

A coordinate system is a reference system used for locating objects in a two or three dimensional space

Geographic Coordinate System

A geographic coordinate system, also known as global or spherical coordinate system is a reference system that uses a three-dimensional spherical surface to determine locations on the earth. Any location on earth can be referenced by a point with longitude and latitude.

We must familiarize ourselves with the geographic terms with respect to the Earth coordinate system in order to use the GIS technologies effectively.

Pole: The geographic pole of earth is defined as either of the two points where the axis of rotation of the earth meets its surface. The North Pole lies 90° north of the equator and the South Pole lies 90° south of the equator

Latitude : Imaginary lines that run horizontally around the globe and are measured from 90° north to 90° south. Also known as parallels, latitudes are equidistant from each other.

Equator : An imaginary line on the earth with zero degree latitude, divides the earth into two halves–Northern and Southern Hemisphere. This parallel has the widest circumference.

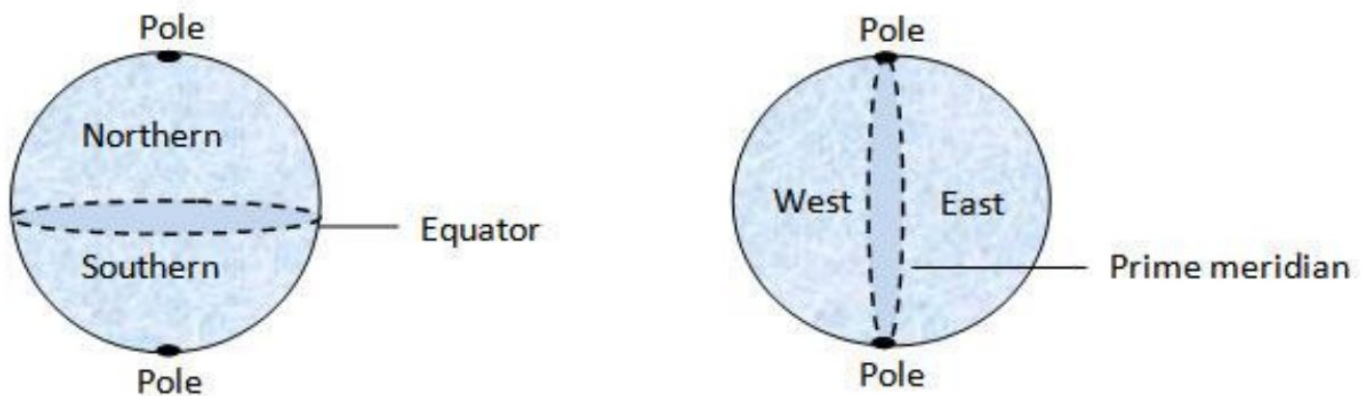


Figure 5: Division of earth into hemispheres

Longitude : Imaginary lines that run vertically around the globe. Also known as meridians, longitudes are measured from 180° east to 180° west. Longitudes meet at the poles and are widest apart at the equator

Prime meridian : Zero degree longitude which divides the earth into two halves–Eastern and Western hemisphere. As it runs through the Royal Greenwich Observatory in Greenwich, England it is also known as Greenwich meridian

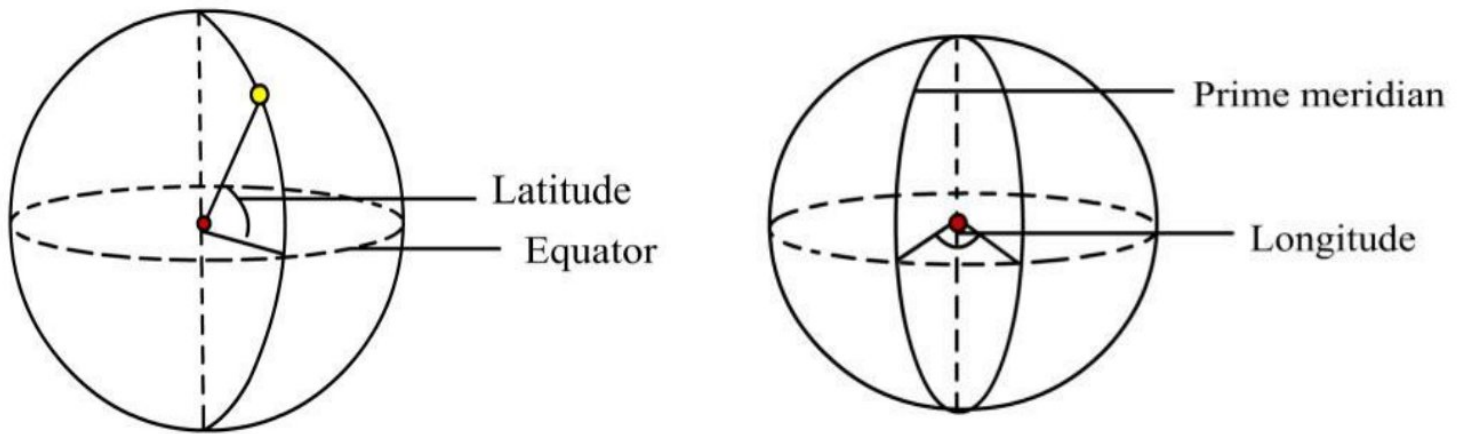


Figure 6: Latitude and longitude measurements

Equator (0°) is the reference for the measurement of latitude. Latitude is measured north or south of the equator. For measurement of longitude, prime meridian (0°) is used as a reference. Longitude is measured east or west of prime meridian. The grid of latitude and longitude over the globe is known as graticule. The intersection point of the equator and the prime meridian is the origin (0, 0) of the graticule.

Did you know?

Meter, the unit of distance was originally defined as one part in 10,000,000 of the distance between the pole and the equator. If that distance corresponds to 90° , to what distance does one degree correspond?

$$10,000,000/90 = 111,111 \text{ meters}$$

$$= 111.11 \text{ km}$$

Coordinate measurement

The geographic coordinates are measured in angles. The angle measurement can be understood as per following:

A full circle has 360 degrees	1 circle = 360°
A degree is further divided into 60 minutes	$1^\circ = 60'$
A minute is further divided into 60 seconds	$1' = 60''$

An angle is expressed in Degree Minute Second.

While writing coordinates of a location, latitude is followed by longitude. For example, coordinates of Delhi is written as $28^\circ 36' 50''$ N, $77^\circ 12' 32''$ E.

Decimal Degree is another format of expressing the coordinates of a location. To convert a coordinate pair from degree minute second to decimal degree following method is adopted:

$$\begin{aligned}
28^{\circ} 36' 50'' &= 28 + (36 \cdot 1/60) + (50 \cdot 1/60 \cdot 1/60) \\
&= 28 + 0.6 + 0.0138 \\
&= 28.6138
\end{aligned}$$

We have 28 full degrees, 36 minutes - each 1/60 of a degree, and 50 seconds - each 1/60 of 1/60 of a degree

While writing coordinates of a location, latitude is followed by longitude. For example, coordinates of Delhi is written as

Similarly $77^{\circ} 12' 32''$ can be written as 77.2088. So, we can write coordinates of Delhi in decimal degree format as: 28.6138 N, 77.2088 E

Local Time and Time Zones

With rotation of earth on its axis, at any moment one of the longitudes faces the Sun (noon meridian), and at that moment, it is noon everywhere on it. After 24 hours the earth completes one full rotation with respect to the Sun, and the same meridian again faces the noon. Thus each hour the Earth rotates by $360/24 = 15$ degrees. This implies that with every 15° of longitude change a new time zone is created which is marked by a difference of one hour from the neighboring longitudes specified at 15° gap. The earth's time zones are measured from the prime meridian (0°) and the time at Prime meridian is called Greenwich Mean Time. Thus, there are 24 time zones created around the globe.

Date

The International Date Line is the imaginary line on the Earth that separates two consecutive calendar days. Generally, it is said to be lying exactly opposite to the prime meridian having a measurement of 180° meridian but it is not so. It zigs and zags the 180° meridian following the political jurisdiction of the states but for sake of simplicity it is taken as 180° meridian. Starting at midnight and going east to the International Date Line, the date is one day ahead of the date on the rest of the Earth.

Projected Coordinate system

A projected coordinate system is defined as two dimensional representation of the Earth. It is based on a spheroid geographic coordinate system, but it uses linear units of measure for coordinates. It is also known as Cartesian coordinate system.

In such a coordinate system the location of a point on the grid is identified by (x, y) coordinate pair and the origin lies at the centre of grid. The x coordinate determines the horizontal position and y coordinate determines the vertical position of the point.

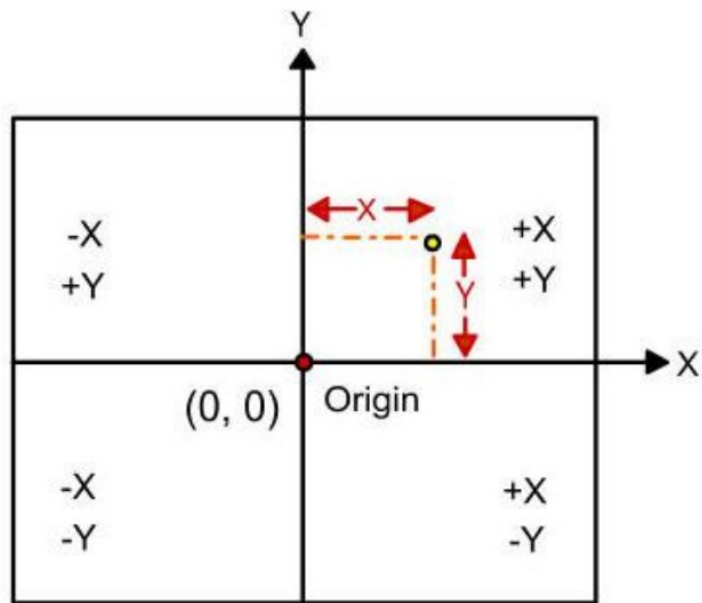


Figure 7: Cartesian coordinate system

In such a coordinate system the location of a point on the grid is identified by (x, y) coordinate pair and the origin lies at the centre of grid. The x coordinate determines the horizontal position and y coordinate determines the vertical position of the point.