Glaciers

About

- A glacier is a large, **perennial accumulation of crystalline ice, snow, rock, sediment,** and **water** that originates on land and moves down slope under the influence of its own weight and gravity. They are **sensitive indicators of changing climate.**
- Out of total water on Earth, **2.1% is in glaciers while 97.2% is in the oceans** and inland seas.
- **Condition of glacier formation:**
    - **Mean annual temperatures** are close to the freezing point.
    - **Winter precipitation** produces significant accumulations of snow.
    - **Temperatures throughout the rest of the year** do not result in the complete loss of the previous winter's snow accumulation.

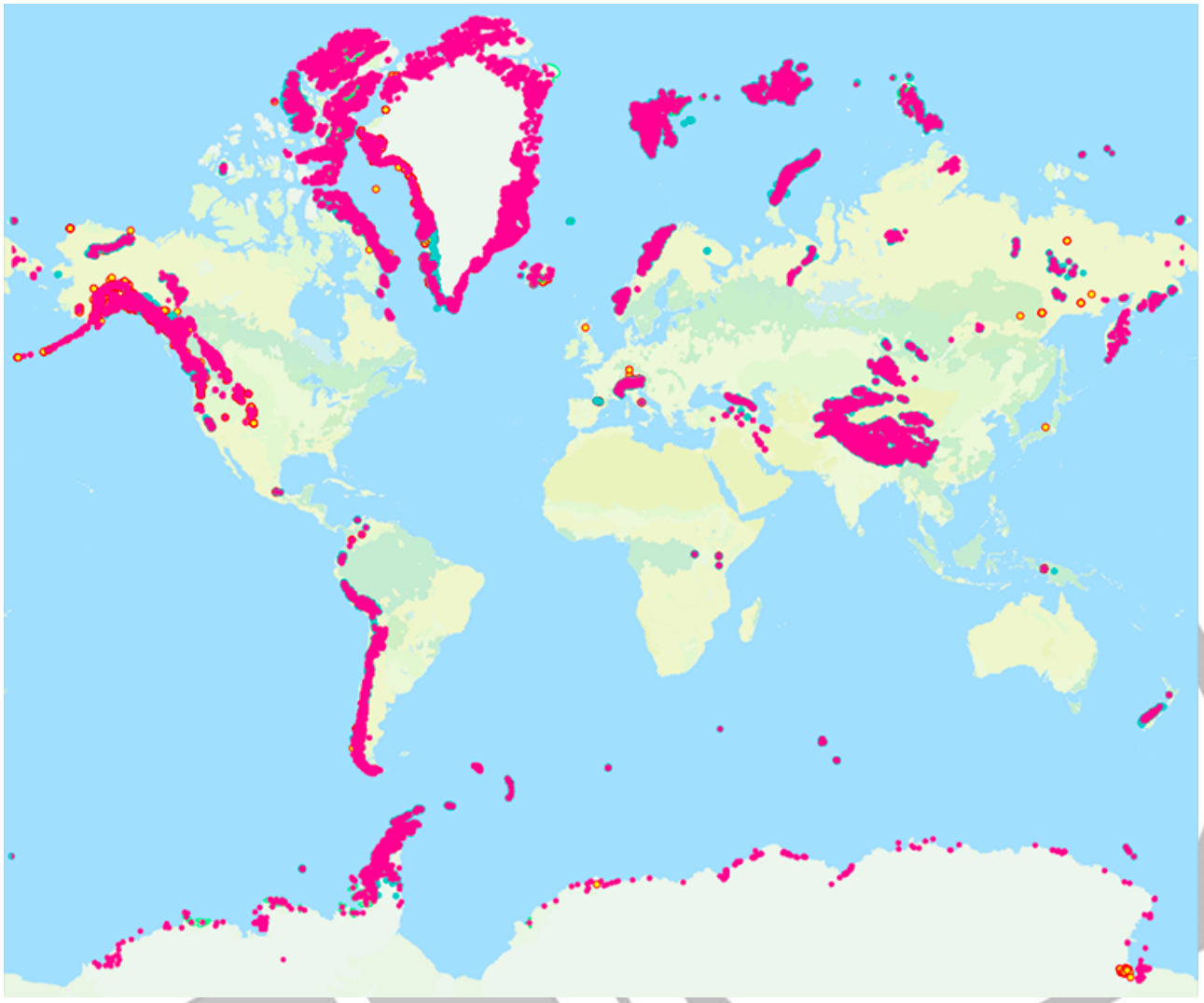
Formation of Glacier

- Glaciers begin forming in places where more snow piles up each year than melts. Soon after falling, the snow begins to compress, or become denser and tightly packed.
    - The process of snow compacting into glacial firn (dense, grainy ice) is called **firnification**.
- When the ice grows thick enough, about 50 meters (160 feet), the firn grains fuse into a huge mass of solid ice. The glacier begins to move under its own weight.
    - Different parts of a glacier move at different speeds. The flowing ice in the middle of the glacier moves faster than the base.

Geographical Location

- **91%** of the Glaciers are in **Antarctica** and **8%** are in **Greenland.** They occupy about 10% of the world's total land area.

//



Significance:

- **Glaciers as Reservoirs:** About **three-quarters** of Earth's freshwater is stored in glaciers. Therefore, glacier ice is the **second largest reservoir of water** on Earth and the **largest reservoir of freshwater** on Earth.
    - The cold runoff from glaciers also affects downstream water temperatures.
- **Glaciers feeding Rivers:** The **Gangotri Glacier**, one of the largest glaciers in the Himalayan Mountains, is **the source of the Ganga River**.
    - The Ganges is the most important source of freshwater and electricity in India and Bangladesh.
- **Glaciers for Aquatic Life:** Many **aquatic species in mountainous environments** require cold water temperatures to survive which is provided by Glaciers.
    - Some **aquatic insects** are **especially sensitive to stream temperature** and cannot survive without the cooling effects of glacial meltwater.
    - Such changes in stream habitat may also **adversely impact native trout** and other **keystone salmon species.**
- **Glaciers for People:** Glaciers provide people with many useful resources. Glacial till **provides fertile soil for growing crops**.
    - Deposits of sand and gravel are used to make **concrete and asphalt**.

Classification of Glaciers

- Glaciers can be classified according to their:
    - **Size** (i.e. ice sheet, ice cap, valley glacier, cirque glacier)
    - **Thermal regime** (polar vs. temperate).

Size Based

- **Ice Cap:** An ice cap is a dome-shaped glacier mass flowing in all directions, such as the ice cap on Ellesmere Island in the Canadian Arctic.
    - There is still some **uncertainty about the full volume of glaciers and ice caps** on Earth, but if all of them were to melt, **global sea level would rise approximately 70 meters** (approximately 230 feet), flooding every coastal city on the planet.
- **Valley Glaciers:** Also called **Alpine Glaciers** or **Mountain Glaciers**, they form on mountainsides and move downward through valleys.
    - They are **found in high mountains of every continent except Australia** (although there are many in New Zealand).
        - Example: The **Gorner Glacier in Switzerland** and the **Furtwangler Glacier in Tanzania**.
- **Ice Sheets:** Unlike valley glaciers, ice sheets are not limited to mountainous areas. They form broad domes and spread out from their centers in all directions.
    - As ice sheets spread, they cover everything around them with a thick blanket of ice, including valleys, plains, and even entire mountains.
    - The largest ice sheets, called **continental glaciers**, spread over vast areas.
        - Continental glaciers **cover most of Antarctica and the island of Greenland**.
- **Cirque glaciers:** They are short and wide, are confined to cirques, or amphitheatres, cut in the mountain landscape.

Thermal Regime based:

- **Polar Glacier:** A polar glacier is defined as one that is below the freezing temperature throughout its mass for the entire year.
    - A subpolar glacier contains ice below the freezing temperature, except for surface melting in the summer and a basal layer of temperate ice.
- **Temperate Glacier:** A temperate glacier is the one that's **essentially at the melting point**, so liquid water coexists with glacier ice.
    - They are found in North America, South America, Europe, Africa, and **Asia** and **New Zealand.**
        - Some of the **Antarctic glaciers** and **Greenland's southern outlet glaciers** are temperate.

Landforms Formed

Erosional Landforms

- **Glacial Valleys/Troughs:** These valleys are **trough-like and U-shaped** with broad floors and relatively smooth, and steep sides.
    - The valleys may contain littered debris or debris shaped as **moraines** with swampy appearance.

    - Very deep glacial troughs filled with sea water and making up shorelines (in high latitudes) are called **fjords/fiords.**
- **Cirques:** Often are found at the heads of glacial valleys, these are the most common of landforms in glaciated mountains.
    - They are **deep, long and wide troughs** or basins with very steep concave to vertically dropping high walls at its head as well as sides.
    - A lake of water can be seen quite often within the cirques after the glacier disappears. Such lakes are called **cirque lakes or tarn lakes.**
- **Horns and Serrated:** Ridges Horns form through headward erosion of the cirque walls.
    - If three or more radiating glaciers cut headward until their cirques meet, high, sharp pointed and steep sided peaks called horns form.

Depositional Landforms:

- **Glacial Till:** The unassorted coarse and fine debris dropped by the melting glaciers is called glacial till.
    - Some amount of rock debris small enough to be carried by such melt-water streams is washed down and deposited.
        - Such glaciofluvial deposits are called **outwash deposits**.
        - The outwash deposits are roughly stratified and assorted.
- **Moraines:** They are **long ridges of deposits of glacial till.**
    - **Terminal moraines** are long ridges of debris deposited at the end (toe) of the glaciers.
    - Lateral moraines form along the sides parallel to the glacial valleys.
    - Many valley glaciers retreating rapidly leave an irregular sheet of till over their valley floors called **ground moraines.**
    - The moraine in the centre of the glacial valley flanked by lateral moraines is called **medial moraine.**
        - They are imperfectly formed as compared to lateral moraines. Sometimes medial moraines are indistinguishable from ground moraines.
- **Eskers:** These are ridges made of sands and gravels, deposited by glacial meltwater flowing through tunnels within and underneath glaciers, or through meltwater channels on top of glaciers.
    - Over time, the channel or tunnel gets filled up with sediments. As the ice retreats, the sediments are left behind as a ridge in the landscape.
- **Drumlins:** They are **smooth oval shaped ridge-like features** composed mainly of glacial till with some masses of gravel and sand.
    - The long axes of drumlins are parallel to the direction of ice movement.
    - They may measure up to 1 km in length and 30 m or so in height.
    - The drumlin end facing the glacier is called the stoss end and is blunter and steeper than the other end called tail.