GPS Conversions

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There are many problems associated with locating dive sites using a GPS receiver. But first it helps if you understand the way the position is given.

Coordinates

Latitude and Longitude coordinates are usually given in degrees, minutes and seconds, sometimes with decimals of a second added. Many navigation receivers will give positions in degrees, minutes and decimals of a minute or as degrees, minutes and seconds. Take care which you use!

It is easy to convert seconds to decimal minutes — simply divide the seconds by 60. Thus if we have a latitude given as 38° 12′ 45″ S (i.e. 38 degrees, 12 minutes, 44.7 seconds South), then we divide the 45 seconds by 60 to give .75. Thus this latitude is 38° 12.75′ S (i.e. 38 degrees, 12.75 minutes South).

To convert decimal minutes to seconds, simply multiply them by 60. So if we have a latitude given as 37° 15.5′ S (i.e. 37 degrees, 15.5 minutes South), then we multiply the .5 minutes by 60 to give 30. Thus this latitude is 37° 15′ 30″ S (i.e. 37 degrees, 15 minutes, 30 seconds South).

In passing it is worth considering what both 0.01 of a minute and a second (approx 0.017 minutes) represent on the Earth's surface. One hundredth of a minute is some 18.5 metres in latitude everywhere on the Earth. However the longitudinal distance varies — largest at the equator and reducing as we move towards the South or North poles. For example, it is about 12 metres in longitude in the South of England at 50° North, and some 9 metres in longitude in the North of Scotland at 60° N.

Similarly, a second is 1/60 of a nautical mile and thus it is about 30 metres in latitude, but some 20 metres in longitude in the South of England or some 15 metres in longitude in the North of Scotland. OK so far? Now it’s time for considering the joys of datum.

Datum

The idea of a datum arises because the dry part of the world is lumpy. When surveyors use a theodolite to take measurements of angles and various instruments to measure distances, they need some way of calculating the results. For small areas (for instance when setting out a supermarket building) it is fine to assume that the earth is flat. We have all done some trigonometry at school and the formulae are relatively simple. (Does anyone remember the sine and cosine rules)?

Now on a bigger scale, say over Australia, things get a bit more complicated. Clearly the lumpy surface of the real world is too complicated to use for calculation and the Earth is not flat so another shaped surface has to be used. Take a sphere, roughly the size of the earth. Squash it along the North/South direction and wiggle it a bit to get the best fit over Australia. Bravo! Keeping it simple, you now have a datum. Calculations on this curved surface are complicated but possible.

Zones

Different shaped spheroids are used over different parts of the world by various mapping agencies and they have changed over time. Because Australia is so large, our charts used different datum over different zones of the country. Zones cover a much larger area than a single page in a Street Directory and are numbered according to a world wide convention.
Australia is covered by 30 zones in the Universal Transverse Mercator grid system. Each zone is referred to by:

A number (49 to 56) to refer a region of longitude which is 6 degrees "wide",

A letter (G, H, J, K, L) to refer to a region of latitude which is 8 degrees "high".

Victoria is covered by zones 54H and 55H. Melbourne, Port Phillip Bay and all point East are in zone 55H.
Within each zone a Cartesian coordinate system is used to specify a location in units of metres.
The East-West coordinate is called an "Easting". It is referenced to the central meridian of longitude (i.e. 3 degrees from each boundary), where it has a value of 500,000 metres.
The North-South coordinate is called a "Northing". In the Southern hemisphere the 0 value is referenced to the latitude which is 10,000,000 metres South of the equator. This means that Northings in Australia have values of several million metres.
A typical set of fully specified coordinates are E 578315, N 5789240, UTM Zone 54H, Datum GDA94.
OK so far? Let’s move on.

GPS Datum

Charts of our coastal area have always been on our own Australian Geodetic Datum as this was convenient and prior to the advent of satellite navigation systems it did not matter. However GPS is a global system and the squashed sphere that is

a good fit in Australia is not the best fit to the real, lumpy surface over the whole world. So a revised, squashed sphere was invented. It is known as the World Geodetic System 1984, or WGS84 for short. (Logical to call it WGS when it fits the world.)
The trouble is that this squashed sphere does not match up with the old Australian Geodetic Datum and the Australian Map Grid based on it. So there is a difference in apparent position for the same point on the Earth's surface when you go from one to the other. This has caused some problems to those not familiar with the idea of applying shifts to the position displayed on the GPS received.

UTM Datums and Map Grids in Australia

Australia now uses the GDA94 datum (Geocentric Datum of Australia 1994) for latitude / longitude and the MGA94 map grid (Map Grid of Australia 1994) for UTM coordinates. This supersedes the AGD66 (Australian Geodetic Datum 1966) and the AMG66 map grid (Australian Map Grid 1996), and their very similar counterparts AGD84 and AMG84 which were used in some parts of Australia.
The change in map grid results in UTM coordinates moving about 100–200 metres to the North-East, so it is important to always specify the datum when recording or publishing UTM coordinates.
GDA94 is the same as the WGS84 (World Grid System 1984) for most practical purposes. The differences are of the order of a few centimetres.
For Australian GPS users this means that they should switch the datum / grid on their GPS receivers from AGD66 (Aus Geoid '66) or AGD84 (Aus Geoid '84) to use WGS84/GDA94, and replace their old topographic maps with new ones which are being updated and published with the new map grid. Then no correction to position will be necessary prior to plotting.

Datum Differences

It is important that if you’re using charts to get dive sites locations, or obtaining locations from others, you need to consider the datum being used and adjust accordingly. Failure to do so means that you may be around 180 metres from the dive site, everything else being accurate.
Let’s work through an example. Say someone gave you the coordinates of a wreck as 34° 08' 21" S and 151° 09' 02" E. The datum used for those coordinates was the old Australian AUS66/AUS84. But, then you use the new Australian GDA94 or World WGS84 datum on your GPS as you hunt for the site. You would be 105.1 metres south and 190.9 metres to the west of the wreck. In a straight line, this would make you 218.2 metres south-west of the wreck. So you can see how important it is that you use the right datum when using GPS.

The coordinates using the GDA94/WGS84 datum for the example wreck site would be 34° 08' 15.3" S and 151° 09' 06.2"E. But unless your GPS is using that datum as you head for the wreck, you still won't find it.

Datum Conversion

On many GPS units you can use the unit itself to do datum conversions for you.

- Change the datum on your GPS to the one being used for the coordinates you have been given (e.g. AUS66/AUS84/AGD84).
- Create a waypoint and enter the GPS reading you were given.
- Change datum back to what you normally use (e.g. GSA94/WGS84).
- The waypoint should now have changed to the correct reading for use with your GPS.

There are also free software programs you can download and use to do the conversions for you.

GPS System Errors

So you think that you are going to find the dive site? Ah, it is not yet that simple. Remember that there are errors in the GPS system. Some small ones are inherent with cheaper units but for a long period the accuracy of the GPS system was deliberately degraded by the USA using a process called "Selected Availability".

The quoted accuracy of the system was then 100 metres for 95% of the time. So for over an hour a day it could well have been outside 100 metres. On 1 May 2000, the US Government finally switched off the "Selective Availability" and raw GPS positions are now accurate to about 10 metres at the worst for 95% or more of the time.

Differential GPS allows virtually all errors to be removed, both for the older degraded positions and for the current un-degraded system. Differential GPS positions should be good to a few metres.

Do remember that all GPS positions are that of the receiving antenna, not for the echo sounder transducers!

Still not found the dive site?

Observation Accuracy

In addition the dive site had to be positioned too, usually by some vessel sounding over the top. However, this vessel had positioning errors as well and the size of these errors, despite the best efforts of those aboard and always as-

suming that no gross mistake was made, will depend on the navigation system employed.
For modern work the dive site position will be good to probably 10 metres, but for old work it could be 50 to 100 metres. Many records of dive sites, wrecks etc. are based on positions reported by other divers, a sinking vessel, members of the public, fishermen etc.
Often there is no way of knowing how accurate the report is (or was) and they have to be accepted at face value.
So if you are recording a site, use an average of the readings. Some GPS units have an averaging feature which can be set to record a certain number of readings over a period of time. The unit then provides an average reading which should, in theory, be more accurate than one recording. If you do not have this automatic feature, you can manually record a large number of readings and later average them out mathematically.

Perhaps you have found the dive site now?

" If ya narced and ya know it, clap ya fins "