Types of Map Projection by S. Manna, Department of Geography, Narajole Raj College

Types of Map Projection.

Many types of map projections are being used for map making. They are basically classified into four groups in accordance with the Map Projection Theory or the types of surfaces that are tangent with the globe. The four categories are:

- Planar, Azimuthal or Zenithal projection
- Conic projection
- Cylindrical projection
- Mathematical or Conventional projection obtained from mathematical calculation.

- **Planar, Azimuthal or Zenithal projection** This type of map projection allows a flat sheet to touch with the globe, with the light being cast from certain positions, including the centre of the Earth, opposite to the tangent area, and from infinite distance. This group of map projections can be classified into three types: Gnomonic projection, Stereographic projection and Orthographic projection.

  1. Gnomonic projection

  The Gnomonic projection has its origin of light at the center of the globe. Less than half of the sphere can be projected onto a finite map. It displays all the large circles as straight lines, and parallels as curved lines. This type of map projection is not suitable for a large and wide area. The disadvantage is that it does not maintain equal-area and conformal properties, particularly in the areas distant from tangent points. However, it is typically used for pilot systems, such as in the navigation and aviation.

  2. Stereographic projection

  The Stereographic projection has its origin of light on the globe surface opposite to the tangent point. The created curved lines will be defined on more than half of the sphere. The meridians are straight lines adjacent to one another in the central area and become more widely spaced at the map periphery, while the parallels are circles. Shape is maintained in this type of projection, making it applicable for aviation mapping.

  3. Orthographic projection

  The Orthographic projection was originated from a made up scenario that if the light is cast straightly past the globe towards a flat sheet that touches the polar regions, the equatorial region or certain areas above the globe's surface, only a hemisphere of the globe will be depicted. The scale of orthographic projection is most accurate at the tangent area. The more distant it is from tangent points, the

more errors will occur. This type of map projection is commonly used for the Earth mapping.

These three types of map projections, however, are different in the position of light sources as well as the tangent points, which include one at the pole, one on equatorial plane, and one at diagonal position.

- **Conic projection** This type of projection uses a conic surface to touch the globe when light is cast. When the cone is unrolled, the meridians will be in semicircle like the ribs of a fan. The tangent areas of conic projection can be classified as central conical projection or tangent cone, secant conical projection, and polyconic projection.

  1. Central conical projection

  This simple map projection seats a cone over the globe then casts the light with the axis of the cone overlapping that of a globe at tangent points. Drawing straight lines will create standard parallel, with a correct scale at the tangent point. The areas distant from tangent points will be more distorted. This type of projection is applicable for the mapping of a narrow long-shaped space in east-west direction.

  2. Secant conical projection

  The projection uses a conical surface to intersect the surface of a globe, creating two tangent points and subsequently two parallels. This increases accuracy around the tangent areas. The projection looks like a tangent cone with one standard parallel, which is a meridian that extends straight out from the pole. The parallels are circular curves which have the pole as their shared center. The inventors of this popular map projection are Lambert and Alber who also invented Lambert conformal project and Alber's conic equal area projection, respectively.

  3. Polyconic projection

  The projection seats a series of cones over a globe with the axis of each cone lapping over the axis of a globe, creating parallels in equal number to that of the tangent cones. The parallels are arcs of circles that are not concentric, but are equally spaced along the central meridian. The parallels and meridians are curves, except the equator which is a straight line. As both parallels and meridians are more curved at the periphery, there is possibility that the scale distortion grows. This type of map projection is commonly used for map-making in an area that extends in north-south direction.

- **Cylindrical projection** This type of projection uses a cylinder as a tangent surface that wraps around a globe, or to intersect the globe at certain positions. If the cylinder is unrolled into a flat sheet, the parallels and meridians will be straight lines that create the right angles where

they intersect each other. The projection displays directions and shapes correctly. The area close to tangent points will be more accurate. The more distant it is from tangent points, the more distortion will be shown. This type of projection is typically used to map the world in particular areas between 80 degrees north and 80 degrees south latitudes.

The cylindrical projection is classified into three types:

1. Cylindrical equal area projection

The projection places a cylinder to touch a globe at normal positions. All the parallels and meridians are straight lines crossing each other at the right angles. Every parallel is in the same length as the equator on the globe. It is widely known as Lambert's cylindrical equal area projection.

2. Gall's stereographic cylindrical projection

Gall invented this type of map projection by using a cylinder to intersect the globe at the 45th parallel north and south, resulting in less distortion around both poles. Parallels and meridians are all straight lines intersecting each other at right angles. The parallel spacing increases in the areas closer to the poles.

3. Mercator projection

Mercator invented this type of projection in the 16th Century and it has been commonly used ever since. This projection uses a cylinder to touch a globe at the equator plane and cast the light for meridians and parallels to appear on cylindrical surface. Meridians are straight lines and equally spaced, while parallels are also straight lines but their spacing increases as they get closer to the poles. Shapes are represented more accurately in tangent point areas. However, the closer to the poles, the more distortion occurs. Therefore, it is not typically used to make a map in areas above 80 degrees north latitude and below 80 degrees south latitude.

The Mercator projection is being applied in varying patterns, such as by taking a cylinder to touch a globe with the axis of cylinder intersecting that of the globe at the right angle, leaving the cylinder to touch any single meridian. By that way, a central Meridian is created. When the cylinder is unrolled, the area adjacent to the central meridian will have constant scales. This type of projection is called Transverse Mercator projection, which is used in the making of Thailand's geographic map.

- **Mathematical or Conventional projection**

1. Mollweide homolographic projection

This type of projection is commonly used to display different parts of the Earth. It maintains area around the central meridian. The equator is a straight horizontal

line intersecting the central meridian at a right angle. Other meridians are curved lines, while other parallels are straight lines. This map projection was initiated by Karl B. Mollweide in 1805. Its disadvantage is the distortion at the Earth's polar regions. However, there is more scale accuracy in the equatorial regions. The projection is ideal for making global maps.

2. Sinusoidal projection or Samson Flamsteed projection

All the parallels are straight lines perpendicular to a central meridian, while other lines are curved like those in the Mollweide projection. The values of sine curves are used to create meridians, making the meridian spacing wider than that of the Mollweide projection. The Sinusoidal projection is typically used for map making of the equatorial regions such as in South America and Africa.

3. Homolosine projection

This type of equal-area projection is a combination of the Homolographic and the Sinusoidal. Normally, the Sinusoidal projection is applied between the 40 degrees south and 40 degrees north latitudes, grafted to the Homolographic in the areas out of the above mentioned range. As the two projections can not match perfectly, small kinks are seen on the meridians where the two projections match