Terms for Coordinates

Azimuth

Angle measured from north clockwise. North is 0 degrees, east is 90 degrees etc. Three common forms of azimuth exist: true azimuth, magnetic azimuth, and grid azimuth.

Angular Coordinates

Latitude, Longitude, and Height can specify a location. This is called an angular frame. To obtain angular coordinates in a spherical earth system, only the radius is needed. This is needed only for the height. For an ellipsoidal earth the parameters of the ellipsoid must be specified to convert height and latitude. (To obtain geographic, or mean sea level, height the geoid is needed.

Cartesian Coordinates

Standard x-y-z coordinates. Three axes perpendicular to each other meet at the origin, or center of the coordinate system. The coordinates of a point are the projection of the location on these axes.

Circle, Great

A great circle is a circle on the earth whose center is the center of the earth. Alternately, it is the intersection of a plane and a sphere when the center of the sphere is on the plane. Shortest distance between two points on the earth in spherical model is a great circle. Meridians are great circles.

Circle, Small

A small circle is a circle on the earth whose center is not the center of the earth. Alternately, it is the intersection of a plane and a sphere when the center of the sphere is not on the plane. Parallels of latitude are small circles.

Coordinate Frame

In general this refers to a Cartesian system of coordinates. The location of the origin and the orientation of the axes with respect to the real earth are also included. Thus this is a realization of the Cartesian system. There are a series of frames used in geodesy. The most modern are called the International Terrestrial Reference Frames (ITRF) and are label with the year of acceptance. For example ITRF96 and ITRF2000.

There are also Coordinate Frames that uses stars or other astronomical objects for alignment. These are fall into the category of Celestial Reference Frames.

The world geodetic system 1984, WGS84, has a frame associated with it. This frame has recently been adjusted to fall in line with the best ITRF frames.

Curvilinear Coordinates

These are the same as angular coordinates in most occasions.

Earth-centered earth-fixed ECEF

Cartesian coordinate system where the X direction is the intersection of the prime meridian (Greenwich) with the equator. The vectors rotate with the earth. Z is the direction of the spin axis.

Ellipsoidal Earth

The model of the earth as an ellipse rotated about the shorter axis. This axis is the polar axis. It is specified several ways, the semi-major axis (a) and the flattening (f) is the most common in map applications. Geodesy often uses the eccentricity in place of the flattening. Both axis can also be supplied to specify the ellipse.

Geodetic

Of or determined by geodesy; that part of applied mathematics which deals with the determination of the magnitude and figure either of the whole Earth or of a large portion of its surface. Also refers to the exact location points on the Earth's surface.

When used to modify a location value (such as geodetic latitude or geodetic height) it implies points taken with respect to the ellipsoid.

Geoid

The particular equal-potential surface that coincides with mean sea level and that may be imagined to extend through the continents. This surface is everywhere perpendicular to the force of gravity.

Heights

Heights are the distance of a point above or below a reference surface. The most mathematically convenient surface is the ellipsoid. This gives ellipsoidal or geodetic height.

The heights used on maps are referred to the geoid, a bumpy surface that must be obtained from measurements. These are called Orthometric or Mean Sea Level (MSL) heights. (There are minor differences between true orthometric and true MSL heights, but the terms are used interchangeably.)

Latitude

In general: Angular distance, in degrees, minutes, and seconds of a point north or south of the Equator.

There are three principle values for the latitude.

Geocentric Latitude:
The angle made by the line to the center of the earth from the surface point and the equatorial plane. This is the only latitude in a spherical model of the earth.

Geodetic Latitude / Geographic Latitude:
The line defined is defined by the perpendicular to the ellipsoid. The angle between this line and the equatorial plane is the geodetic latitude. This is the latitude found on maps.

Astrodetic Latitude

The line is defined by the local "up", that is the local gravity field. This is very close to the geodetic latitude.

Longitude

Angular distance, in degrees, minutes, and seconds, of a point east or west of the prime meridian. Since 1878 this has been the Greenwich meridian. Newer International Terrestrial Reference Systems define their own prime meridian. These are extremely close to the old standard.

Meridian

A north-south reference line. It may be taken through the position of the instrument, or, in special cases, through a reference point (such as the Royal Observatory in Greenwich, England, which designates the Prime Meridian - 0^o longitude).

Meridian (of Longitude)

A line along a fixed longitude, often from pole to pole. This is a great circle. The meridians converge at the poles.

Parallel (of Latitude)

A line of fixed latitude. This forms a small circle around the earth. The radius and circumference are a function of latitude. (The radius is the radius of curvature in the prime vertical times the cosine of the geographic/geodetic latitude.)

Radius of Curvature

The relation between an arc-length on the surface (distance on the surface of the earth) and the angle between the endpoints seen from the center of the earth is the radius of curvature. For a spherical earth this is the physical radius, and independent of position.

For the ellipsoidal earth, the relation between the angle and the surface distance is a function of latitude and the direction (azimuth). There are two principle values, that in the north-south and east-west that can be used to determine the value in a general direction.

The east-west value is called the radius of curvature in the prime vertical. It is often denoted as R_N, or a Greek Nu or sometimes N. The north-south value is called the radius of curvature in the meridian. It is often denoted as R_M.

Because these are functions of latitude, only small differential changes are represented by the value at a point. The change over a finite arc must be obtained by integration.

Spherical Earth

The model of the earth as a sphere. It is often adequate for some applications. The errors in using a spherical earth approximation are usually about 1/300 times the distances involved.

State Plane Coordinates

For legal work, a fixed projection and coordinate system is usually specified by law. In the US a series of systems are specified because no single projection fits all states. Most larger states have several zones with the same generic projection but different parameters. The UTM is a common choice. Other countries have similar systems.

Surface / Pseudo-surface Coordinates

It is often useful to have coordinates that represent distances on the surface of the earth. Of course this can accurately be done only in very small area. Therefore these are really pseudo-surface coordinates.

UTM (Universal Transverse Mercator) and State Plane Coordinate systems are this type.

UTM Coordinates

The Universal Transverse Mercator (UTM) system is usually thought of as a map projection. It does assign coordinates, in meters, to each point on the earth along with a zone number. These values are called Easting and Northing. These values are often printed on maps in other projections. This is particularly true of topographic maps. The lines of fixed Easting or Northing are not straight on other projections. However for small areas (large scales) they are often approximately straight and can be used for navigation.