

Basic Geodesy

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Horizontal Datums and Earth Reference Frames

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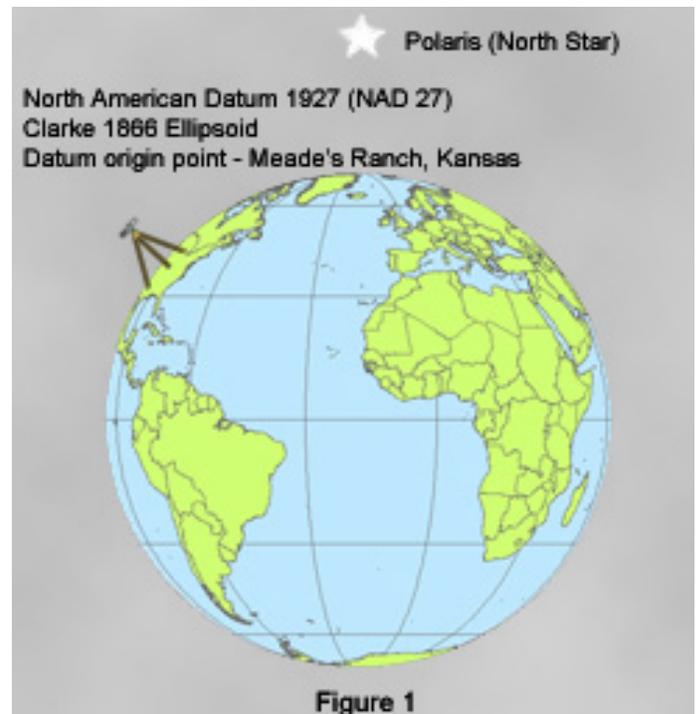
In previous articles, we have discussed the shape of the earth, ellipsoid parameters and earth centered versus non-earth centered ellipsoids. These developments were useful for mathematical models of the earth's shape, but it still does not tell us how the cartographers and scientists were able to determine geographic location values (latitudes and longitudes).

Lines of latitude are also known as "parallels" since they never converge. Lines of longitude, also known as "meridians" do converge at the poles. To determine the astronomic latitude of a point in the northern hemisphere is relatively simple. Since the star Polaris, also known as the North Star, is almost directly above the Earth's axis of rotation, an observer can simply measure the elevation of Polaris above the horizon. Determining the longitude of the point requires very accurate time determinations while making observations of stars. Later, these observations are compared to star catalogues showing the stars relative positions at the same point in time.

When the origin point is created for a horizontal datum, as shown in Figure 1, additional corrections and assumptions are made. This figure illustrates that North American Datum 1927 (Clarke 1866 ellipsoid) has its origin point located at Meade's Ranch, Kansas.

It should be noted that horizontal datum origin points are only established for non-earth centered ellipsoids. In fact, it is technically incorrect to refer to World Geodetic System 1984 (WGS 84) or North American Datum 1983 (NAD 83) as datums since they both use earth-centered ellipsoids, World Geodetic System 1984 ellipsoid and Geodetic Reference System ellipsoid

respectively. The proper terminology to use is Earth Reference Frames for these systems. However, it has become standard practice to refer to these as datums even though they do not have a datum origin point (latitude of origin, longitude of origin). Both WGS 84 and NAD 83 are referred to as datums in Geographic Information Systems (GIS) and in the marginal notes of maps and charts.



The defining parameters for Earth Reference systems, such as WGS 84 and NAD 83, are:

- a - Semi-major axis
- $1/f$ - Reciprocal of flattening
- ω - Angular Velocity of the Earth
- GM - Earth's Gravitational Constant (Mass of Earth's Atmosphere included)

Ellipsoidal Coordinates

In a future article, the subject of ellipsoidal (geodetic) coordinates will be discussed. (Thanks to Robert Harwin for assistance with the globe image.)