Lecture 15

GLY102

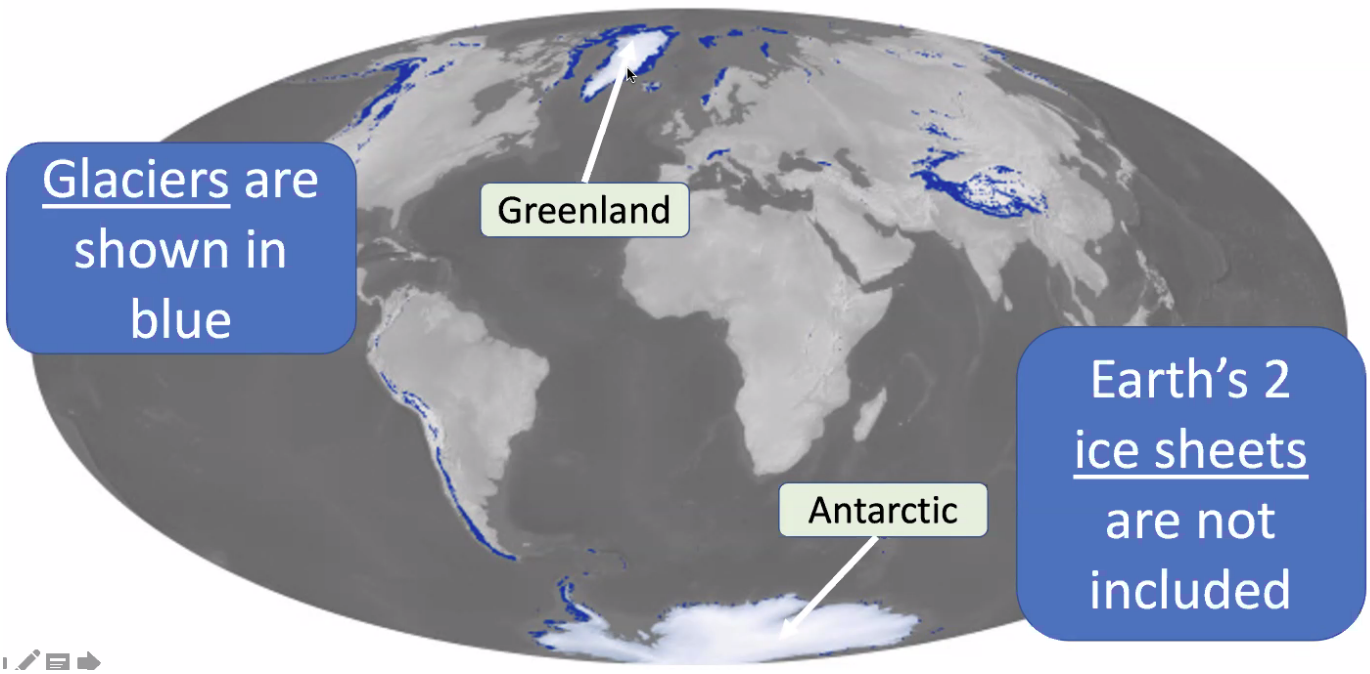
3/23/2021

Glaciers

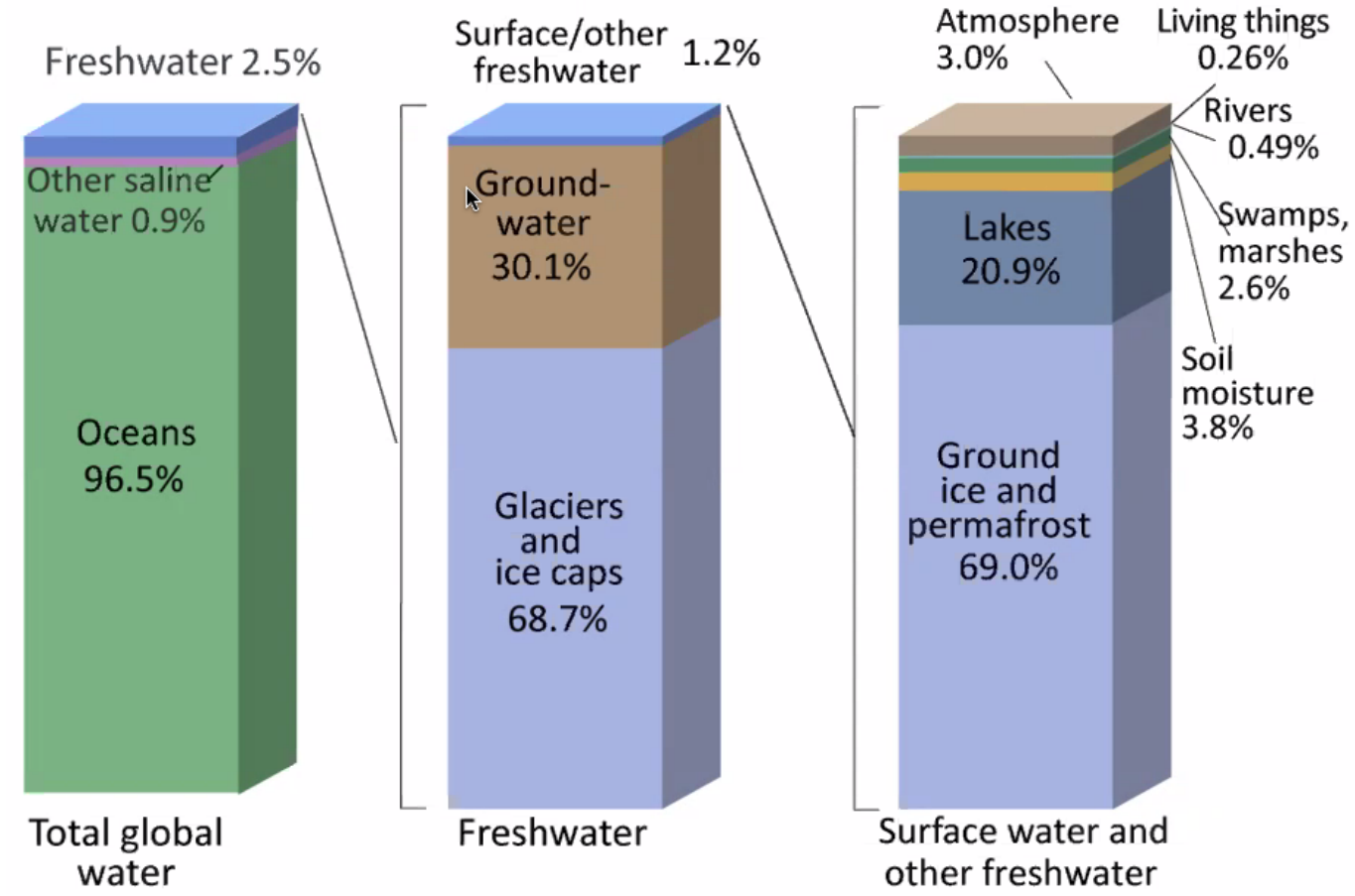
What is a glacier?

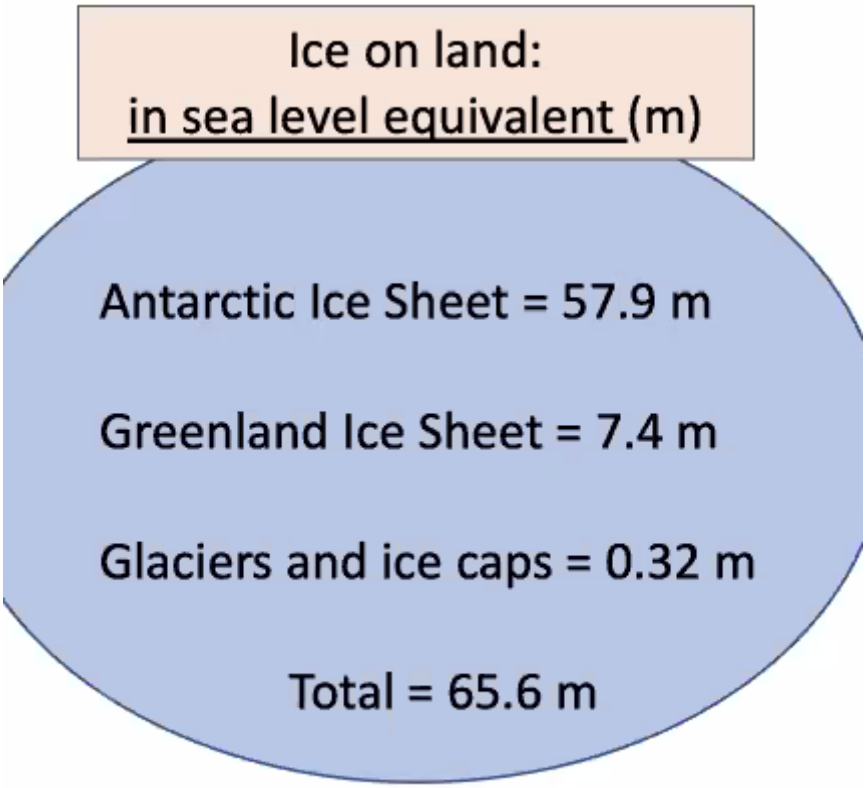
1. A glacier is made up of snow that, over many years, compresses into ice.
2. Glaciers form when snow remains in one location long enough to transform into ice.
3. What makes glaciers unique is their ability to flow due to the force of gravity.

Where are the glaciers?



Where is Earth's Water?

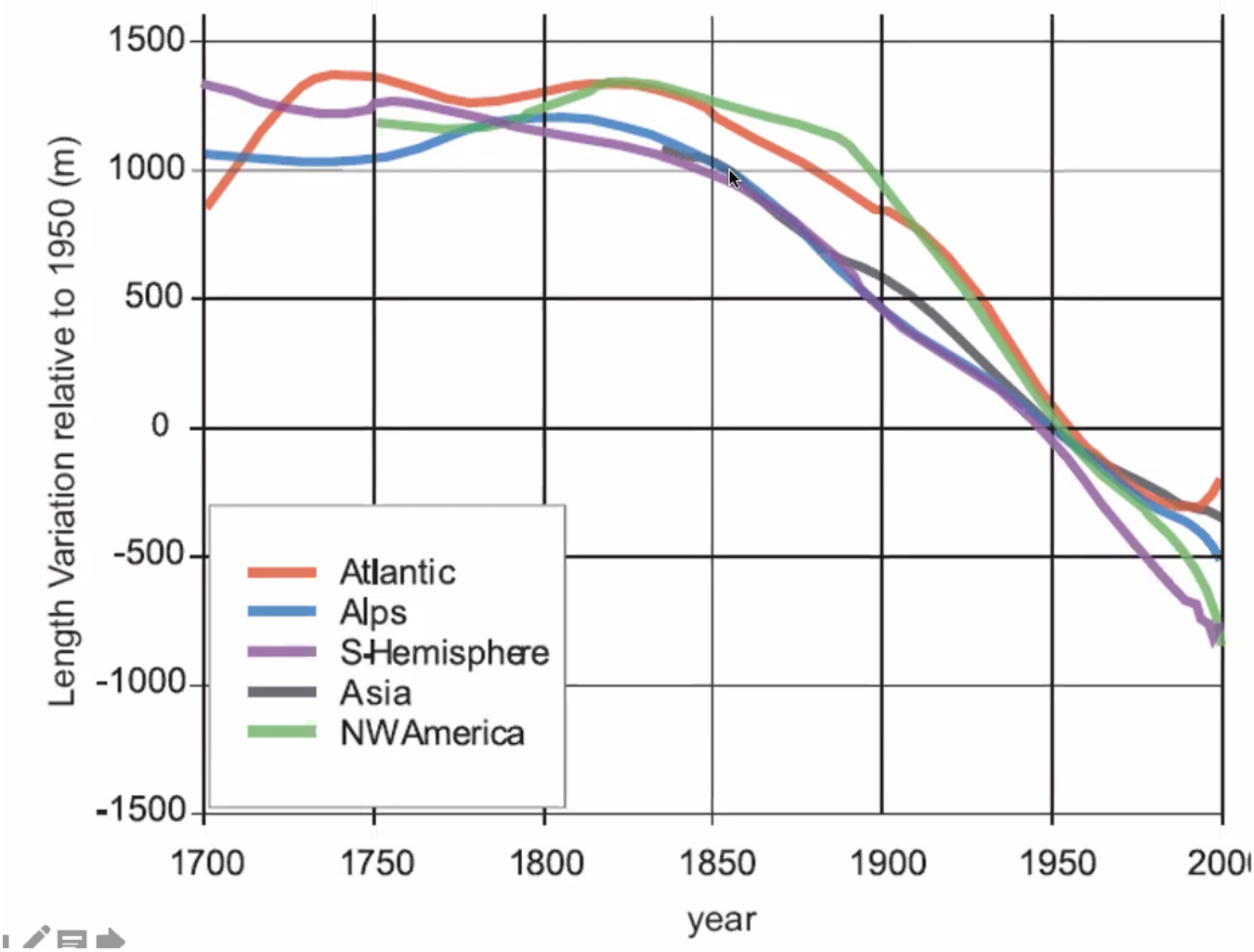




Ice on land in sea level equivalent (m)

- Antartic Ice Sheet = 57.9 m
- Greenland Ice Sheet = 7.4 m
- Glaciers and Ice Caps = 0.32 m
- Total = 65.5 m

If you take all of the glacier changes, and you normalize them together and study the length of the glaciers on average in the different areas, you'd get the following:



So glaciers everywhere are in retreat. They're getting shorter.

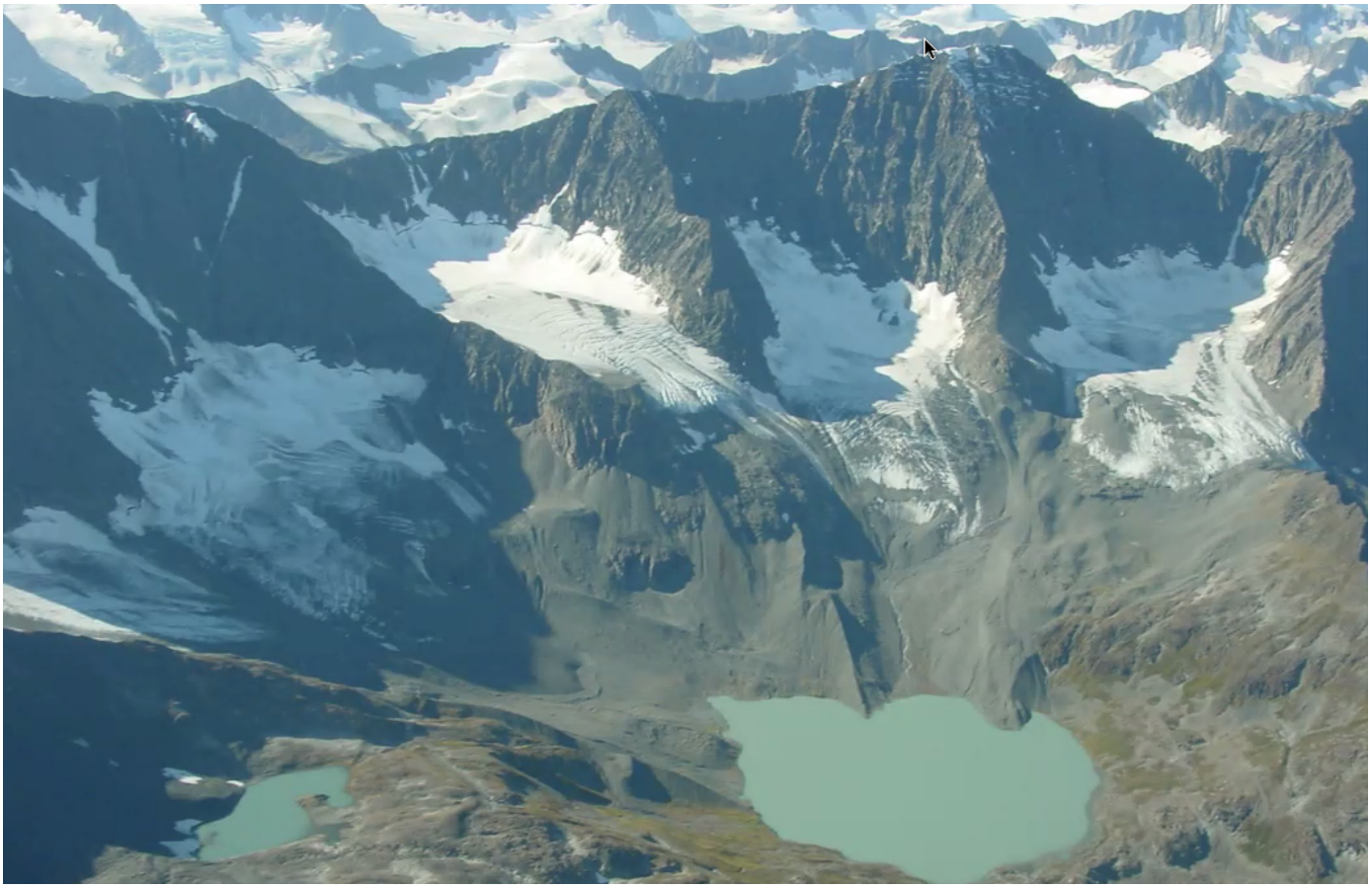
> **1850 --> Industrial Revolution**

There are a few exceptions:

- The Atlantic plot has a bit of an uptick.
  - This may be related to the local circulation phenomenon (cold blob)
  - There's a lot of room for variability in specific places even if, on average, the globe is getting warmer.

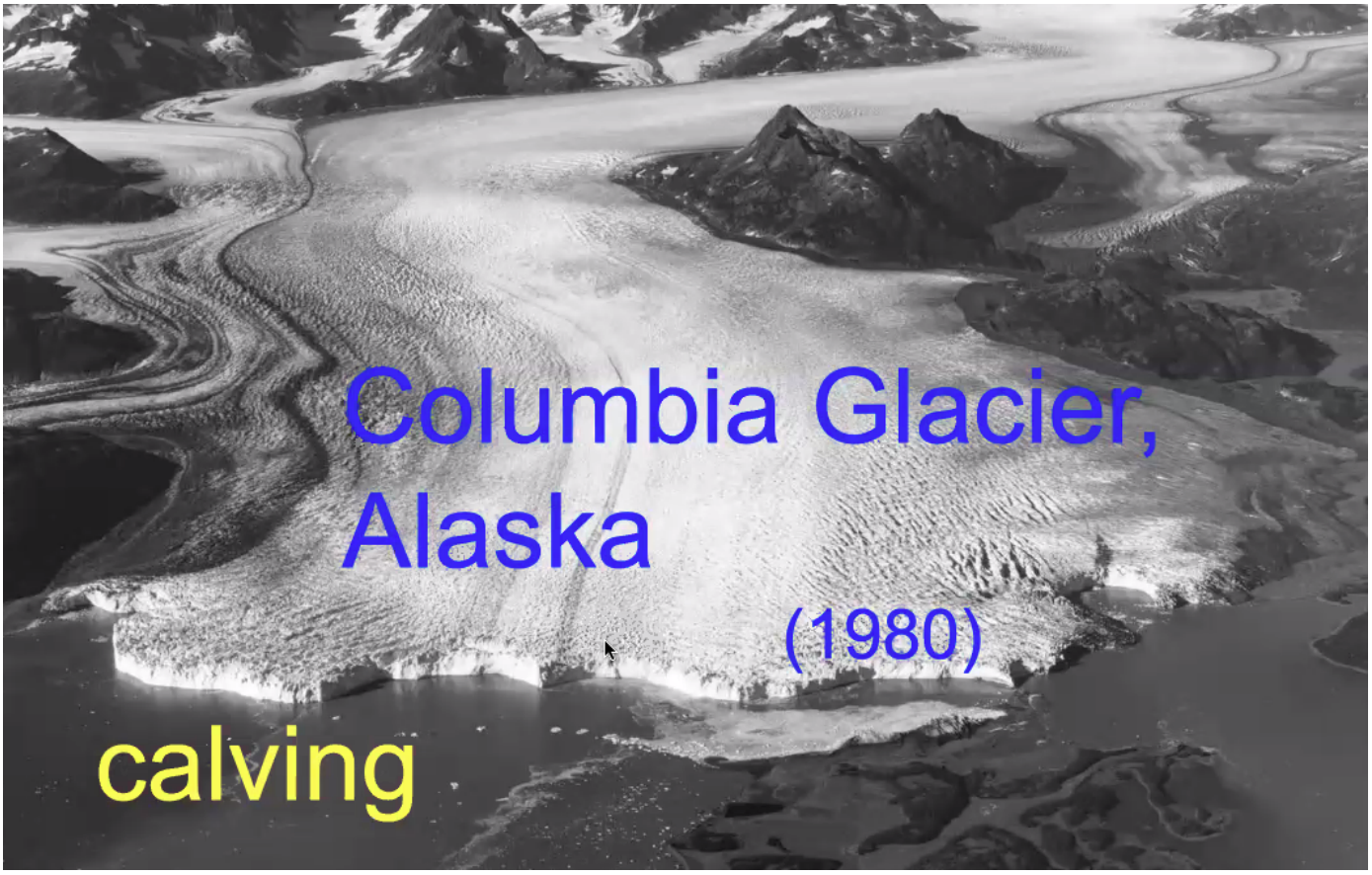
Classification of Glaciers

Cirque Glaciers - small glaciers that occupy cirques (small bowl-shaped depressions at mountain tops)



Valley Glaciers **- When cirque glaciers flow down valley, sometimes joining together, to form "long glaciers" flowing through valleys**

Calving Glaciers **- any glacier that flows into a lake or ocean, and breaks off (calves) into icebergs**



This one has been retreating since 1980 as seen below.

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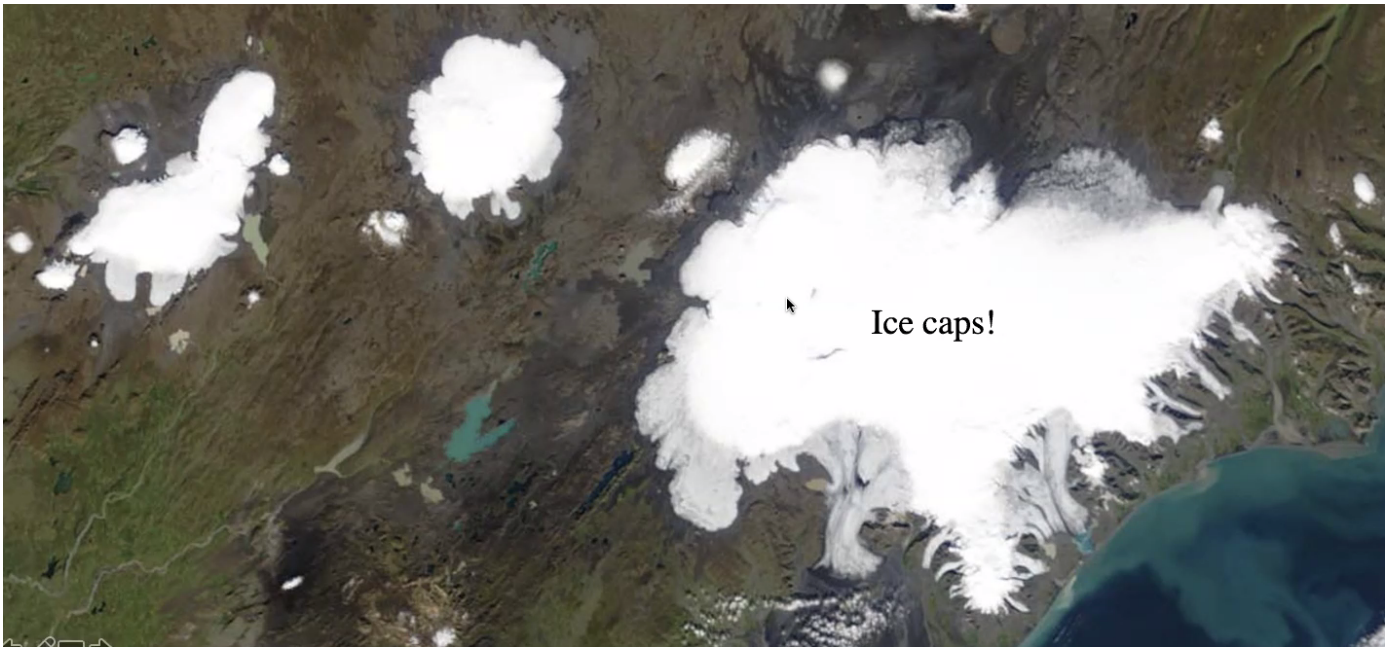
Ice Cap - when a glacier smothers topography (not confined by topography) and forms an upland dome of ice

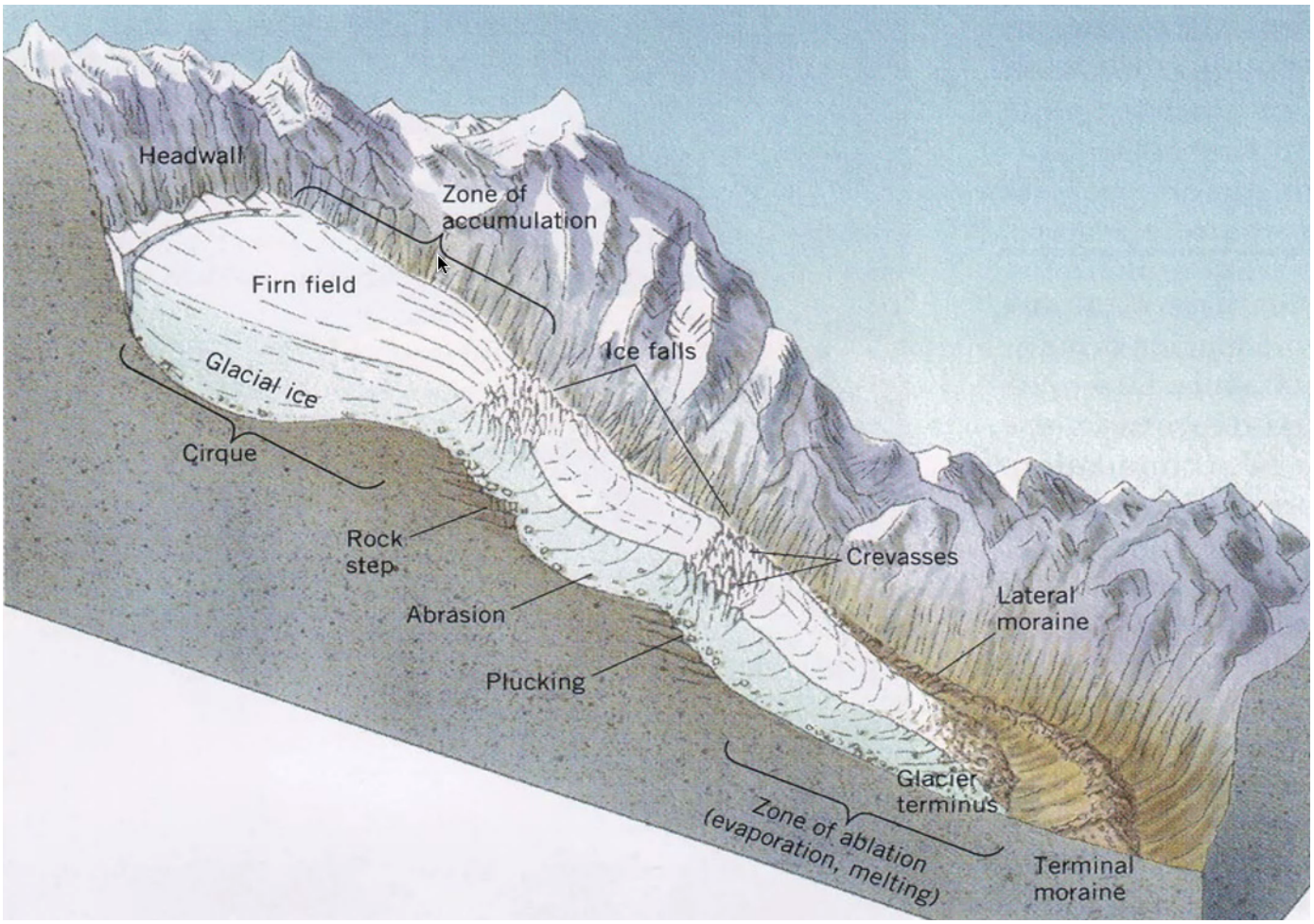
Ice caps "feed" valley glaciers

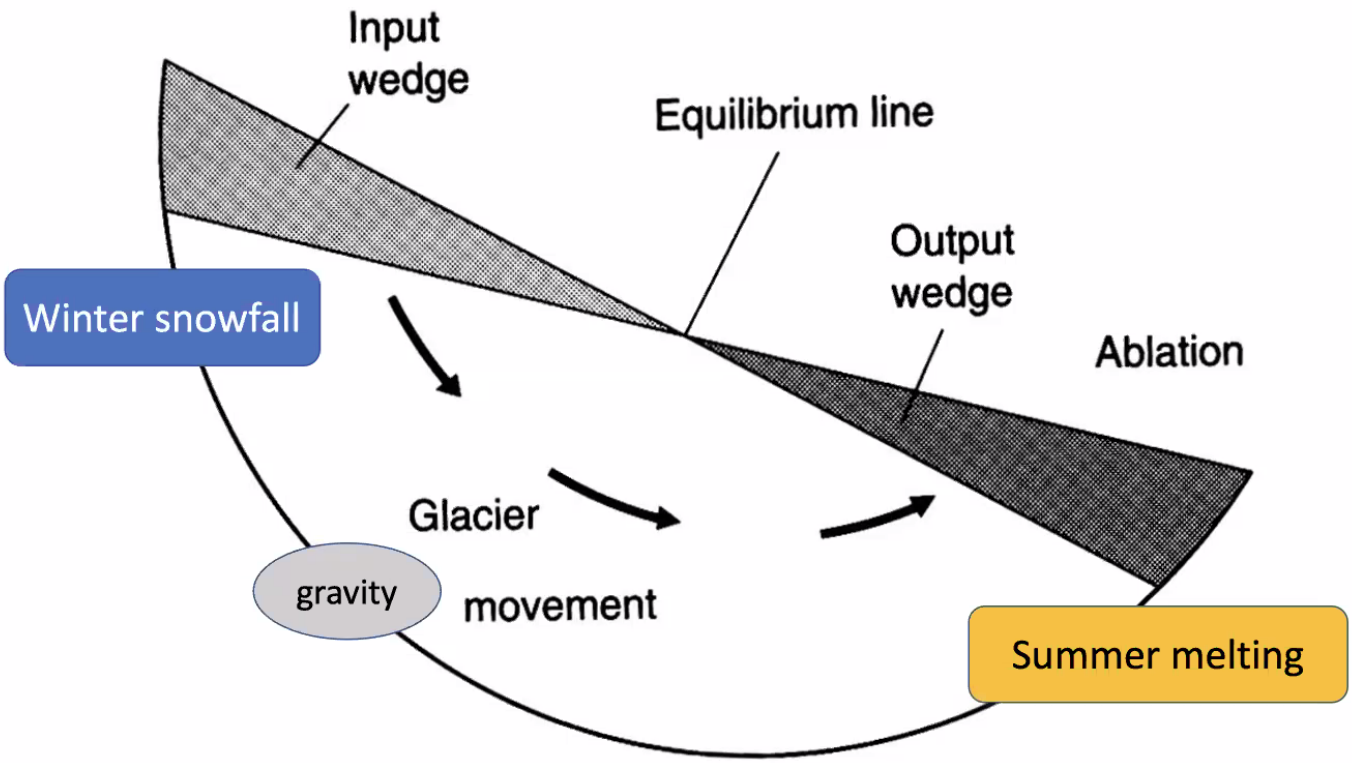


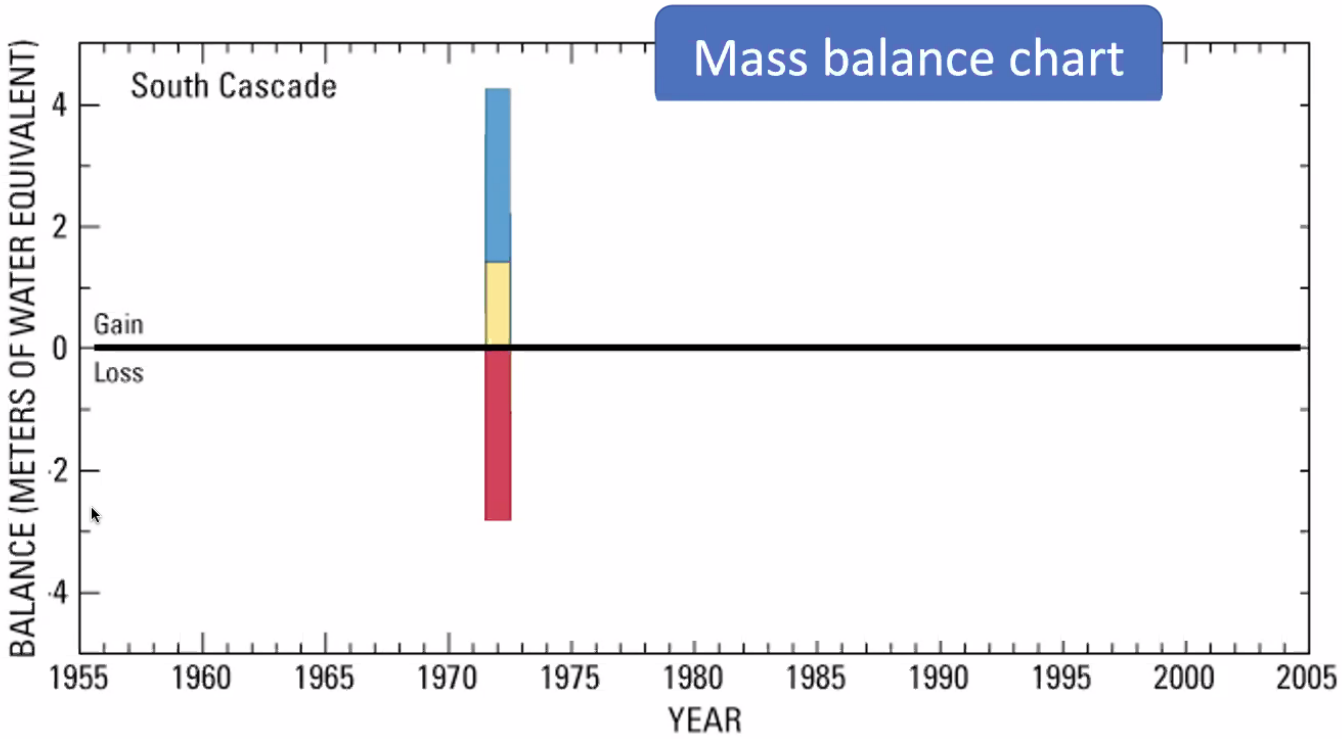
Mass balance (of a glacier)

All glaciers strike a *balance* between parts that accumulate snow (which turns into ice) and parts that experience net ice loss.

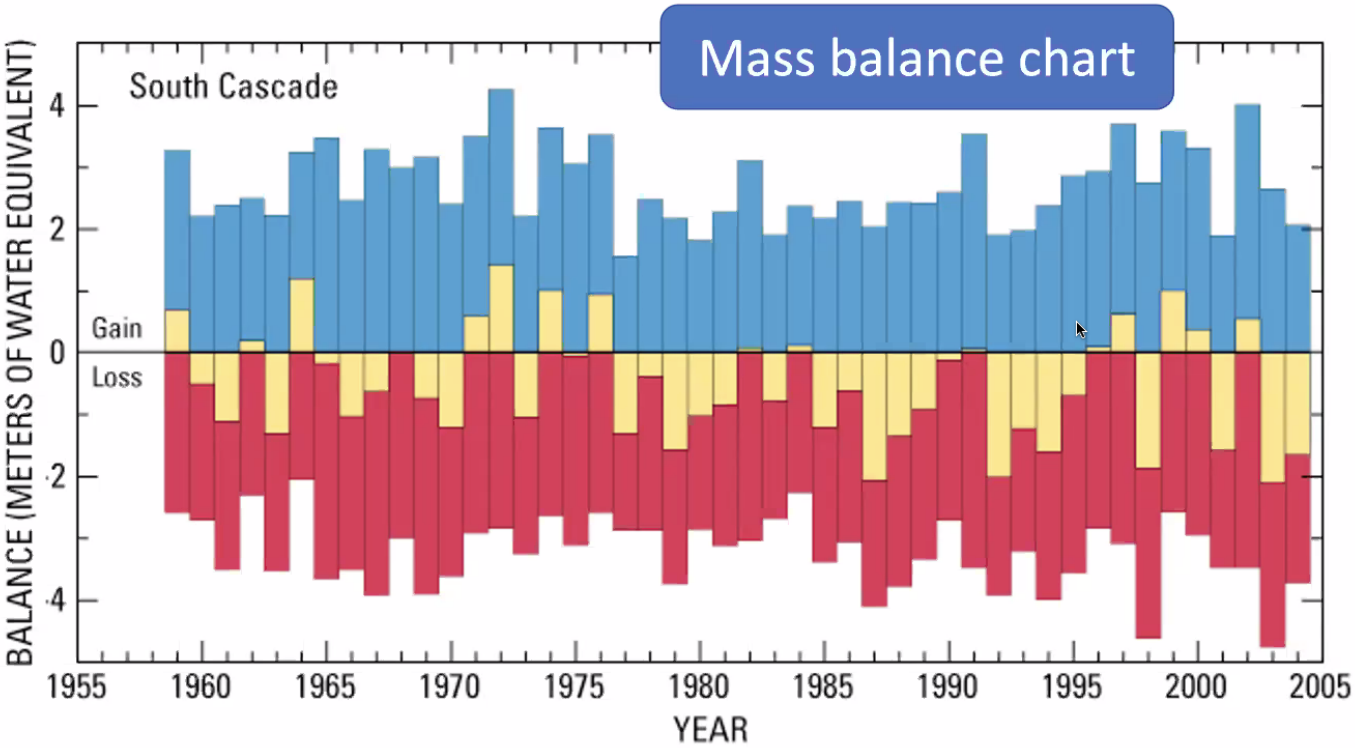
These zones are referred to as the “accumulation zone” and the “ablation zone”.







This is a "healthy" glacier because it still has a positive balance (yellow).



In reality, it's had quite a few healthy years but it's had several more unhealthy years. So, this glacier is likely *shrinking* in length.

Here are some pictures of this glacier's change:
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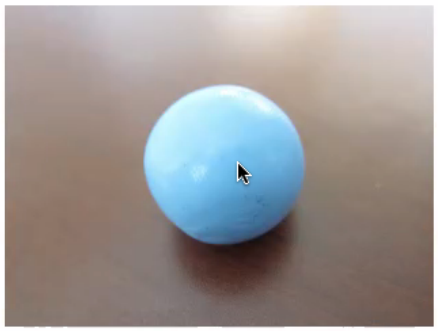
Glacier flow

Glaciers move via two mechanisms:

1. Internal deformation, like silly putty



2. Sliding at their base
    - Sliding causes *abrasion*, which leaves these scratches called *striations*

      Screen Shot 2021-03-23 at 1.51.55 PM.png

      
    - "The Earth's surface is sort of like a brake pad for the glaciers."
    - If the stratching agent is fine particles, then this leads to *glacial polish*.
    - This happens when there is no water at the bed of the glacier...

Glacier Plumbing

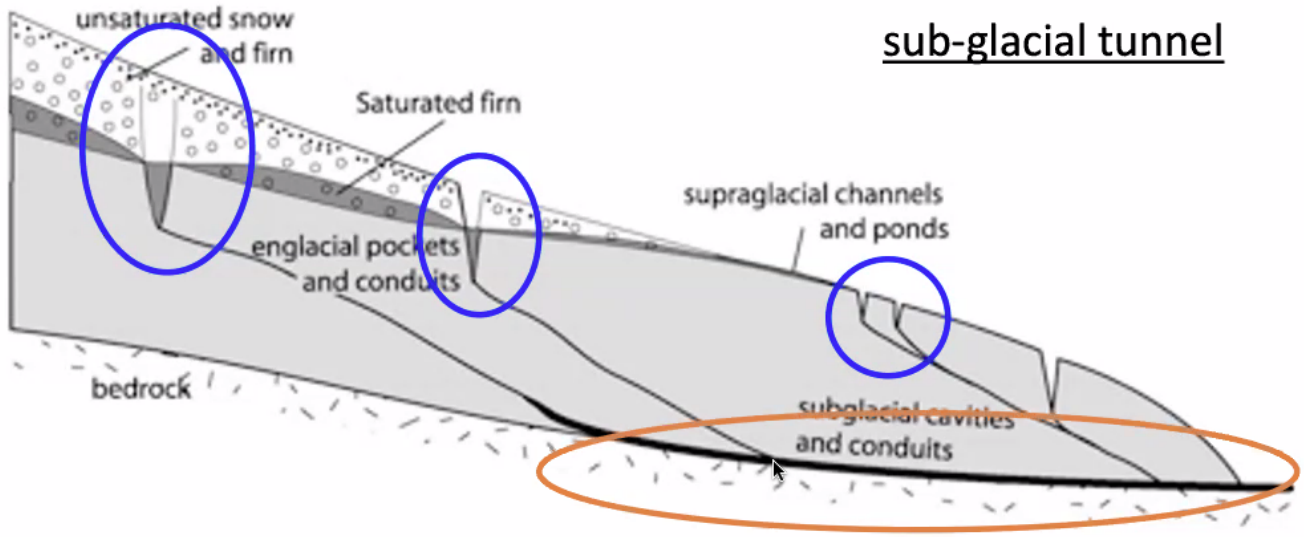
Glaciers can have rivers or lakes on top:

A *moulin* is the hole that surface water falls into. It is a pipe that carries the water to the glacier bed.

Sub-glacial Tunnels!

moulins

sub-glacial tunnel



This water “lubricates” the bed, allowing it to flow a bit faster.

> **Given global temperature increase, how might glacier flow change?**
> The melt water may speed up the glacier even more and cause it to rise the sea level even quicker.