

New Work Item: Requirements for using Geographic Coordinate System in Postal Applications

1 Scope

The standard will be a specification describing requirements for use of the Geographic Coordinate System (geocoding) in postal applications and specifically as postal codes. The standard will provide a technical foundation for a variety of customer and postal applications where knowledge of geographic coordinates could be used for mail sorting, transportation and delivery purposes as well as for monitoring quality of service, data services for customers and similar applications.

2 Deliverables

UPU Working draft standard: Geocoding in Postal Applications.

Note: the name for the standard is tentative and will be modified or changed by the working group subject to SB approval.

3 Justification

Significant improvements in postal services, service performance and broad measures of quality can be achieved if it would be possible to create a system of identifying geographic locations corresponding to traditional postal addresses based on a single internationally recognised system of location encoding that is widely used in many non postal applications. Such system by definition will have many desirable characteristics including fixed stable indexing for a variety of postal addressing databases and ready availability of commercial hardware and software required by postal applications.

Many posts use their own internal postal codes to identify all operationally significant location of their networks, but these postal codes represent only a partial solution because they are fluid (when network locations are added or removed), require significant on-going maintenance, not always known to the mailers or sister postal operators. Many other posts especially in developing world do not have a system of postal codes. Besides, postal codes where exist are frequently artificial coding systems that were designed strictly for identification purposes without having any linkage to geographic measurements in mind or carrying any other payload (that could be used for example by GPS). For this reasons it seems desirable to define a set of requirements that would provide for use of geographic coordinates in the context of applications specific to postal networks.

4 Development Strategy

It is proposed that PEG review and recommend this NWI for approval by UPU SB. The first draft of the specification will be produced by an ad-hoc working group, reporting to the PEG and working in consultation with addressing standards group responsible for development of UPU S24. PEG will take responsibility for finalizing and presenting the document for status 0 approval by the Standards Board.

Key parameters to be defined are:

- Requirements for postal codes (size, location representation accuracy, granularity –i.e. processing plants and exchange offices, airport facilities, satellite offices, delivery points)
- Requirements for geographical codes (size, accuracy, data interpretation)
- Data Compression
- Correspondence between traditional postal and geographical codes

5 Terms of reference

S 42 (Postal Address Components)

6 Work Allocation

The work should be undertaken jointly by a new working group reporting to the PEG.

7 Approach

See 4 above.

7.1 Related Standards

UPU S42 (Postal address components)

7.2 Inputs

Variety of materials on geocoding technology is available. These inputs will be creatively modified to adapt to postal application

7.3 Base Documentation

7.4 Constraints

The document will specify constraints imposed by postal coding application, specifically when postal codes (expressed in geocoordinates) would have to be evident on mail items

7.5 Concertation

Not applicable.

8 Planning and Milestones

TBD (if NWI approved a new working subgroup will be formed with participation from Canada Post, Pitney Bowes, La Poste and others)

8.1 Priority

High; needed for stimulation of mail usage and effective mail processing

8.2 Duration

A status 0 proposal should be presented to SB meeting 2008-4.

8.3 Resources and Timing

SB: Review of the status 0 proposal;

PEG: Review of the draft status 0 proposal during meeting 2008-3;

Working group: Individual and teleconference review of drafts. A total workload of 8-16 hours per participant is envisaged; working group members from envelope manufacturers and suppliers should be involved.

Coordinator/Editor: A further 32-48 hours is envisaged to finalise the draft specification and to prepare a supporting application for status 0 approval.

9 Geographic coordinate system

A *geographic coordinate system* is a 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 coordinates. The values for the points can have the following units of measurement:

- Linear units when the geographic coordinate system has a spatial reference system identifier (SRID) that DB2® Geodetic Data Management Feature recognizes.
- Any of the following units when the geographic coordinate system has an SRID that DB2 Geodetic Data Management Feature does not recognize.
 - Decimal degrees
 - Decimal minutes
 - Decimal seconds
 - Gradians
 - Radians

For example, [Figure 1](#) shows a geographic coordinate system where a location is represented by the coordinates longitude 80 degree East and latitude 55 degree North.

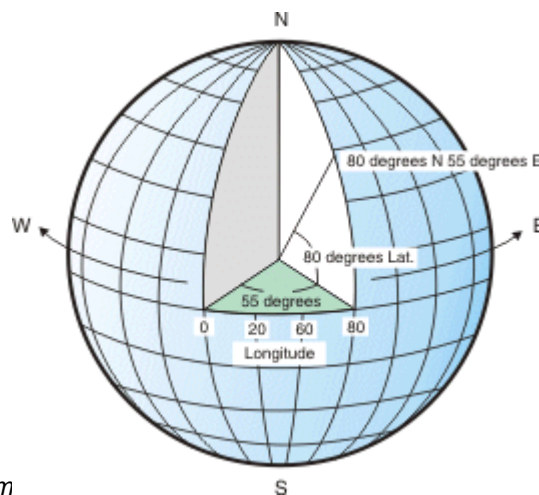


Figure 1. A geographic coordinate system

The lines that run east and west each have a constant latitude value and are called *parallels*. They are equidistant and parallel to one another, and form concentric circles around the earth. The *equator* is the largest circle and divides the earth in half. It is equal in distance from each of the poles, and the value of this latitude line is zero. Locations north of the equator have positive latitudes that range from 0 to +90 degrees, while locations south of the equator have negative latitudes that range from 0 to -90 degrees.

[Figure 2](#) illustrates latitude lines.

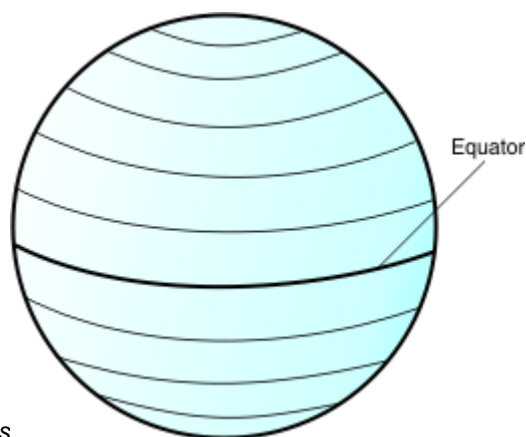


Figure 2. Latitude lines

The lines that run north and south each have a constant longitude value and are called *meridians*. They form circles of the same size around the earth, and intersect at the poles. The *prime meridian* is the line of longitude that defines the

origin (zero degrees) for longitude coordinates. One of the most commonly used prime meridian locations is the line that passes through Greenwich, England. However, other longitude lines, such as those that pass through Bern, Bogota, and Paris, have also been used as the prime meridian. Locations east of the prime meridian up to its *antipodal* meridian (the continuation of the prime meridian on the other side of the globe) have positive longitudes ranging from 0 to +180 degrees. Locations west of the prime meridian have negative longitudes ranging from 0 to –180 degrees.

[Figure 3](#) illustrates longitude lines.

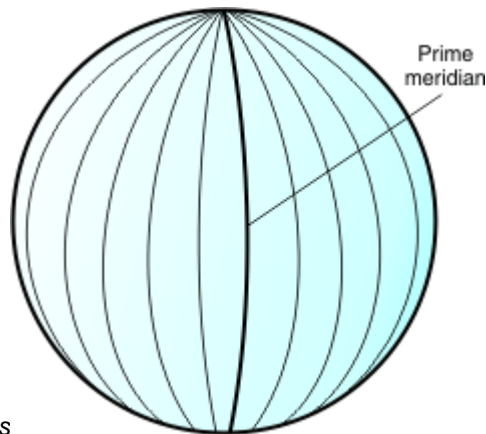
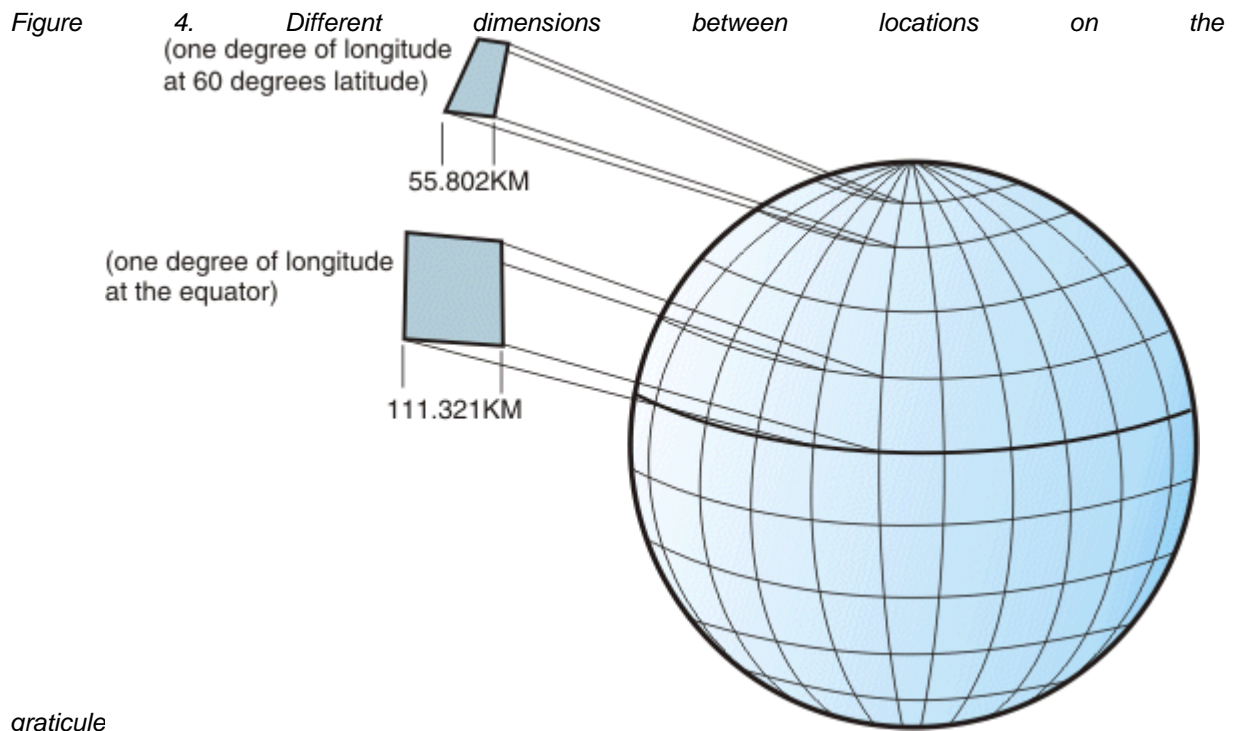


Figure 3. Longitude lines

The latitude and longitude lines can cover the globe to form a grid, called a *graticule*. The point of origin of the graticule is (0,0), where the equator and the prime meridian intersect. The equator is the only place on the graticule where the linear distance corresponding to one degree latitude is approximately equal the distance corresponding to one degree longitude. Because the longitude lines converge at the poles, the distance between two meridians is different at every parallel. Therefore, as you move closer to the poles, the distance corresponding to one degree latitude will be much greater than that corresponding to one degree longitude.

It is also difficult to determine the lengths of the latitude lines using the graticule. The latitude lines are concentric circles that become smaller near the poles. They form a single point at the poles where the meridians begin. At the equator, one degree of longitude is approximately 111.321 kilometers, while at 60 degrees of latitude, one degree of longitude is only 55.802 km (this approximation is based on the Clarke 1866 spheroid). Therefore, because there is no uniform length of degrees of latitude and longitude, the distance between points cannot be measured accurately by using angular units of measure.

[Figure 4](#) shows the different dimensions between locations on the graticule.



A coordinate system can be defined by either a sphere or a spheroid approximation of the earth's shape. Because the earth is not perfectly round, a spheroid can help maintain accuracy for a map, depending on the location on the earth. A *spheroid* is an ellipsoid, that is based on an ellipse, whereas a sphere is based on a circle.

The shape of the ellipse is determined by two radii. The longer radius is called the semimajor axis, and the shorter radius is called the semiminor axis. An ellipsoid is a three-dimensional shape formed by rotating an ellipse around one of its axes.

[Figure 5](#) shows the sphere and spheroid approximations of the earth and the major and minor axes of an ellipse.

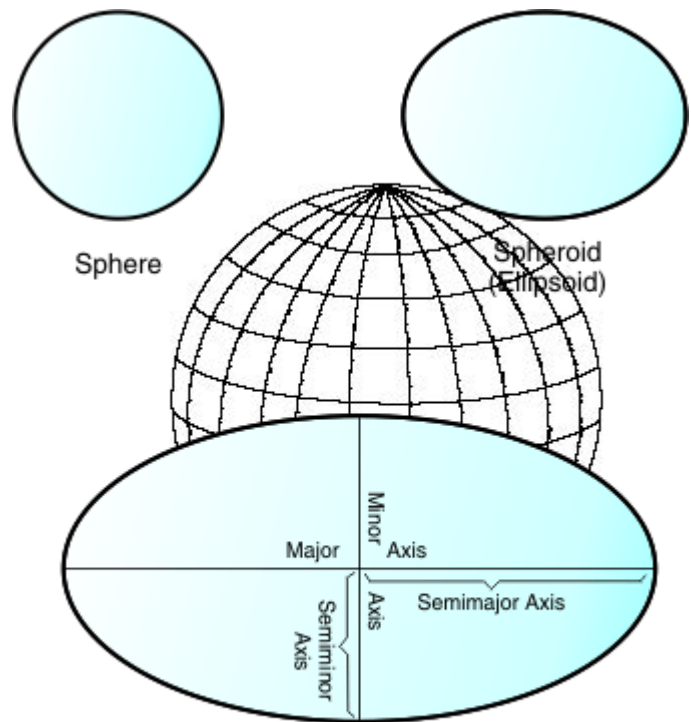


Figure 5. Sphere and spheroid approximations

The major and minor axes of an ellipse

A *datum* is a set of values that defines the position of the spheroid relative to the center of the earth. The datum provides a frame of reference for measuring locations and defines the origin and orientation of latitude and longitude lines. Some datums are global and intend to provide good average accuracy around the world. A local datum aligns its spheroid to closely fit the earth's surface in a particular area. Therefore, the coordinate system's measurements are not be accurate if they are used with an area other than the one that they were designed.

Figure 6 shows how different datums align with the earth's surface. The local datum, NAD27, more closely aligns with Earth's surface than the Earth-centered datum, WGS84, at this particular location.

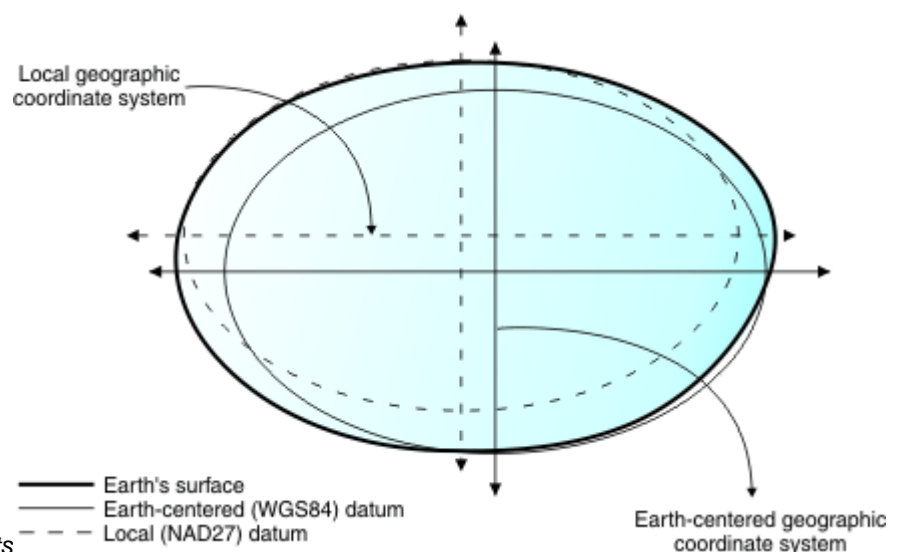


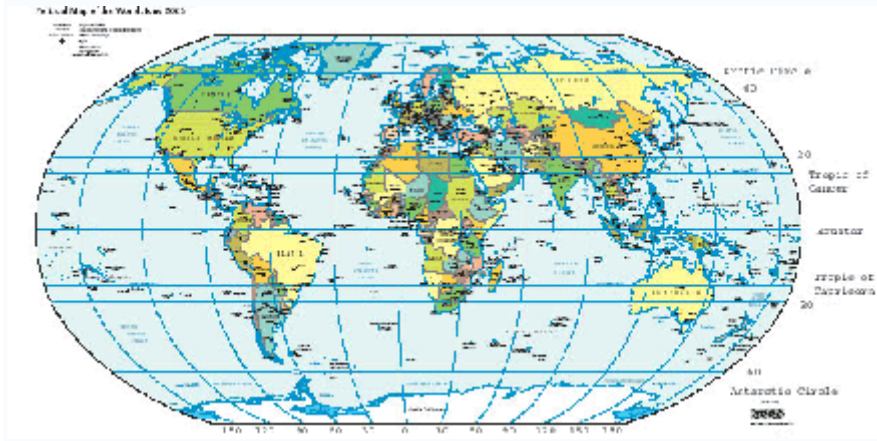
Figure 6. Datum alignments

Whenever you change the datum, the geographic coordinate system is altered and the coordinate values will change. For example, the coordinates in DMS of a control point in Redlands, California using the North American Datum of 1983 (NAD 1983) are: "-117 12 57.75961 34 01 43.77884". The coordinates of the same point on the North American Datum of 1927 (NAD 1927) are: "-117 12 54.61539 34 01 43.72995".

10 Geographic coordinate system

10.1.1 From Centiare, the free directory

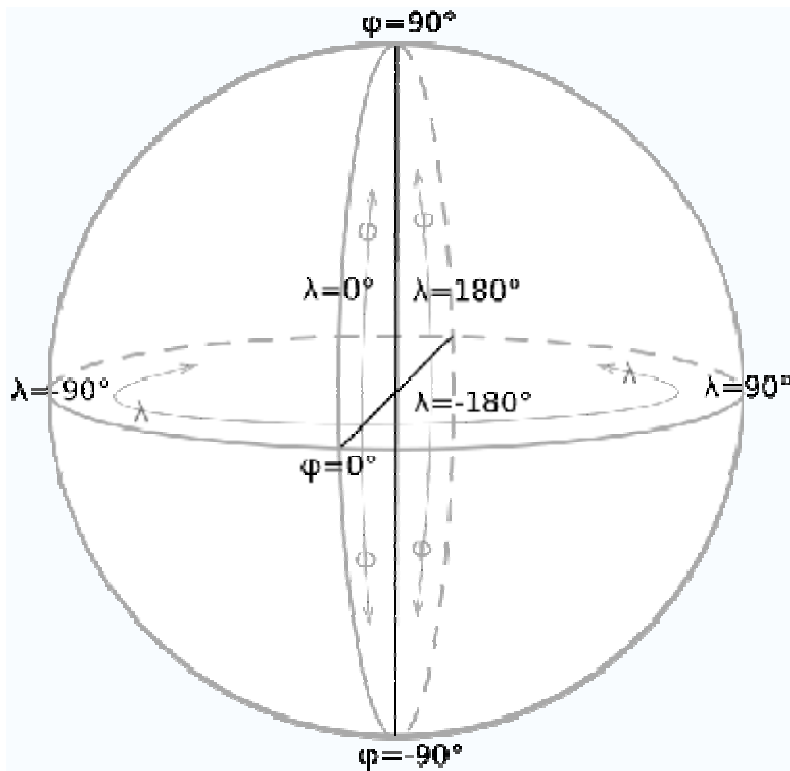
Jump to: [navigation](#), [search](#)



Map of [Earth](#) showing lines of [latitude](#) (horizontally) and [longitude](#) (vertically), Eckert VI projection; [large version](#) (pdf, 1.8MB)

A **geographic coordinate system** expresses every location on Earth by two of the three coordinates of a [spherical coordinate system](#) which is aligned with the spin axis of [Earth](#).

10.2 First and Second Dimensions: Latitude and Longitude



Borrowing from theories of ancient [Babylonians](#), later expanded by the famous [Greek](#) thinker and geographer [Ptolemy](#), a full circle is assigned 360 [degrees](#) (360°).

- [latitude](#) (Lat.) is the angle between any point and the [equator](#). Lines of constant latitude are called [parallels](#). They trace circles on the surface of Earth, with each [pole](#) being 90 degrees ([north pole](#) 90° N; [south pole](#) 90° S). The equator, an imaginary line that divides the globe into the Northern and Southern Hemispheres, is located at 0° latitude.
- [longitude](#) (Long.) is the angle east or west of an arbitrary point on Earth: The [Royal Observatory, Greenwich \(UK\)](#) is the international zero-longitude point (longitude=0 degrees). The [antipodal](#) meridian of Greenwich is both 180°W and 180°E. Lines of constant longitude are called [meridians](#). The meridian passing through Greenwich is the [Prime Meridian](#). Unlike parallels, all meridians are halves of great circles, and meridians are not parallel: they intersect at the north and south poles.

By combining these two angles, the horizontal position of any location on Earth can be specified.

For example, [Baltimore, Maryland](#) (in the [USA](#)) has a latitude of 39.3° North, and a longitude of 76.6° West ([39.3° N 76.6° W](#)). So, a vector drawn from the center of Earth to a point 39.3° north of the equator and 76.6° west of Greenwich will pass through Baltimore.

This latitude/longitude "webbing" is known as the common [graticule](#). There is also a complementary [transverse graticule](#) (meaning the graticule is shifted 90°, so that the poles are on the horizontal equator), upon which all [spherical trigonometry](#) is ultimately based.

Traditionally, degrees have been divided into [minutes](#) (') and [seconds](#) ("). There are several formats for degrees, all of them appearing in a Lat.-Long. order:

- **DM** Degree:Minute (49:30.0-123:30.0)
- **DMS** Degree:Minute:Second (49:30:00-123:30:00)

- **DD** Decimal Degree (49.5000-123.5000), generally with 4 decimal numbers.

To change from DM or DMS to DD, Decimal degrees = whole number of degrees, plus minutes divided by 60, plus seconds divided by 3600. Decimal division is now the most common and standard.

The equator is obviously an important part of this coordinate system, it represents the zeropoint of the latitude angle, and the halfway point between the poles. The equator is the [fundamental plane](#) of the geographic coordinate system. All spherical coordinate systems define such a fundamental plane.

Latitude and Longitude values are established based on an associated [Geodetic system](#) or [datum](#) such as [WGS 84](#). In other words, the same exact point on the earth's surface will be expressed by different latitude and longitude values, depending on the reference datum.

In popular GIS software, data projected in latitude/longitude is often specified via a 'Geographic Coordinate System'. For example, data in latitude/longitude with the [datum](#) as the [North American Datum](#) of 1983 is denoted by 'GCS_North_American_1983'.

10.3 Third dimension: altitude, height, depth

To completely specify a location on, in, or above Earth, one has to also specify the elevation. The elevation specifies the vertical position of the location relative to some measure of Earth's surface. This could be expressed in terms of the vertical distance to Earth below, but, because of the ambiguity of "surface" and "vertical", is more commonly expressed relative to a more precisely defined [datum](#) such as [mean sea level](#) (as height [above mean sea level](#)) or the [geoid](#). The distance to Earth's center is a practical coordinate both for very deep positions and for positions in space.

Various elevation / height coordinates either with respect to the surface or some other datum are [altitude](#), [height](#), and [depth](#).

10.4 Geostationary coordinates

[Geostationary](#) satellites (e.g., television satellites) are over the equator. So, their position related to Earth is expressed in longitude degrees. Their latitude does not change, and is always zero over the equator.

10.5 First and second dimensions: latitude and longitude

http://en.wikipedia.org/wiki/Image:Geographic_coordinates_sphere.svg

http://en.wikipedia.org/wiki/Image:Geographic_coordinates_sphere.svg

Latitude phi (φ) and Longitude lambda (λ)

Borrowing from theories of the ancient [Babylonians](#), later expanded by the famous [Greek](#) thinker and geographer [Ptolemy](#), a full circle is divided into 360 [degrees](#) (Borrowing from theories of the ancient [Babylonians](#)' angle) (360°).

- [latitude](#) (abbreviation: Lat.) is the angle at the centre of the coordinate system between any point on the earth's surface and the plane of the [equator](#). Lines joining points of the same latitude are called [parallels](#), and they trace concentric circles on the surface of the earth. Each [pole](#) is 90 degrees: the [north pole](#) 90° N; the [south pole](#) 90° S. The 0° parallel of latitude is designated the equator, an imaginary line that divides the globe into the Northern and Southern Hemispheres.
- [longitude](#) (abbreviation: Long.) is the angle east or west, at the centre of the coordinate system, between any point on the earth's surface and the plane of an arbitrary north-south line between the two geographical poles. Lines joining points of the same longitude are called [meridians](#). All meridians are

halves of great circles, and are not parallel: by definition they converge at the north and south poles. The line passing through the (former) [Royal Observatory, Greenwich](#) (near London in the [UK](#)) is the international zero-longitude reference line, the [Prime Meridian](#). The [antipodal](#) meridian of Greenwich is both 180°W and 180°E.

By combining these two angles, the horizontal position of any location on Earth can be specified.

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This latitude/longitude "webbing" is known as the common *graticule*. There is also a complementary **transverse graticule** (meaning the graticule is shifted 90°, so that the poles are on the horizontal equator), upon which all [spherical trigonometry](#) is ultimately based.

Traditionally, degrees have been divided into [minutes](#) (1/60th of a degree, designated by ' or "m") and [seconds](#) (1/60th of a minute, designated by " or "s"). There are several formats for degrees, all of them appearing in the same Lat-Long order:

- **DMS** Degree:Minute:Second (49°30'00"-123d30m00s)
- **DM** Degree:Minute (49°30.0'-123d30.0m)
- **DD** Decimal Degree (49.5000°-123.5000d), generally with 4 decimal numbers.

To convert from DM or DMS to DD, [decimal degrees](#) = whole number of degrees, plus minutes divided by 60, plus seconds divided by 3600. DMS is the most common format, and is standard on all charts and maps, as well as global positioning systems and geographic information systems.

On a spherical surface at [sea level](#), one latitudinal second measures *30.82 metres* and one latitudinal minute *1849 metres*. [Parallels](#) are each *110.9 kilometres* away. The circles of longitude, the [meridians](#), meet at the [geographical poles](#), with the west-east width of a second being dependent on the latitude. On a spherical surface at sea level, one longitudinal second measures *30.92 metres* on the [equator](#), *26.76 metres* on the 30th parallel, *19.22 metres* in [Greenwich](#) (51° 28' 38" N) and *15.42 metres* on the 60th parallel.

The width of one longitudinal degree on latitude can be calculated by this formula (to get the width per minute and second, divide by 60 and 3600, respectively):

where [Earth's average meridional radius](#) approximately equals 6,367,449 m. Due to the average radius value used, this formula is of course not precise due to [Earth's flattening](#). You can get real width of a longitudinal degree on latitude by:

where Earth's equatorial and polar radii, equal *6,378,137 m*, *6,356,752.3 m*, respectively.

The equator is the [fundamental plane](#) of all geographic coordinate systems. All spherical coordinate systems define such a fundamental plane.

Latitude and longitude values can be based on several different [geodetic systems](#) or [datums](#), the most common being the [WGS 84](#) used by all GPS equipment. In other words, the same point on the earth's surface can be described by different latitude and longitude values depending on the reference datum.

In popular GIS software, data projected in latitude/longitude is often specified via a 'Geographic Coordinate System'. For example, data in latitude/longitude with the [datum](#) as the [North American Datum](#) of 1983 is denoted by 'GCS_North_American_1983'.

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Other terms used with respect to the distance of a point from the earth's surface or some other datum are [altitude](#), [height](#), and [depth](#).

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