North American Datums

Definition

Datum (pl. datums) In surveying, a reference system for computing or correlating the results of surveys.

Geodetic datums define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth. Hundreds of different datums have been used to frame position descriptions since the first estimates of the earth's size were made by Aristotle. Datums have evolved from those describing a spherical earth to ellipsoidal models derived from years of satellite measurements.

Modern geodetic datums range from flat-earth models used for plane surveying to complex models used for international applications which completely describe the size, shape, orientation, gravity field, and angular velocity of the earth. While cartography, surveying, navigation, and astronomy all make use of geodetic datums, the science of geodesy is the central discipline for the topic.

Referencing geodetic coordinates to the wrong datum can result in position errors of hundreds of meters. Different nations and agencies use different datums as the basis for coordinate systems used to identify positions in geographic information systems, precise positioning systems, and navigation systems. The diversity of datums in use today and the technological advancements that have made possible global positioning measurements with sub-meter accuracies requires careful datum selection and careful conversion between coordinates in different datums.

There are two principal types of datums: vertical and horizontal. A vertical datum is a level surface to which heights are referred. In the United States, the generally adopted vertical datum for leveling operations is the National Geodetic Vertical Datum of 1929. The horizontal datum is used as a reference for position. The North American Datum of 1927 is defined by the latitude and longitude of an initial point (Meade's Ranch in Kansas), the direction of a line between this point and a specified second point, and two dimensions that define the spheroid. The new North American Datum of 1983 is based on a newly defined spheroid (GRS80); it is an Earth-centered datum having no initial point or initial direction.

Specifically Canadian Information

The horizontal datum has switched from North American Datum (NAD) 27 to NAD 83 for Ontario Energy, Mines and Resources and NTS 1:50,000 scale topographic maps printed since 1992. Projected map coordinates, based on the NAD27 set of parameters for representing the earth have had to be revised. In practical terms, Universal Transverse Mercator (UTM) coordinates read from the new map editions will have approximately 200 metre larger Northing than coordinates read from the old editions based on NAD27.
Also affected by the datum change are 100 km 'square' values. For example, the square 17 MV used to include part of the Bruce Peninsula; now the square 17 MV is several hundred kilometres to the north, including part of the James Bay shoreline.

When collecting coordinates, it becomes important to indicate which datum (NAD 27 or NAD 83) is being used; otherwise, it would be difficult for anyone to return to the site at a later date with any degree of confidence. For those storing coordinates in a database, either indicate in any documentation what datum was used, or include a field for indicating the datum for individual records.

To find out which datum an NTS map is published in, check to the right of the scale in the bottom part of the map. A datum is a set of parameters defining a coordinate system based on a spheroid representing the shape of the earth. Since the earth is ellipsoid with local variations, many local datums have been used to represent different portions of the globe. Mapping coordinate systems in Ontario generally use the North American Datums of 1927 and of 1983 (NAD 27 and NAD 83).

NAD 27 uses the Clarke spheroid of 1866 to represent the earth. Control points for defining the parameters were done manually at a number of stations over a number of years.

NAD 83 used both earth and satellite data to update the spheroid. Errors were reduced as satellite coverages provided a quicker measurement system capable of dealing with large areas at a time.


Some current map standards:

- Ontario Digital Topographic Database’s Ontario Base Maps (OBMs) currently NAD 27 with MAY 76 (May of 1976) adjustment; future conversion to NAD 83.
- EMR NTS Maps prior to 1992, NAD 27; 1992 and later, most are NAD 83 (check the datum on any maps published in the 90’s).
- Statistic Canada: 1991 and 1996 NAD 27. For the 2001 Census NAD 83.
- City of Ottawa, including the former Regional Municipality of Ottawa-Carleton: NAD 83.

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- National Capital Commission: NAD 83

- Global Positioning System (GPS) units default to WGS 84. WGS 84 co-ordinates are comparable to NAD 83 for horizontal coordinates;

- GPS units must be set to collect data in a datum such as NAD 83 or converted afterward.

**Where can I find more information on Datums?**

See the subject headings in the Library Catalogue: [http://catalogue.library.carleton.ca/](http://catalogue.library.carleton.ca/)

*Geodesy* and/or *Geodesy – by place (eg: North America, etc.)*

**A selected bibliography from Library Catalogue:**


**Selected Internet Links:**


ESRI Support website at [http://support.esri.com](http://support.esri.com) including “NAD27 data does not line up with NAD83 data”.

Geodetic Datum Overview by Peter H. Dana, [http://www.colorado.edu/geography/gcraft/notes/datum/datum_f.html](http://www.colorado.edu/geography/gcraft/notes/datum/datum_f.html) part of the The Geographer's Craft Project, Department of Geography, The University of Texas at Austin.


