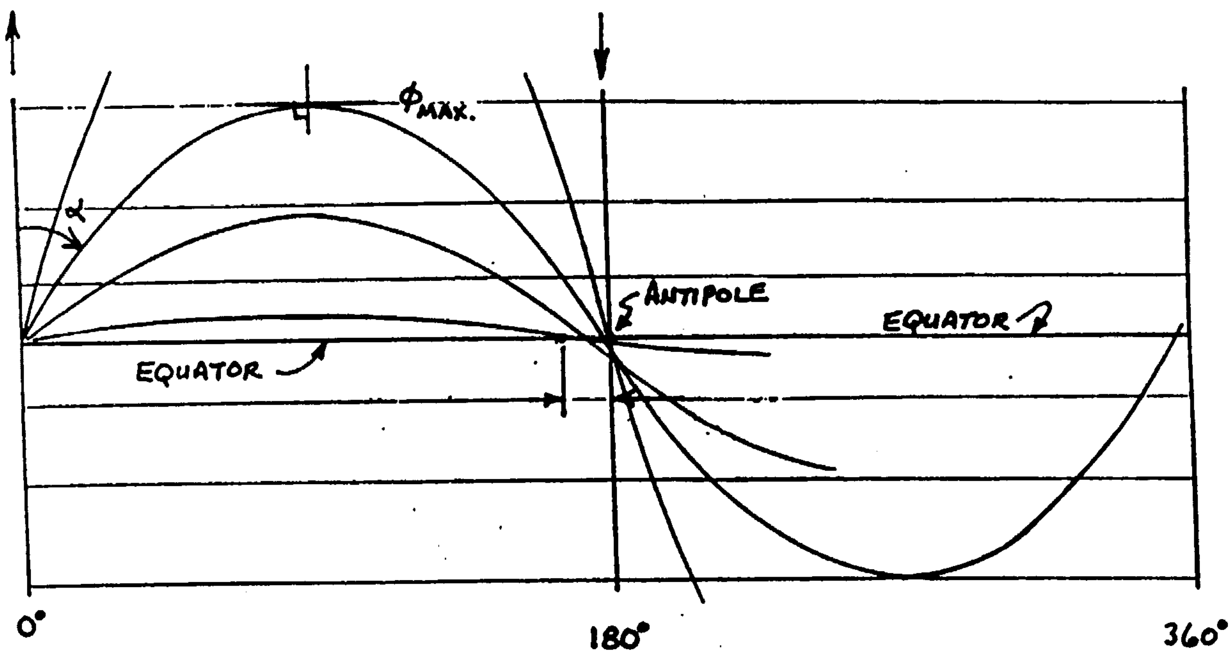
The Geodetic Line

The geodetic line, also known as the geodesic, is defined as the shortest distance between any two ellipsoid surface points. The geodetic line on the ellipsoid is analogous to a great circle arc drawn on a sphere. When a geodetic line is drawn on a rectangular graticle of meridians and parallels, it appears as a curved line as shown below.

If one were to start at a point on the equator and traverse a geodetic line to the antipole (a point 180° opposite the point of beginning), the route would go across either the south pole or the north pole and follow a meridian exactly. If the end point were several kilometers to the right or left of the antipole, the geodetic line will not cross either pole, but will pass to the right or left of same and will cross some meridian at exactly 90° at some maximum latitude. Note too, if a geodetic line does not follow a meridian exactly, it will cross the equator at some azimuth other than 0°. As the azimuth of a geodetic line at the equator increases, the maximum latitude reached by the line decreases until the limit where a geodetic line with an azimuth of 90° at the equator just stays on the equator.



An important useful feature of the geodetic line is that every line through every point has a unique constant (numerical value) which can be used to compute the azimuth of a geodetic line at any latitude. The number is known as Clairaut's Constant and defined as:

$$K = N_1 \cos \phi_1 \sin \alpha_1 = N_2 \cos \phi_2 \sin \alpha_2 = \text{Clairaut's Constant}$$

where N = length of the normal at each latitude ϕ and α is the geodetic line azimuth at the point. The azimuth at some latitude is needed to get started. Given the latitude of any other point on the line, the azimuth at the point can be readily computed. Convergence of meridians is easily computed as the difference in azimuths at two points.

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