

Server: Apache/1.3.23 (Unix) PHP/4.1.1 Connection: close Transfer-Encoding: chunked Content-Type: text/html

A General Introduction to the use of a GPS for bushwalkers

<http://anusf.anu.edu.au/~mld900/walks/gps.html>, author Murray Dow

While some of this information applies specifically to the Garmin Etrex and to Australian maps, it should provide a useful introduction to most modern GPS receivers.

[What is GPS](#)

[Selecting and buying a unit](#)

[Setup](#)

[Grid references](#)

[Capabilities](#)

[More involved use](#)

[Recording you walks](#)

[Likes & dislikes](#)

[URLS for further information](#)

[Convert Lat & Long to UTM](#)

1. What is GPS

The Global Positioning System was set up by the US military. It is a network of 24+ satellites whose orbits are carefully controlled: a ground control segment maintains the satellite orbits, calculates ephemeris (orbital information) & uploads this to the satellites. A user's GPS receiver converts data from the satellites into position & time information. Up until May 2nd 2000, civilian users accuracy was ± 100 m, but this has now been improved by the removal of 'Selective Availability', so the accuracy is about ± 15 m horizontal and ± 30 m vertical, as GPS was becoming so widespread. For example, in a car equipped with a GPS receivers & detailed road maps, drivers couldn't tell which freeway they were on!

There is a Russian system called GLONASS which is also available to civilians.

2. Selecting & buying a unit.

Have a look on the web for the latest models & prices. For a bushwalker, you want a rugged, waterproof and light unit which is economical on batteries. The GARMIN Etrex for example I purchased for \$A277, though the RRP seems now to be over \$400. Most modern units are twelve parallel channel which means they should be able to maintain a 'lock' under tree cover. I find my etrex will maintain a lock most of the time under eucalypts but cannot get any satellites under rain-forest. If you plan to use a GPS under heavy tree cover you should investigate buying one with an external aerial.

3. Setup

After buying the unit, you need to choose units (UTM or Latitude & Longitude), Australian map datums, time zone and whether magnetic or true north are used in bearings. The map datum refers to a model of the earth's shape. The datum you choose should match the date of the maps you use, thus use Australian geodetic 66 or 80 for most older maps of the ACT. For more recently published maps etrex advises WGS84. Use of the wrong map datum will mean that gridrefs are inaccurate. Try checking the grid ref then changing the map datum!

To convert from AGD66 (most Australian maps) to WGS84, add 112m to easting and 184m to northing (see below).

4. Grid References - UTM

In some respects UTM (Universal Transverse Mercator) is easier to use than latitude & longitude as UTM is in metres, and on most maps and street directories are marked with a 1km grid. As is described on most maps, to give a gridref you quote easting and northing as two 3 digit numbers, making a 6-digit number, eg for Mt Ainslie 962 948. It is important to understand the units used here: the 96 comes from the VERTICAL 1km grid line 96 & the '2' means 200m to the right. Thus 962 is in units of 100m. On a 1:25000 scale map, 1mm scales to 25metre, and the 1km squares are 4cm apart. To supply or read a fully accurate gridref on a GPS you must use two 6-7 digit numbers, the units being in metres. Hence we multiply 962 by 100, so it becomes 96200. Then we must prefix 96200 with the smaller digits on the top or bottom of the map - in this case 6, thus the easting is 696200. Similarly for northing: we prefix with 60, thus the full gridref is 55H 696200 6094800. On walking up there and checking it I find 55H 696269 6094854.

On the edge of some maps this is written as 696269 6094854, which emphasises the original 6 digit grid ref.

It can also be important to note that in the ACT region we are in 'map zone' 55H. Each map zone is 6° wide and 8° high; there is a boundary at 150° longitude, (which runs through Marulan/Bungonia) where the easting 'jumps' discontinuously.

Thus if we are entering gridrefs that cross this boundary we will need to prefix with the correct map zone. All NSW and VIC is covered by 6 map zones (54,55,56 J & H). For a pic of the World's map zones see [utmworld.gif](#). Being a Mercator projection, UTM is not useful close to the poles.

Alternatively use of lat & long will avoid the complication of map zones and the confusing tiny lettering around the edge of maps.

I have written two fortran programs to convert between lat/long and UTM:

To convert from lat/long to UTM see [geog_grid.f](#)

To convert from UTM to lat/long see [grid_geog.f](#)

Most maps have lat & long marked around the edge of the map with 1' markers in alternate black & white filled-in lines. However to specify a co-ord in lat & long is longer and harder to remember than a simple 6 digit UTM reference that is accurate to 100m.

You can of course use the GPS to convert any co-ord in lat&long into other systems such as UTM.

5. What GPS can & can't do.

The receiver will give reasonably accurate horizontal positions provided it has a clear view of 3 satellites, but for reasonable height information needs more than 3. If you are under heavy tree cover it may not be able to do this, but it will warn you of poor signal. Worse still, if you are in a gorge or on the side of a steep hill, **it can give misleading readings**. It appears to do this because it picks up *reflections*, and can thus indicate an unvarying direction that is 180° out until it gets better reception. For optimal accuracy you will need more than 4 satellites, the accuracy depending on the geometry of the available satellites - thus if they are all in a straight line, accuracy will be poor. Because of this it is not recommended that you navigate solely by GPS, apart from the desirability of following scrub free areas or ridge routes rather than just walking in straight lines irrespective of the terrain. On my first helicopter flight into Christies creek in the Blue mtns I wondered why the pilot had dymoeed a warning 'not to navigate solely by GPS' above the unit! When you first turn the receiver on it 'locks on' to the satellites, meaning it downloads complete ephemeris information, provided it has a clear view. Any interruption means it has to listen to the whole cycle again, so it is important that the GPS has a clear view of as many satellites as possible. From then on it can maintain that lock despite interruptions to signals, thus the GPS will be tracking up to 12 satellites but may be maintaining sufficient simultaneous signal strength from only 3-4. Altitude information will be quite misleading if it only has 3 satellites visible, and it is also worth leaving the GPS on for a few minutes before using it for serious work, as the initial readings can be misleading. At any stage the US military may degrade the accuracy of civilian signals, and its accuracy depends on the current geometry of the available satellites.

The direction arrow on the GPS display is not like a compass - you have to start walking before it indicates direction of travel, so some spatial knowledge or initial use of a compass is desirable. Most stationary GPS units will not give north, though it will give a bearing to your next waypoint, so you may need to transfer this bearing to your compass to start walking! It also does not matter which way you point the GPS - it indicates the direction you have just walked by placing it at the top of the display.

The Etrex has a battery save option which causes the GPS receiver to be turned on only every 5 seconds. Unfortunately this can make it hard to follow the direction arrow as it jigs around erratically due to the delay between slight changes of direction and the GPS registering this. For this reason, transferring the GPS bearing to an oil-damped compass is advisable, or using normal mode (non-battery-save) when approaching your destination.

6. More involved use

Modern receivers give speed, heading, bearing, height, grid ref, distance & time travelled and the distance & expected time to your next waypoint. They may have a map display showing detailed contour/street information or just a simple display of 'waypoints' and route followed. The ideal way to use the GPS is in conjunction with digital map information on your computer. Thus you choose a sequence of 'waypoints' (grid refs), these are linked to form a 'route' which is downloaded to the GPS unit. Then while walking the GPS will navigate you past each waypoint without any tricky entering of gridrefs. Gridrefs in UTM are 2 six-digit numbers, easily stuffed up if you have to determine them from maps by hand but easily done if all you have to do is click a mouse on a point on the computer screen. Thus for example you can use the GPS to give you an accurate bearing to your destination, then just use your compass to follow this bearing, which is easier than holding a GPS unit whilst walking! If you choose a waypoint that is a recognizable landmark, you will only need to turn your GPS on when you reach its vicinity to check for the next bearing. As you walk past the waypoint, the GPS should automatically recognize you are heading for the next one. Then save batteries and turn it off until you approach the next waypoint to check your heading!

6.1 Routes

When entering a route into the GPS it appears necessary to start the route with your current or starting position otherwise the first route point may be ignored as the GPS attempts to 'insert' you into the route. It also does not appear to be possible to specify a circular route as the GPS attempts to find where you are in the route, which will probably be where you want to end/start, and will not direct you away from there until you are some distance from the start/end.

7. Recording your walks

By leaving the GPS on whilst travelling, it automatically records any changes in velocity, recording your position and altitude whenever you change speed or direction. Then you can download this track information to your computer and plot it, giving such information as total distance walked, average speed etc. The model I own used to be able to record several days of bushwalking (1500 track points), but version 2.10 of the software records many more accurate trackpoints.

8. Likes & Dislikes of the GARMIN Etrex receiver.

- **The display of grid reference or lat & long is so small to be useless in an emergency - it is very hard to read. You would get very little chance on a sinking boat to be able to read the grid ref and get out a mayday in difficult circumstances**
- Version 2.10 of etrex software now displays satellite positions and signal strengths. (See [garmin etrex software](#)).
However it now stores more track points, using more memory. For example, on a 2 hour walk I used 50% of the memory! Admittedly, this was a 'crinkly' walk. Workaround is to 'save' the track regularly.
- tiny font used for Grid ref, making it very difficult to edit a grid ref on the fly
- discards time information when track is 'saved'.
- Does not work if put vertically in a shirt pocket (because your body is shielding some of the satellites)
- You can save batteries by using 'demo' mode when interfacing with a PC or entering waypoints, because demo mode turns off the power-hungry GPS receiver.
- The distance that the GPS reports you have walked does not seem to include changes in height, thus it understates distances.

I recommend buying [OZI Explorer](#). You can interface with a laptop when in a vehicle to get 'moving map' display, but you have to scan your own maps. The etrex 'demo' mode will simulate this.

9. URLs for further information

General Information	
http://www.gpsworld.com	gpsworld
http://www.igeb.gov	interagency gps executive board (IGEB)
http://www.colorado.Edu/geography/gcraft/notes/gps/gps_f.html	Peter Dana's course on GPS
http://joe.mehaffey.com	GPS Information, Software, and Hardware Reviews
pic of the World's map zones	See http://www.dmap.co.uk/utmworld.htm
http://www.garmin.com/aboutGPS/manual.html	GPS Guide for beginners
Suppliers of GPS-PC Communications software	
http://www.macgpspro.com	MACGPSPro software
http://www.gpsu.co.uk	GPS Utility
http://www.gpsy.com	Macintosh GPS comms
http://members.home.net/crh24/gps/g7towin/g7towin.htm	G7ToWin freeware
http://www.ozieplorer.com	Ozi Explorer Page - cost \$USA75 (scan your own maps)
http://members.nbci.com/kpv	NavSafe???
http://shareit1.element-5.de/programs.html?productid=101412&languageid=1	NavSafe cost \$95(can use scanned maps)
Suppliers of GPS Receivers	

http://www.garmin.com	garmin
http://www.magellangps.com	magellan
http://www.lowrance.com	lowrance
http://www.ja-gps.com.au/gpsprod_etrex.html	Johnny Appleseed G P S Products
Miscellaneous	
http://www.auslig.gov.au	Australia's national mapping agency
http://www.rssi.ru/SFCSIC/english.html	Russian GPS (GLONASS)
More on UTM	
http://www.nps.gov/prwi/readutm.htm	
http://members.home.net/don.bartlett/gpsutm.htm	

The newsgroup sci.geo.satellite-nav can be very useful.

See also [article by Chris Miller et al.](#)

As far as I know the digital maps supplied by auslig are not good enough for most bushwalking, as they are taken off a the 1:250000 scale series. The lack of a national approach to mapping is evidenced by maps such as Nadgee 1:25000 - the map stops at the border!

Recent advice is that AUSLIG will be providing smaller scale maps soon.

Interim solution is provided by (if you have a scanner) [DesNewman's Ozi Explorer](#)

You can get co-ords of places from [auslig's website](#), but they are not accurate enough for serious work.

10. Convert lat & long to UTM

Here are fortran programs which convert lat & long to UTM [geog_grid.f](#) and to do the reverse: [grid_geog.f](#)
Test data files are [dat_gegrid](#) and [dat_gridge](#)

The formulae used are from [GDA Technical Manual](#) but any mistakes are mine... as I'm sure there are regions where the program will be wrong. See [DMAP](#)

12 August 2002

Mail: