<u>Mercator projection</u>

Mercator projection

The **Mercator projection** is a cylindrical map **projection** presented by the Flemish geographer and cartographer Gerardus **Mercator** in 1569. It became the standard map **projection** for navigation because of its unique property of representing any course of constant bearing as a straight segment. Such a course, known as a rhumb or, mathematically, a loxodrome, is preferred by navigators because the ship can sail in a constant compass direction to reach its destination, eliminating difficult and error-prone course corrections.

<u>History</u>

During the sixteenth century information on trade routes and geography was constantly increasing.For this reason, navigators, explorers and merchants needed more accurate maps. Thus the cartographer and geographer Gerardus Mercator (1512-1594) decided to develop the cylindrical projection that bears his name.

Principles:

i. This is cylindrical orthomorphic projection designed by Flemish, Mercator and Wright.

ii. In this, a simple right circular cylinder touches the globe along the equator.

iii. All the parallels are of the same length equal to that of the equator and the meridians are equispaced on the parallels.

iv. Therefore, the tangential scale increases infinitely toward the pole.

v. To maintain the property off orthomorphism, the radial scale is made equal to the tangential scale at any point. Hence, parallels are variably spaced on the meridians and the poles can never be represented.

vi. The parallels and meridians are represented by sets of straight lines intersecting at right angles.

Properties

i. Parallels are represented by a set of parallel straight lines.

ii. All parallels are of the same length as the equator.

iii. Parallels are variably spaced on a meridian; interparallel distance increases away from the equator.

iv. The poles cannot be represented in this projection.

v. Meridians are represented by a set of parallel straight lines truly spaced on the equator only.

vi. Meridians are equispaced on all the parallels and they are of equal dimension as well.

vii Parallels and meridians intersect each other at right angles.

viii. On the map, the radial and the tangential scales are identical at all points.

ix. It is an orthomorphic projection.

x. Direction being preserved in this net, any straight line drawn on this projection intersects the parallels at constant angles and

Advantages of Mercator projection

1- Explore the world

Before Mercator's projection, there were already maps showing the full extent of planet Earth.

However, this was the first that provided people with the means to explore and navigate across the seas. Mainly, this projection is useful for tracing routes with a steady course in a straight line.

In addition to creating a projection, Mercator published a geometric formula that corrected the distortion presented on its map. These calculations enabled seafarers to transform projection measurements into degrees of latitude by facilitating navigation.

Like any flat rendering of the Earth, Mercator's projection presents distortion. The globe is the only true representation of the earth's surface.

In spite of this, the fact that these are so small makes them impractical for navigation. For this reason, the projection of Mercator is still preferred.

2- Calculations of this projection are simpler than those of other projections

The mathematics behind the Mercator projection are much simpler than other projections today. For this reason, online mapping services prefer its use.

The applications of Google Maps, Bing Maps and Open Street Maps are based on Mercator projection.

3- Keep the scales

The projection of Mercator is proportional. This means that to compensate for the north-south distortion (from pole to pole), an east-west distortion is also introduced.

Other projections can make a square building look rectangular, because the distortion exists in only one direction.

On the other hand, because it is proportional, the distortion generated by Mercator does not make the objects appear more elongated or flattened, but simply larger.

This is another reason why the cartography web services use this type of projection and not others.

4- Angles are represented correctly

The projection of Mercator has the property of representing the angles as they are. If in the real plane there is an angle of 90 ° the projection will show an angle of the same amplitude.

This is another reason why Google Maps and other similar applications prefer Mercator before other projections.

Disadvantages

1- Distortion of the Earth's surface

As Mercator's projection moves away from the equator, the representation of the Earth's surface is distorted. This distortion makes the shapes found at the poles look bigger than they really are.

Mercator's projection shows that Greenland is the size of Africa, that Alaska is larger than Brazil and that Antarctica is an infinite expanse of ice.

In fact, Greenland is the size of Mexico, the territory of Alaska is 1/5 that of Brazil and Antarctica is a little larger than Canada.

As a result, business charts for educational purposes often do not employ Mercator projection, so as not to create problems in the student learning process. However, they are still used in the representation of areas near Ecuador.

2- Polar zones are not represented

Because the projection of Mercator is based on a cylinder, it is difficult to represent the polar zones of the planet Earth. For this reason, the poles are not included in this type of cartographic projection.

Examples of Mercator projection

One of the best examples of Mercator projection is Google Maps. This is a global positioning software developed in 2005.

Bing Maps and Open Street Maps are other of the cartography web services that use the projection of Mercator.

Loxodromes:

A speciality of Mercator's projection is that if a straight line is drawn anywhere on the map, it makes equal angles with all the meridians. This results in a line of constant bearing which is known as a Loxodrome or Rhumb line. This line always represents a true direction. This fact is of great use to navigators at sea, for if the line is followed then there is no need for always changing direction. It results from the following two facts: (a) parallels of lat.- itude and meridians intersect at right angles, and (b) the vertical and horizontal scales are equally distorted at each point.

Construction:

i. A straight line is drawn horizontally through thecentre of the paper to represent the equator.

ii. It is then divided by d for spacing the meridians.

iii. Through each of these division points, straight lines are drawn perpendicular to the equator to represent the meridians.

iv. On the central meridian, heights of different parallels ($y\phi$) from the equator are marked.

v. Through each of these points, straight lines are drawn perpendicular to the central meridian to represent the parallels.

vi. The graticules are then properly labeled.

a. Theory:

i. Radius of the generating globe reduce to the given Scale.

$$\mathrm{R} = \frac{Radius\ of\ the\ actual\ Earth}{Denominator\ of\ \ R.F}$$

ii. The height of any parallel(∅) above the equation,

$$y\phi = 2.3026\ \mathrm{R} \log \tan\left(\frac{90° + \emptyset}{2}\right)$$

iii. The division on the equator for spacing the meridians at i° interval.

$$\mathrm{d} = \frac{2\pi\mathrm{R}}{360°} \times\ i°$$

Q. Draw the Graticules of M Mercator's Projection for the map of whole world at an interval of 20° on a scale of 1:200000000

Ans:

Step -1: Radius of the generating globe reduce to the given Scale.

$$\text{R} = \frac{Radius\ of\ the\ actual\ Earth}{Denominator\ of\ R.F}$$

$$= \frac{640000000}{200000000}$$

= 3.2 cm.

Step-2: Selected Parallels are- **0°**, 20°N/S, 20°N/S, 60°N/S, 80°N/S
Standard Parallel is - 0°

Step-3: Meridians to be drawn- **0°**, 20°E/W, 40°E/W, 60°E/W, 80°E/W, 100°E/W, 120°E/W, 140°E/W, 160°E/W, 180°

Step-4 : Divisional length along the equator for spacing the meridians at 20° interval-

$$\text{d} = \frac{2\pi \text{R}}{360°} \times i°$$

$$= \frac{2\times 3.14\times 3.2}{360°} \times 20°$$

= 1.12cm.

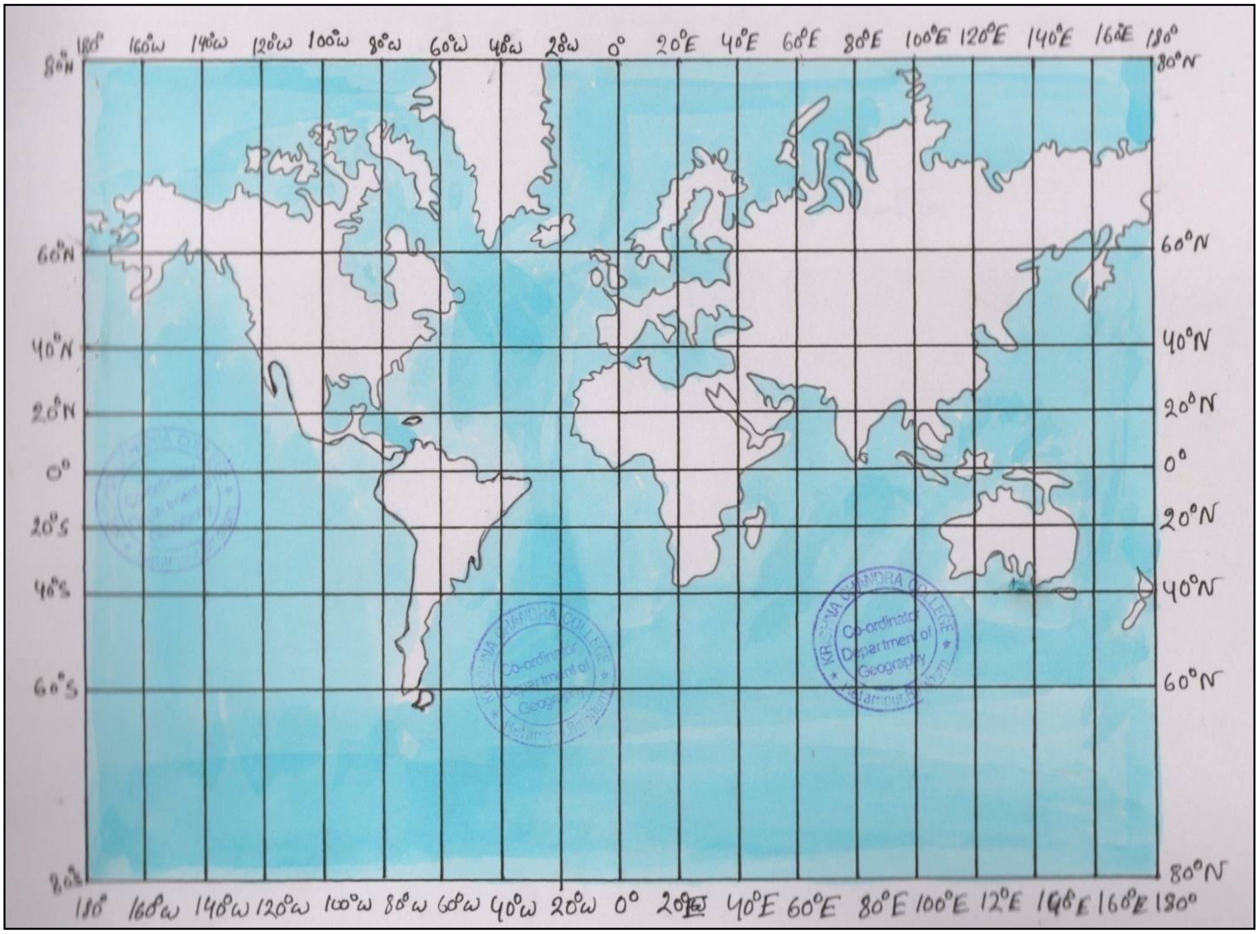
Step-5 : The Length of any parallel above the equator

Ɵ N/S / $y\phi$	**20°**	**40°**	**60°**	**80°**
$y\emptyset = 2.3026\ \text{R} \log \tan\left(\frac{90° + \emptyset}{2}\right)$	1.401	2.4413	4.214	7.7960

MERCATOR'S PROJECTION

Showing the Map of World

EXTENSION
Latitude-0° -80°N/S
Longitude-0°E-180°E/W
Interval: 20°



R.F. 1:200000000

SCALE
1 cm. to 2000 km.