Research project

Why Does Greenland Appear Larger On Maps Than It Actually Is?

Step 1: Introduction

When we look at a map, “Greenland” looks really big. But when we look at an earth globe, it seems much smaller. I want to figure out why this happens and understand why maps sometimes show things differently from what they really are.

Step 2: Theory Research Notes

1. *Where and How is Greenland ?*

   Greenland is a territory of **Denmark** right now.

   It is the world’s largest island with an area of **836,330 square miles.**

   Greenland is covered by **ice and snow** with a very cold climate.

   It is **adjacent to Canada**, **located in the Arctic Circle mainly.**

2. *Find easy tools to identify Greenland*

   A globe (a ball that illustrates the world)

   A flat map from my elementary school's library

   A school chromebook connected to internet for searching

   An orange

   Crayons, pencil, ruler and A4 papers for drawing

3. *Look at the Globe*

   We found a white area in the arctic part of the globe.

   The area labeled with "Greenland" has a capital named Nuuk.

   We find that the area of Greenland is smaller than the east part of the United States from the Mississippi river.

   Compared with Africa and South America, the area of Greenland is even smaller.

4. *Look at the Flat Map*

When we look at the flat map, Greenland looks really big, bigger than the United States, South America and even Africa. Actually, this is not true.

United States: 3,796,742 square miles

South America: 6,878,706 square miles

Africa: 11,730,000 square miles

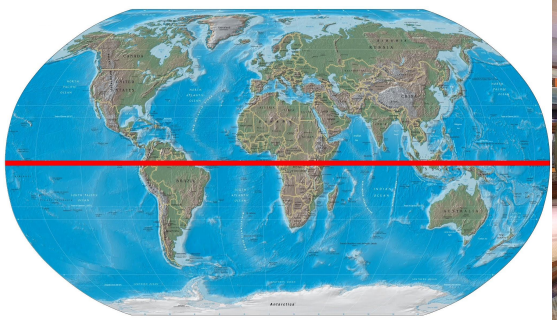
5. *What happened to Greenland?*

   The size of Greenland may be stretched?

   Because we look at it from different angles, the difference between global and flat maps is the reason.

6. *Global and flat map, which one deceives us?*

   As a matter of common sense, the earth is like soccer. Compared to the globe, a flat map is more likely to give us some kind of illusion.



7. *Let's focus on the Map*

I searched the definition of Map on the wikipedia.

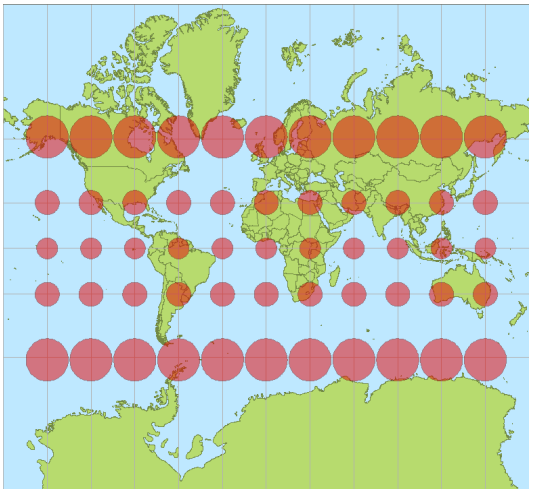
Geographic maps use a projection to translate the three-dimensional real surface of the geoid to a two-dimensional picture.

one dimensional stuff: a straight line

two dimensional stuff: a rectangle on a paper, a little man on a paper, a flat map of the world

three dimensional stuff: a ball, earth, sun, planet, a earth globe

One of the most important projection methods is **Mercator Projection.** It was used to draw most of the World Maps.

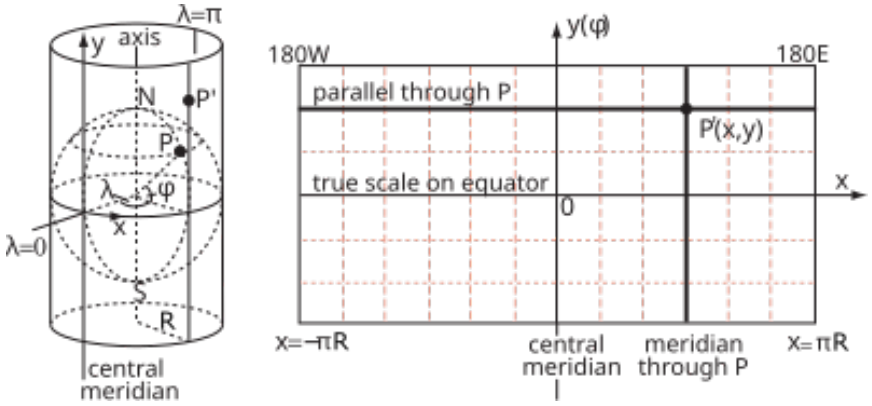


8. *We found the key point*

The **Mercator projection** is a conformal cylindrical map projection first presented by Flemish geographer and mapmaker Gerardus Mercator in 1569.

When applied to world maps, the Mercator projection **inflates the size of lands the further they are from the equator.** Therefore, landmasses such as Greenland and Antarctica appear far larger than they actually are relative to landmasses near the equator.

Mercator projection uses **complex mathematical transformations** to convert three dimensional earth to a two dimensional flap.



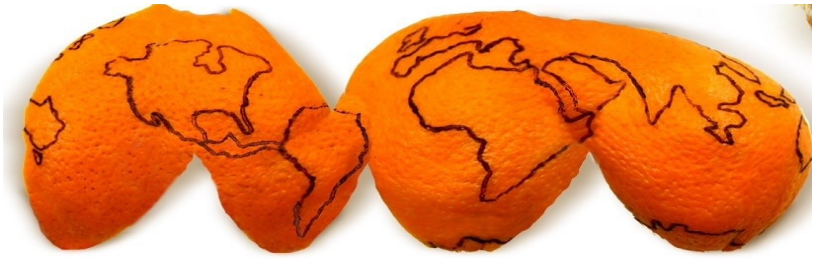
9. *We simulate the Mercator Projection*

Peel the Orange

Mark the Equator and Poles

Divide the Orange into Latitude Lines

Simulate the Projection

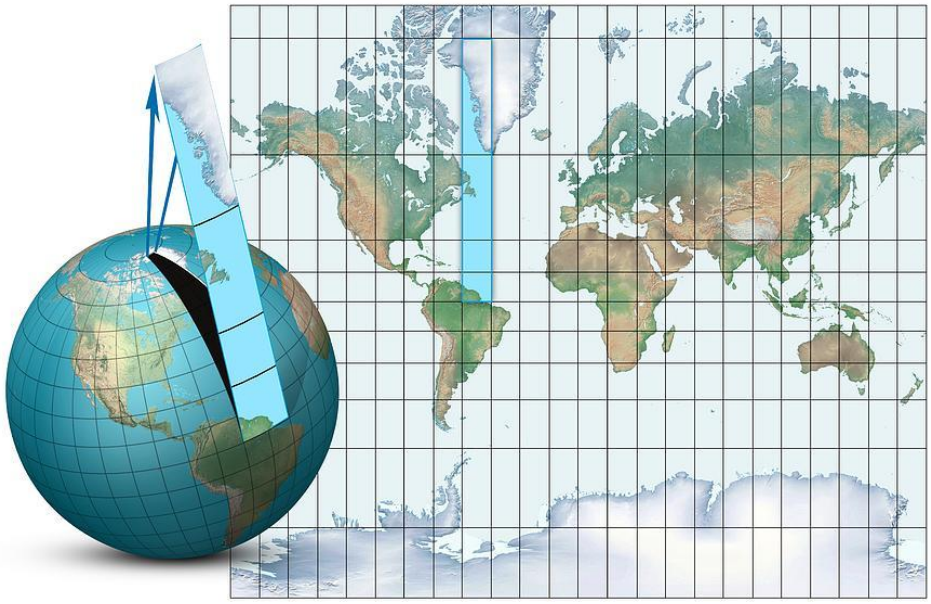


10. *What we found?*

On the globe, an area like a triangle was stretched to a rectangle.

The closer to the North Pole, the more the map was stretched.

Greenland is very close to the North Pole, So it was stretched a lot on a flat map.



Step 3: Using mathematics for analysis

1. *We want to know how much Greenland is enlarged?*

   We know that the area near the equator is not enlarged, we find a country near the equator which is about the same size as greenland. We search the list of countries and dependencies by area. The Democratic Republic of the Congo is about 905,000 square miles slightly bigger than Greenland.

2. *Math principles*

   In the Mercator projection, the size of an object gets stretched more the farther it is from the equator. The amount of stretching depends on the latitude. The "scale factor" that blows up the size is related to the secant of the latitude.

   At the equator (latitude = 0°), the cosine of 0° is 1, so the secant is 1 ÷ 1 = 1. No stretching.

   At 60° latitude (Greenland's southern tip), the cosine of 60° is 0.5, so the secant is 1 ÷ 0.5 = 2. That means the width and height are each doubled, and the area gets multiplied by 2 × 2 = 4 times.

   At 80° latitude (Greenland's northern edge), the cosine of 80° is about 0.174, so the secant is 1 ÷ 0.174 ≈ 5.75. Area gets stretched by 5.75 × 5.75 ≈ 33 times.

3. *Comparing Greenland and DRC*

   Greenland's average latitude is roughly 70°. Cosine of 70° is about 0.342, so secant is 1 ÷ 0.342 ≈ 2.92. Area stretches by 2.92 × 2.92 ≈ 8.5 times.

   So, on a Mercator map:

DRC looks like 905,000 square miles (close to real size). Greenland looks like 836,000 × 8.5 ≈ 7,106,000 square miles.

Step 4: Conclusion

A thing is often not what it appears to be. There must be a law behind it. That's about science.

Bibliography:

1. *Wikipedia website: https://www.wikipedia.org/*
2. *Saint Louis County Library https://www.slcl.org/*
3. Laminated World Map & US Map Poster Set - 18" x 29" - Wall Chart Maps of the World