If your ice were no longer there what would be the effect on Antarctica?
- If your ice were no longer there what would be the effect on Global Climate?

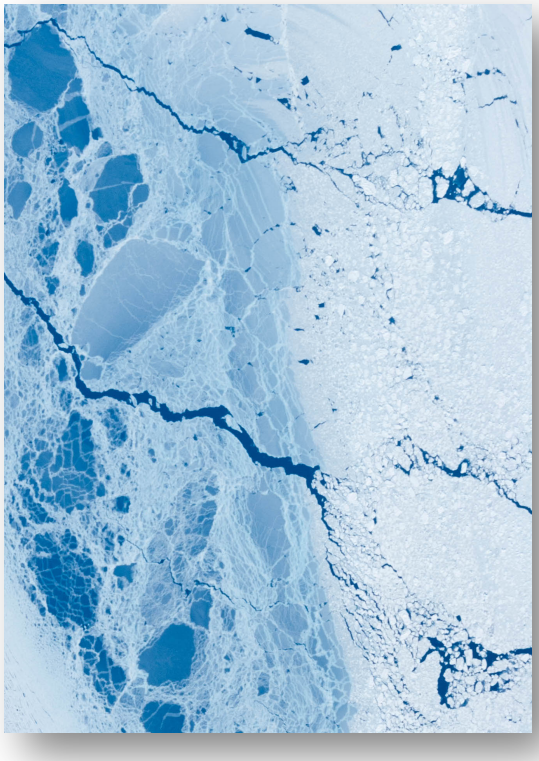
2. **Place Your Ice:** Using the map of Antarctica provided identify where your ice would be found. Label the area.

3. **Represent your ice in a team meeting**: Using the map as a guide take turns explaining:

- Where would your ice be found?
- How does your ice interact or relate to other types of Antarctic ice?
- What its role is in Antarctica's stability?
- What its role is in the larger Global Climate?

4. **Discuss:** Discuss as a team:

- Recall how the different types of ice interact. What if your ice were to disappear tomorrow, what would be the **effect on the other types of ice**?
- If your ice disappeared tomorrow what would be the **effect on climate** both in Antarctica and Globally?
- Thinking further, based on what you have discussed do you feel that certain types of ice more important than other types? If so which type of ice and what is the evidence you are citing?



SEA ICE

- When the atmosphere and ocean are really cold, the ocean surface freezes into ice called ***sea ice***.
- Ocean water is salty, but as the surface freezes it rejects the salt crystals pushing the salt out.
- The rejected salt drops down creating very dense water that sinks below other water. The cold dense water is pulled north helping to drive ocean circulation and global cooling.
- The white surface of sea ice is highly reflective (called albedo) to the sun's heat energy, an important part of local and global cooling.
- The ice packs up against both the land and ice shelves. It provides habitat for many marine organisms, birds and mammals such as plankton, krill, penguin and seal.
- Unlike sea ice in the Arctic the most Antarctica sea ice is seasonal, forming next to the continent in the winter when it is colder and melting or drifting away in the open ocean in the summer

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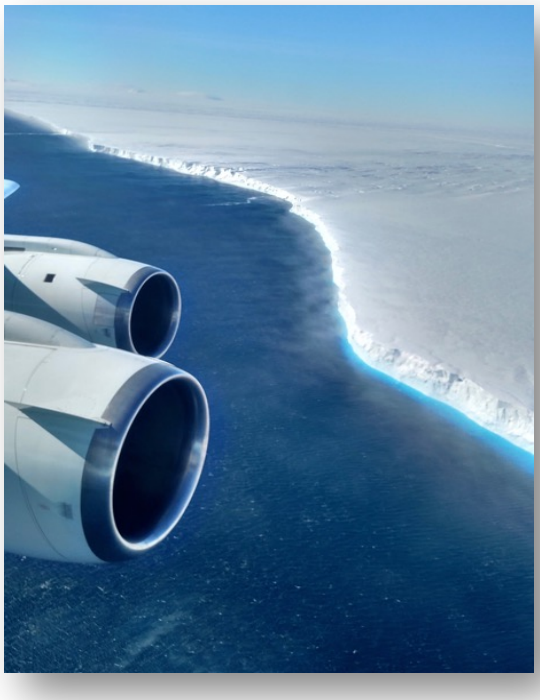

ICE SHELVES

- Ice is not static. It flows like honey under the gravitational pull of its own weight.
- Ice flows from where it is stacked high in the center of the continent toward the edges. It moves off the land into the water forming thick floating sections called shelves.
- Resting in the ocean, ice shelves are thick aprons of floating ice that is still attached to the land.
- Ice shelves are deep, ~ 1 km thick where they first go afloat, thinning to several hundred meters at their front. ~90% is below water.
- The shelves are critical for the future stability of the Antarctic ice sheet, a barrier or buttress to hold back the continental ice sheet, slowing the flow from land into the ocean.
- Today ~ 45 ice shelves exist covering almost half the Antarctica coastline, representing an area of ~1.5 million km², or almost10 percent of Antarctica's total ice cover. In human history some have thinned and collapsed.

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ICEBERGS

- One major way that Antarctica sheds her ice is through the release of icebergs.
- Sections or slabs of ice collapse from the steep ice shelf fronts, or break off in large tabular slabs of ice like in this photo.
- The shedding of icebergs is a natural part of the ice system of Antarctica, and each section that breaks off is not a cause for alarm, but if more ice is lost through iceberg release and ice surface-melt than is added as new ice, the ice total for Antarctica will drop.
- Currently Antarctica is losing more ice than it is gaining, primarily because of loss in West Antarctica. The loss is from both iceberg releases and surface ice melt on the shelves, the result of both a warming ocean and atmosphere.

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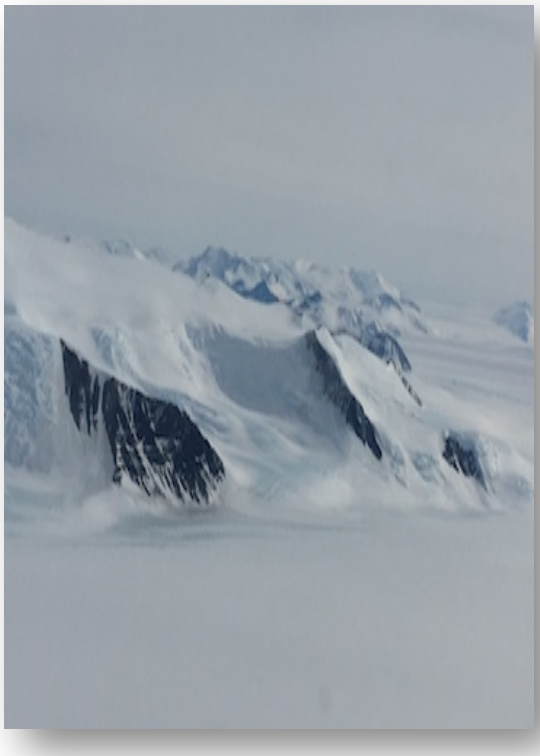
ICE SHEETS



- The vast majority of Antarctic ice is the large ice sheet that covers 98% of the continent.
- Ice Sheets are large expanses of land ice > 50,000 km^2 (about the size of Louisiana).
- In today's world we have ice sheets only on Greenland and Antarctica. Both are much larger than 50,000 km^2.
- Permanent land ice began to form in Antarctica some 34 million years ago and has collected through time growing to its current extent, and to a thickness of up to 4.8 kms (3 miles) in the deep interior.
- Antarctica's ice sheet is divided by the Transantarctic Mountains. Some call it two ice sheets, the East Antarctica Ice Sheet and the West Antarctic Ice Sheet.
- The high 'albedo' or reflectivity of the massive white expanse of ice reduces heat absorption not only in Antarctica but contributes to cooling the whole planet.

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Fimbul Ice Shelf
Riiser Larson Ice Shelf
New Schwabenland
Queen Maud Land
Enderby Land
Graham Land
Larsen Ice Shelf
Biscoe Islands
Palmer Land
Alexander Island
Fichner Ice Shelf
Berkner Island
Ronne Ice Shelf
Mac. Robertson Land
Amery Ice Shelf
American Highland
Ellsworth Land
South Pole
Antarctica
Abbot Ice Shelf
Dennas Ice Tongue
Shackleton Ice Shelf
Marie Byrd Land
Ross Ice Shelf
Roosevelt Island
Getz Ice Shelf
Wilkes Land