

Transformation Options

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This information sheet explains four of the available methods for transforming data between the Australian Geodetic Datum of Australia (AGD) and the Geocentric Datum of Australia (GDA). This information sheet is designed to assist spatial information specialists who use or develop software for spatial information systems.

Background

Maps show coordinates which are based on a mathematical model of the Earth known as a datum. This model closely represents the shape of the Earth. Over the years, different techniques were used to define the Earth's surface resulting in the adoption of many different datums.

The Geocentric Datum of Australia 1994 (GDA) is a new coordinate system for Australia that is compatible with the Global Positioning System (GPS). GDA supersedes the AGD coordinate system, Australia's previous datum. Because the centre of the AGD is about 200 metres from the Earth's centre of mass, coordinates on the new geocentric datum will differ by 200 metres.

Can I use WGS84 instead of GDA?

For most practical purposes, GDA and World Geodetic System 1984 (WGS84) reference frames can be considered the same and the transformation is accepted as zero. The WGS84 is well known, as it is the geodetic reference system used by the GPS. The centre of the WGS84 is the earth's centre of mass, as given by the mean position of the worldwide network of GPS tracking stations.

For high accuracy applications there is a need to recognise there is a difference between GDA and WGS84 is about 10cm. Confirmation of this was obtained when WGS84 positions were computed by the United States Department of Defense for the fifteen permanent GPS reference stations of the Australian Regional GPS Network (ARGN). When these values compared with the equivalent GDA positions, they agreed to within 25cm, which was the stated uncertainty of the WGS84 positions.



What are the transformation options?

In order to achieve the most accurate and consistent results, the Intergovernmental Committee on Surveying and Mapping (ICSM) recommends the grid transformation option for survey-type data and high accuracy work.

Whilst the grid transformation is the preferred option, there are three other methods available. The following table below shows the typical accuracies that each transformation option can achieve.

Transformation Option		Approx. accuracy
1.	Grid	0.1 – 0.3 m
2.	3-Dimensional Similarity	1 m
3.	Molodensky	5 m
4.	Simple Block Shift	10 m

Whichever transformation method is selected, the metadata for the dataset should contain the method and parameters used to ensure other users of the data are aware of its accuracy and lineage.

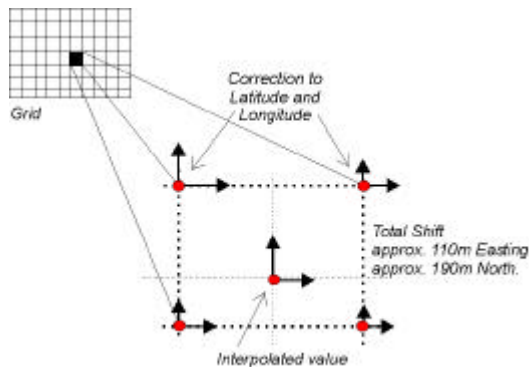
Option 1. Grid Transformation

In November 1997, ICSM adopted the concept of a unique and standard national grid of coordinate differences to model the difference between the AGD and GDA. Based on this, the Canadian National Transformation version 2 (NTv2) data format was chosen as the means to make transformation grids available to the industry.

The NTv2 is a specific format used to distribute the grid transformation data. It can handle large volumes of data, whilst maintaining the original data quality.

The NTv2 format stores the distortion between datums via a grid of corrections to latitude and longitude at grid nodes to convert from AGD to GDA. The change in latitude and longitude from AGD to GDA can be determined for any position by simple interpolation, and this value is then added to the AGD66 position to give the GDA position.

The following diagram illustrates this process:



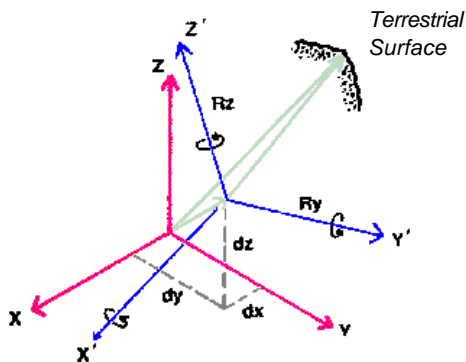
State and Territory authorities are producing these grid files for their area. When all files are complete, they will be merged to produce a unified national grid file for Australia. In fact there will be two grids. The first is an AGD66 to GDA national grid. The second is an AGD84 to GDA grid, covering Western Australia, South Australia and Queensland (that is, the jurisdictions which implemented AGD84). This transformation method is expected to have accuracy 10cm or better.

The NTV2 format supports sub grids with different density grids. These grids are used for increased accuracy in areas of dense control, particularly in metropolitan areas. The grid spacing is subject to the particular circumstances of each State and Territory and the relative control network density. Each grid or sub grid will contain a header file which will describe the lineage, currency, size and extent of the grid.

Option 2. Three Dimensional Similarity Transformation

The three dimensional similarity transformation option is sometimes known as the seven parameter transformation or conformal transformation process. It is often used to transform thematic type data (vegetation, soil type, geology etc) where the accuracy is not critical. This method is commonly used to transform spatial data derived from GPS observations, to local datums.

As the following diagram shows, the seven parameters are derived from origin shift at the centre of the Earth, axis rotations and a change of scale.



The official parameters are published in the technical manual (<http://www.anzlic.org.au/icsm/gdatm/>)

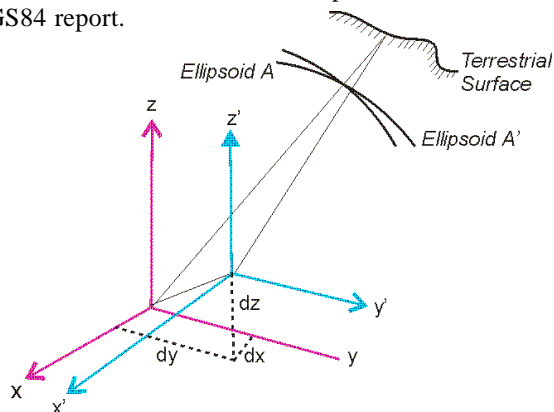
This method of transformation has an uncertainty of about 1m. Due to the inconsistent nature of the AGD66 survey control network, it is not possible to compute a set of national AGD66/GDA parameters with an acceptable accuracy. Therefore, AGD66/GDA parameters are only available on a regional basis – ACT, NSW, Victoria, Tasmania and Northern Territory. These regional parameters are also available in the GDA Technical manual

Option 3. Molodensky Transformation

The Molodensky transformation method uses only an origin shift at the centre of the Earth with the difference in the parameters of the two ellipsoids.

The GDA Technical Manual contains official Molodensky transformation parameters for either AGD66 or AGD84 to GDA, located at: (<http://www.anzlic.org.au/icsm/gdatm/>)

These parameters supersede previous parameters published in the United States Department of Defense WGS84 report.



These parameters have an absolute accuracy of about 5m and are suitable for coarse applications, such as hand-held GPS.

Option 4. Simple Block Shift Transformation

The block shift transformation option is a very basic method of transforming between datums by adding an average block shift in position, as determined from available common points. The accuracy of this transformation process depends on the accuracy of the common point coordinates and the area over which the shifts are averaged.

The GDA Technical Manual contains block shifts between AGD66, AGD84 and GDA averaged over 1:250 000 topographic map areas across Australia. Using the parameters produced from the Technical Manual, an accuracy of approximately 10m has been achieved. However, over a small area, the block shift may achieve higher accuracy. This method is only recommended where it is not practical to use one of the other transformation options.

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