Overview of Datums from ArcGIS Help Menu
Geocentric datums - Local datums

While a spheroid approximates the shape of the earth, a datum defines the position of the spheroid relative to the center of the earth. A datum provides a frame of reference for measuring locations on the surface of the earth. It defines the origin and orientation of latitude and longitude lines.

Whenever you change the datum, or more correctly, the geographic coordinate system, the coordinate values of your data will change. Here are the coordinates in DMS of a control point in Redlands, California, on the North American Datum of 1983 (NAD 1983 or NAD83).

-117 12 57.75961
34 01 43.77884

Here's the same point on the North American Datum of 1927 (NAD 1927 or NAD27).

-117 12 54.61539
34 01 43.72995

The longitude value differs by approximately three seconds, while the latitude value differs by about 0.05 seconds.

NAD 1983 and the World Geodetic System of 1984 (WGS 1984) are identical for most applications. Here are the coordinates for the same control point based upon WGS 1984.

-117 12 57.75961
34 01 43.778837

Geocentric datums
In the last 15 years, satellite data has provided geodesists with new measurements to define the best earth-fitting spheroid, which relates coordinates to the earth's center of mass. An earth-centered, or geocentric, datum uses the earth's center of mass as the origin. The most recently developed and widely used datum is WGS 1984. It serves as the framework for locational measurement worldwide.

Local datums
A local datum aligns its spheroid to closely fit the earth's surface in a particular area. A point on the surface of the spheroid is matched to a particular position on the surface of the earth. This point is known as the origin point of the datum. The coordinates of the origin point are fixed, and all other points are calculated from it.

The coordinate system origin of a local datum is not at the center of the earth. The center of the spheroid of a local datum is offset from the earth's center. NAD 1927 and the European Datum of 1950 (ED 1950) are local datums. NAD 1927 is designed to fit North America reasonably well, while ED 1950 was created for use in Europe. Because a local datum aligns its spheroid so closely to a particular area on the earth's surface, it's not suitable for use outside the area for which it was designed.The two horizontal datums used almost exclusively in North America are NAD 1927 and NAD 1983.

NAD 1927

NAD 1927 uses the Clarke 1866 spheroid to represent the shape of the earth. The origin of this datum is a point on the earth referred to as Meades Ranch in Kansas. Many NAD 1927 control points were calculated from observations taken in the 1800s. These calculations were done manually and in sections over many years. Therefore, errors varied from station to station.

NAD 1983

Many technological advances in surveying and geodesy—electronic theodolites, global positioning system (GPS) satellites, Very Long Baseline Interferometry, and Doppler systems—revealed weaknesses in the existing network of control points. Differences became particularly noticeable when linking existing control with newly established surveys. The establishment of a new datum allowed a single datum to cover consistently North America and surrounding areas.

The North American Datum of 1983 is based on both earth and satellite observations, using the GRS 1980 spheroid. The origin for this datum is the earth's center of mass. This affects the surface location of all longitude–latitude values enough to cause locations of previous control points in North America to shift, sometimes as much as 500 feet. A 10-year multinational effort tied together a network of control points for the United States, Canada, Mexico, Greenland, Central America, and the Caribbean.

The GRS 1980 spheroid is almost identical to the WGS 1984 spheroid. The WGS 1984 and NAD 1983 coordinate systems are both earth centered. Because both are so close, NAD 1983 is compatible with GPS data. The raw GPS data is actually reported in the WGS 1984 coordinate system.

HARN or HPGN

There is an ongoing effort at the state level to readjust the NAD 1983 datum to a higher level of accuracy using state-of-the-art surveying techniques that were not widely available when the NAD 1983 datum was being developed. This effort, known as the High Accuracy Reference Network (HARN), or High Precision Geodetic Network (HPGN), is a cooperative project between the National Geodetic Survey and the individual states.

Currently, all states have been resurveyed, but not all of the data has been released to the public. As of January 2004, the grids for 46 states and four territories have been published.

Other United States datums

Alaska, Hawaii, Puerto Rico and the Virgin Islands, and some Alaskan islands have used other datums besides NAD 1927. New data is referenced to NAD 1983.