Geneva International Centre for Humanitarian Demining
Centre International de Déminage Humanitaire - Genève

Datums – Why You Should Care

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- What is a datum?
- Operational recommendations

Key Tips:

- Always know your datum, whether on a map sheet, a GPS point, or a GIS layer.
- Be sure to use the right ellipsoid for your datum.
- Whenever possible, use the WGS 84 datum.
- Be aware of datum conversion factors between the commonly used datums in your area.

Datum Resources:

Books and Articles

Working with Projections and Datum Transformations in ArcGIS: Theory and Practical Examples by Werner Flacke and Birgit Kraus. Points Verlag Norden, 2005.

Datums and Map Projections for Remote Sensing, GIS and Surveying, by J.C. Iliffe. Whittles Publishing, CRC Press, 2000.

Danger in Using the Wrong Datum

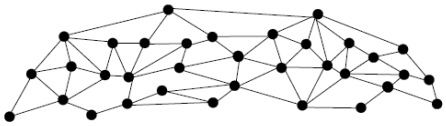
Did you know that using the wrong datum can create an error of up to 200 or 300 meters on your map? In this fact sheet we explain what a datum is and make some recommendations about managing datums.

An example of datum error:

- In the map at the right, two teams have mapped minefield perimeters using GPS. They are for the same minefield, but when they are displayed on an air photo in a GIS, it is obvious that one of them is wrong.
- In this case, the lower one is in the wrong location. Why? Because the team that mapped it used the wrong datum. Their perimeter is 200 meters south of the correct location.
- Using the wrong datum usually results in errors of a few meters to several hundred meters. These kinds of errors are not as obvious as errors of 10,000 meters, so they may not be noticed, but they are important!

So, what is a datum?

Every map projection and coordinate system begins with a precisely surveyed starting point. The starting point and the network of points that extends from it is called the datum. Each datum has a name and often a date associated with it, such as European Datum of 1950, Pulkovo Datum of 1942, or Adindan Datum. Here is an example of a datum network:



There are both horizontal and vertical datums, but for this fact sheet we are interested in horizontal datums.

On a paper map the datum is usually (but not always) given in the marginal or "collar" area of the map. For digital maps, the datum is contained in the metadata. Here is an example from a paper map:

Horizontal Datum: Adindan
Vertical Datum: Mean Sea Level
Transverse Mercator Projection

"Grids and Datums" is a regular column published by Clifford Mugnier in the journal Photogrammetric Engineering and Remote Sensing (PE&RS). It is an excellent source of information on the background and characteristics of datums.

Datum Lists

There are numerous web sources of datums, associated ellipsoids, and their parameters. These can be easily found by searching for "geodetic datums list". As of this writing, here are two easily accessible sources:
1. Peter Dana's Geodetic Datums list at the University of Colorado.
2. The National Center for Geographic Information and Analysis (NCGIA) Geodetic Datum List.

Free Coordinate Calculator

Tatuk GIS provides a free coordinate calculator that can convert coordinates between different datums:
www.tatukgis.com
(Click on "Products")

Contact Us

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How do ellipsoids fit into this? Ellipsoids (or spheroids) are geometrical models of the earth's shape, which is somewhat like a flattened sphere that bulges at the equator. Every datum is based on a specific ellipsoid – in other words, surveyors selected the ellipsoid that best represented their part of the earth when they defined a new datum. This means that every datum has an associated ellipsoid. (Note that maps often do not list the ellipsoid associated with the map datum.)

Here are a few examples of datums and their ellipsoids:

Datum	*Ellipsoid*
Adindan	Clarke 1880
European 1950	International 1924
Pulkovo 1942	Krassovsky
WGS 84	WGS 84

Local versus global datums. As you probably can guess from some of the names above (Adindan, European, Pulkovo), most datums were originally designed to be used only in a specific country or region of the globe. Using a local datum outside its designated area will lead to serious errors.
With the advent of GPS, new datums and ellipsoids have been developed for the entire globe. WGS 84 is now accepted as a universal global datum.

Datum conversions are not perfect! Geographic information system (GIS) software and other programs such as coordinate conversion calculators include functions to convert map or image coordinates from one datum to another. However, none of these systems can convert coordinates without some degree of error. Here are the main reasons why:

- Because of inconsistency in the original surveys, the amount of error varies from location to location. These inconsistencies mean that no single mathematical formula will work equally well for all locations within the area covered by the datum.
- Some mathematical solutions are better than others, but they are not available for all datums or all locations (or in all software systems).

Operational Recommendations

Always know your datums! This means you should know:

- The commonly used datums in your country or region
- Which datum is used on your maps and in your GIS layers
- Any problems in converting from one datum to another

Be sure to use the proper ellipsoid for your datum.
Remember that each datum has an associated ellipsoid. If you use the wrong ellipsoid, your map coordinates will have errors.

WGS 84
Unless local policy or circumstance dictates otherwise, you should keep GIS layers and record GPS locations using the WGS 84 datum, which is a global standard. If you use a different datum, be sure to document it.

Datum Conversions
Remember that whenever you convert map coordinates from one datum system to another, there will be some degree of error. Be aware of datum conversion factors and errors for your area.