How to use the Macintosh to Geocode media for Google Earth and Google Maps

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Abstract. Google Earth and Google Maps are making the world smaller and more visible. All sorts of ingenious applications are being developed to give data location: tourism, media, real estate, disease, sport, the list goes on. In his presentation James will show you how to use a range of applications to use raster topographical maps to plan routes, navigate them via GPS, display the routes in Google Earth and Google Maps with geocoded photographs and other data, and share these with the community.

Keywords: GPS, global position systems, geocode, Google Maps, Google Earth.

Note

The usual warning applies: You should NOT rely on GPS alone for navigation. Take spare batteries, a paper map and compass, and know how to use them. Tell someone what your plans are, and report back when you return.

1 Introduction

Google Earth. Google Maps, Assisted GPS (AGPS) on phones, e911, e112 are great opportunities for the Mac community. There are many activities in universities that could benefit from simple techniques to geolocate data and include it in research and teaching. I see the exploding growth of location data, in the sciences, engineering, anything that currently uses maps, even art.

GPS has of course its limitations: it's not accurate enough for surveying and it doesn't work indoors. Urban canyons, tropical rainforests, any decent tree cover, anywhere you don't have a good view of the sky will challenge the technology. If you want to use GPS to find yourself within a few centimetres then you will be disappointed.

Assisted GPS will improve the indoors experience, but AGPS needs access to an assistance server at the base station end, and of course a signal on your phone. If you don't get a carrier signal indoors on your phone now, AGPS is not going to be of much help.

Having said that, there are still plenty of ways you can determine your location at a particular point in time. Keeping records of these locations can help you add data to digital files that will make it easy to display data in context, on Google Earth, for example.

The main example I will be using is adding location data to digital photo files, but the basic techniques can be used for motion images, sound and any sort of information that has location. Geocoding photos is really quite simple. The best way is to combine the location data with the digital photo file when the picture is actually taken. Your camera might have a built-in GPS receiver (like the Ricoh Pro G3 – GPS), or you may have a GPS unit with a camera built in (Navman N40i Automotive GPS with NavPix™ 1.3 Megapixel Digital Camera), or a camera which interfaces with a GPS unit (Nikon D200). You can also use the Sony GPS-CS1 - Digital camera GPS unit, or any GPS unit that stores location information by time, but then you need a way of inserting the data into the digital photo file.

EXIF (Exchangeable Image File Format) is a standard for storing information like location data in image files, especially JPEG files. Most digital cameras now use the EXIF format, part of the DCF (Design rule for Camera File system) standard created by the Japan Electronics and Information Technology Industries Association (JEITA) to encourage interoperability between imaging equipment.

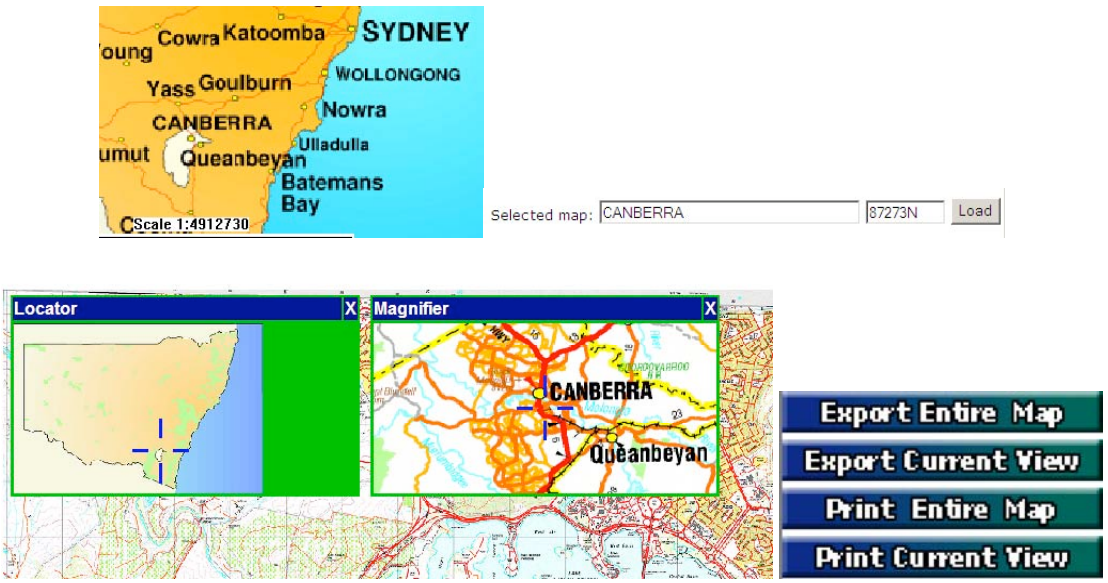
This paper will take you through how to use topographical maps to plan routes and guide you, capture location data, match the location data to photographs (and other media), and present the results. I'll use a bushwalking example to show you how to plan your route using topographical maps, transfer the route to a GPS, capture the track you actually followed on the walk, match it to digital photographs taken during the walk, and display the photos and the track in

Google Earth and on Google Maps. If you already know where you are going, or don't care to plan your route, you can skip the Topographical Maps section and go straight to Tracking.
I'm an enthusiast rather than expert in this area, but I would like to share some of my enthusiasm for mapping media.

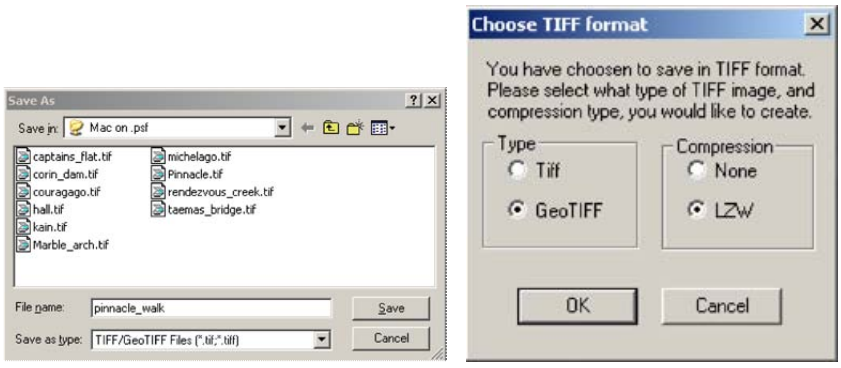
2. Topographical Maps

In New South Wales, I use the Department of Lands' TopoView Raster application and maps (see Tools at the end of the paper for links to the applications I refer to). These maps come on DVD and cover the whole of New South Wales at 1:100,000, 1:50,000 or 1:25,000, depending on where they are: the east coast maps are at the larger scale, central is the mid-size, and the 1:100,000 scale is used for the maps in the west of the state.

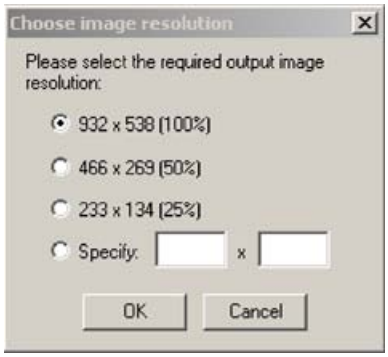
Unfortunately the NSW Department of Lands doesn't support the Macintosh, and I have been unsuccessful in finding an application that will read the map files (the Department uses MrSid compression on the raster map files for which I can't find a decompressor). But not to worry, with Parallels and Windows it's not a problem.
You start off with a map of the state, click the general area you want the map for, and load it. Export the map (or the current view) as a GeoTIFF file to somewhere you can see it on the Macintosh.



Load your selected topographical map and export it (entire map or just the selected view)



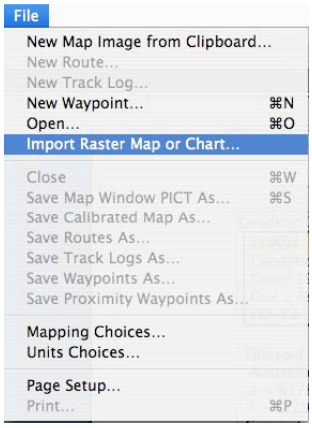
Save the exported map as a GeoTIFF somewhere the Macintosh can see it



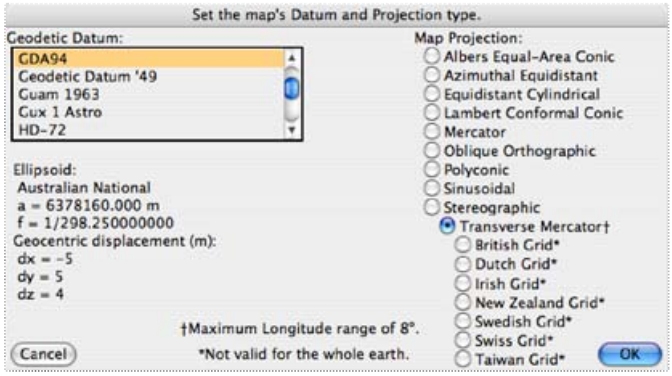
Save the image at 100%

Get info on the map before you leave the PC. Check the Datum and the Zone (55 here)

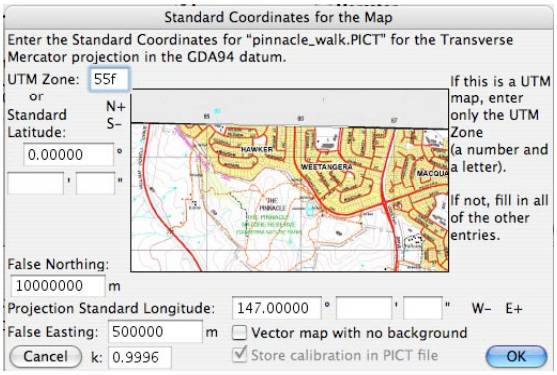
When you have exported the map (and taken note of the Datum and the Zone), open MacGPS Pro on the Macintosh. Choose Import Raster Map or Chart… from the File Menu, and select the map you exported from TopoView Raster on the PC.



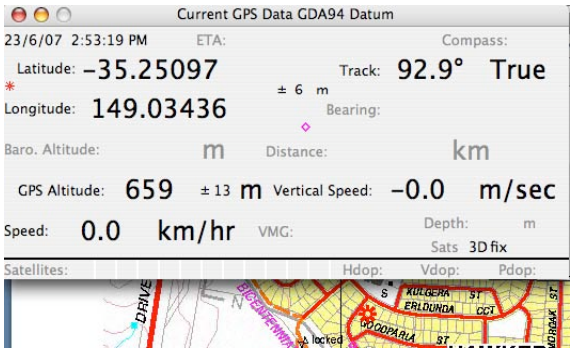
You will be prompted to save the GeoTIFF format original map as a PICT file: choose a suitable location to store your maps, so you can later open them without the need to reimport them. While you are importing the map several windows appear for you to set various parameters for the map so MacGPS Pro knows where it represents and so on.



Set the map's datum and projection type. The datum is CDA94 (from the info panel on the original map), and the projection is Transverse Mercator.



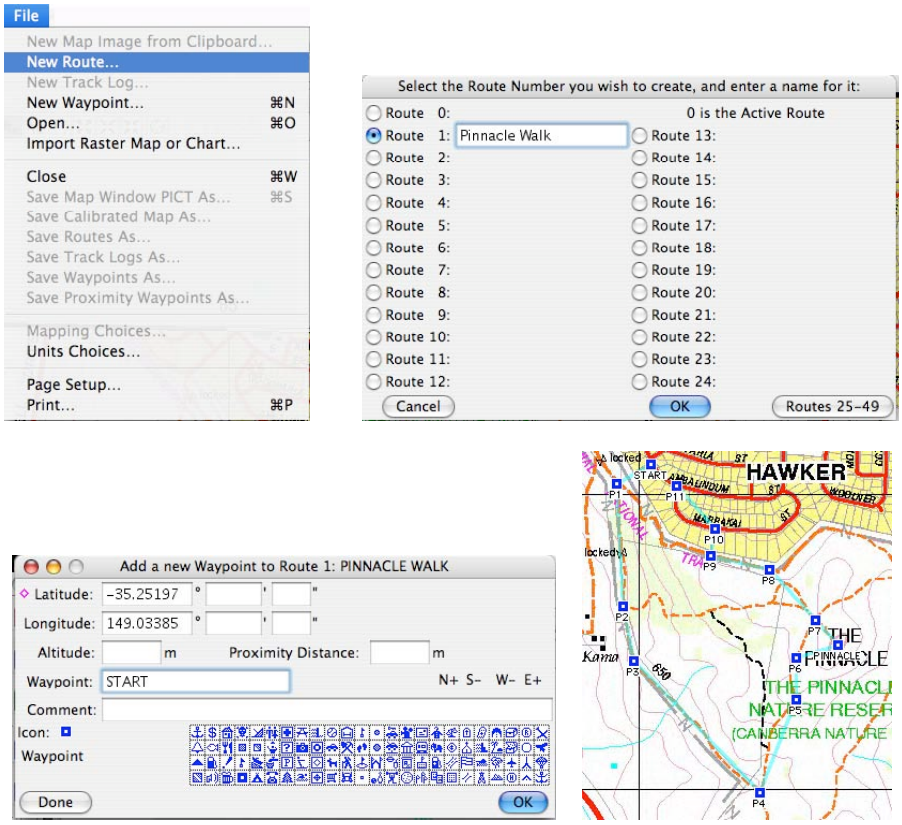
The NSW topographical maps are UTM maps, so you can enter the UTM Zone to tell MacGPS Pro where the map is located in the world. The Zone is the Zone you recorded from TopoView (55), plus a letter. See http://www.dmap.co.uk/utmworld.htm for the grid: New South Wales lies within H or J, it doesn't seem to matter all that much which you use. The paper topographical maps do record the Zone fully (including the letter), but not the electronic versions that I have been able to see. If you have a GPS unit available to the computer at this point, and the GPS receiver can get a position fix, you can see your current position on the map.



The red asterisk is the current position

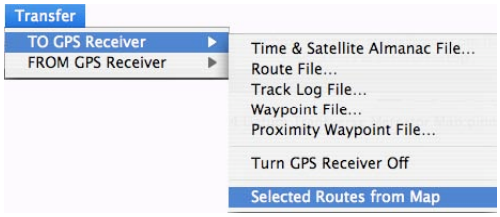
3. Plan your route

Now that you have your map, you need to plan your route. In MacGPS Pro, choose File>> New Route… Name the route, click OK and start adding waypoints to the route by clicking points on the map and naming them.



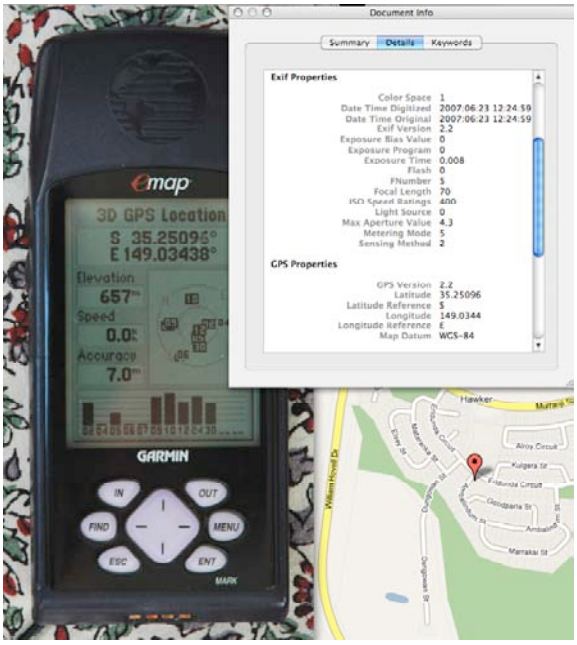
Create a new Route, name it and add waypoints

Save the route, and transfer it to the GPS (you will have to stop current GPS reading: Real Time >> Stop Current GPS Readings): Transfer>>TO GPS Receiver>>Selected Routes from Map.



4. Tracking

Check the camera's date is correct, clear any track logs from the GPS (leave the route you've just entered if you have one), and navigate the route or just wander about with the GPS on. Take a shot of the location screen of your GPS as a reference photo every now and then to confirm the location with whatever other system you are using to geocode: make sure the GPS is set up to display your current location in whatever location format and datum that makes sense to the geocoding system you are using. It's a good idea to test this out before you commit too much time and energy to collecting data only to find out what you see on your photos of the GPS screen don't line up with the map later.
For the photo in the screenshot below (I'm using Preview to display the Info from the file), I set the GPS to display the location using the hddd.dddd° location format and GDA84 datum that is supported by the PhotoInfoEditor application I used to add the data to the photo. You can see the info in the photo file matches (almost) the display on the GPS screen. You can also see the time the photo was taken. Later you will see how to geocode a whole range of photos automatically by matching the time each photo was taken with a GPS track log. Reference photos of the GPS screen will confirm the automatic process (especially if you can see something in the photo of the GPS screen that can be used to confirm its location when the shot was taken.

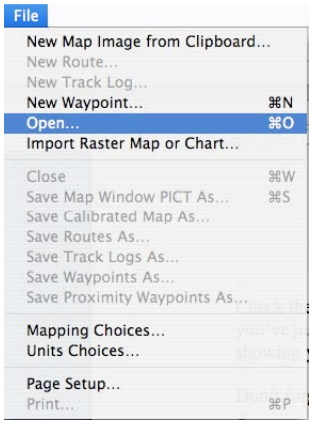


Geocoded photo in Preview showing Get Info window. Map is in PhotoInfoEditor

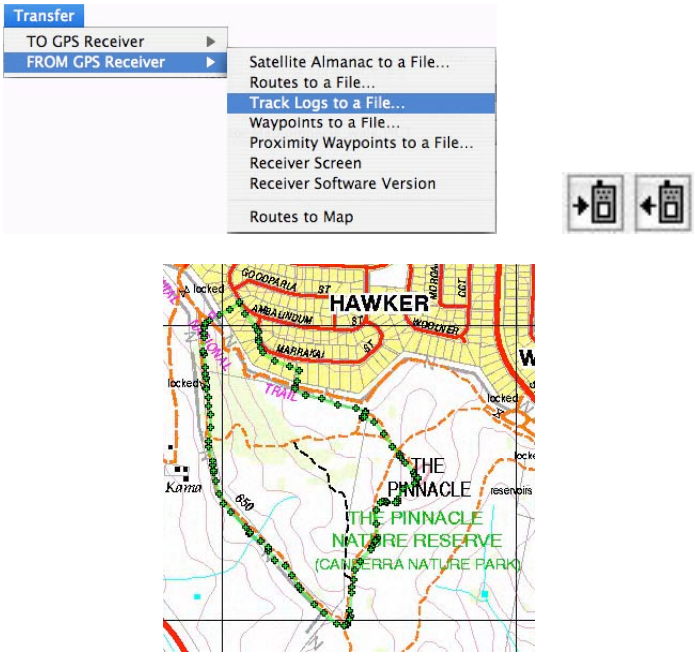
Make sure the time and date are set correctly on your camera. This can be a bit of a challenge when Daylight Saving starts or ends, and is especially important when you travel across different time zones.
Take a reference photo of the GPS screen showing your location at a known point. Be careful not to take the photo of the GPS screen somewhere where you might be twice at different times on a walk: it might confuse the matching process later on. Also take the photo at a point you are only at for a short period of time to increase the accuracy of the geocoding of the other photos.
Don't forget to take plenty of photos on the route.
When you finish the route, save the track log in the GPS. Make sure the track log that your GPS unit saves includes the time data as well as location. Altitude is also useful for 3D applications.

5. Geocoding the location of the photos

Back at the computer, transfer the photos to the computer (I use iPhoto, but you need the photos outside iPhoto to do the geocoding). I import the photos to iPhoto from the camera, export them to the Finder for geocoding, and re-import the geocoded photos into iPhoto when they are done, deleting the original imports.
Open MacGPS Pro, and open up the base map you used to plan the route.



Transfer the track log from the GPS unit (you can use the menu command Transfer>>FROM GPS Receiver>>Track Logs to a File…), or the tool.



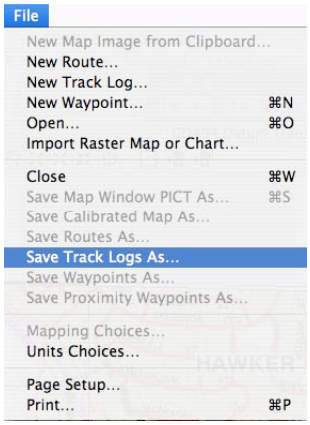
The green line is an imported Track Log, selected

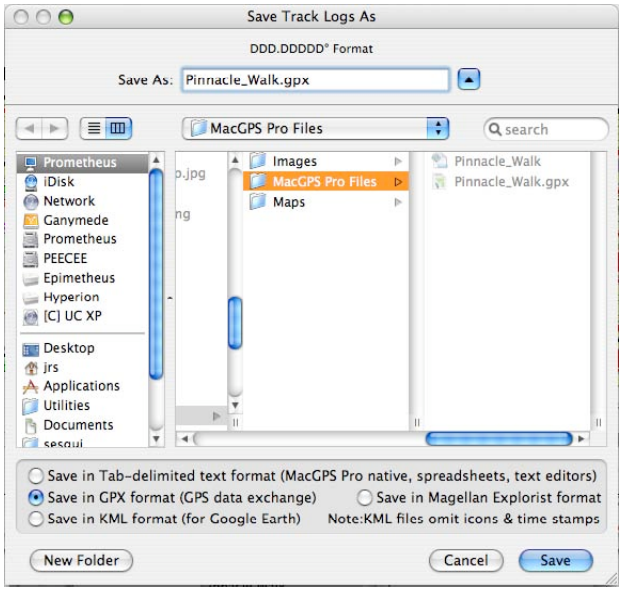
```
Format: DDD  M/D/Y H:M:S  10.00 hrs  Datum[115]: WGS 84
ID        Date Time Latitude Longitude   Altitude
L         ACTIVE LOG
T         05/06/2007 09:54:31     -35.25105   149.03450   631.7
T         05/06/2007 09:55:48     -35.25094   149.03461   635.1

T         05/06/2007 09:57:08     -35.25101   149.03523   635.1
T         05/06/2007 09:57:18     -35.25092   149.03443   650.5
T         05/06/2007 09:57:24     -35.25092   149.03439   648.1
T         05/06/2007 09:57:39     -35.25090   149.03430   648.1
T         05/06/2007 09:58:22     -35.25105   149.03415   651.4
T         05/06/2007 09:58:51     -35.25159   149.03390   650.9
T         05/06/2007 09:59:12     -35.25191   149.03396   652.4
T         05/06/2007 09:59:40     -35.25210   149.03405   652.9
T         05/06/2007 09:59:41     -35.25210   149.03405   652.9
T         05/06/2007 10:00:06     -35.25232   149.03366   654.8
T         05/06/2007 10:00:36     -35.25251   149.03327   655.8
T         05/06/2007 10:01:04     -35.25268   149.03293   656.7
T         05/06/2007 10:01:17     -35.25277   149.03278   656.7
```

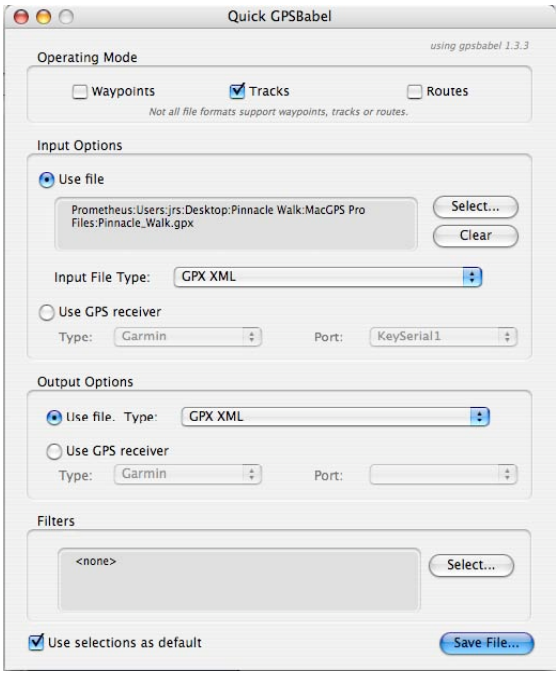
Part of a Track Log (MacGPS Pro tab-delimited format)

There is no single standard for GPS files, the trick is to make sure you can translate your files to each of the standards used in each of the applications you use. The Garmin eMap I use supports NMEA 0183, RTCM 104 DGPS and proprietary GARMIN data formats. MacGPS Pro understands the device (a list of compatible GPS units is on the James Associates website: see Tools later in this paper) and translate the track log data to its own format (tab-delimited text, which can be opened in other applications if required and edited). For geocoding using PhotoGPSEditor, you need GPX format (but not the GPX format MacGPS Pro exports: you need to translate the MacGPS Pro GPX format to GPX XML format using GPSBabel+), for Google Earth and Google Maps, use KML (although MacGPS Pro doesn't support time or icon data in KML, so you lose that when you export the track log from MacGPS Pro. More on this later).



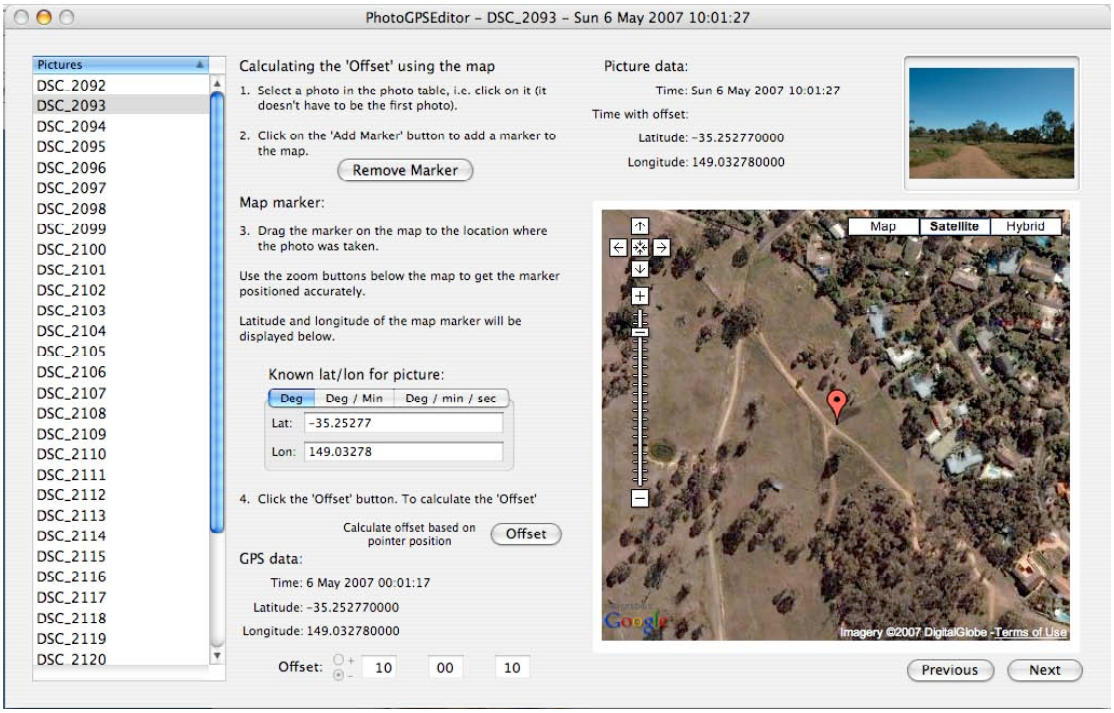


Save the Track Log in GPX format, then convert it using GPSBabel+ to GPX XML format (!)
File Management can be a pain with all of these various files and formats, and you need to keep everything if something goes wrong and you need to go back a few steps. I haven't got an answer to this yet, but you need to work out a system that suits your requirements. Probably the best idea is to create a directory structure for each project, with folders for the various files to be used.
Open GPSBabel+, Operating mode: Tracks. Input Options: Choose the GPX file you saved from MacGPS Pro, select GPX XML as the Input File Type. Output Options: Use file Type GPX XML (it does some translation: if you compare the two file you will see they are different in format). Save File…



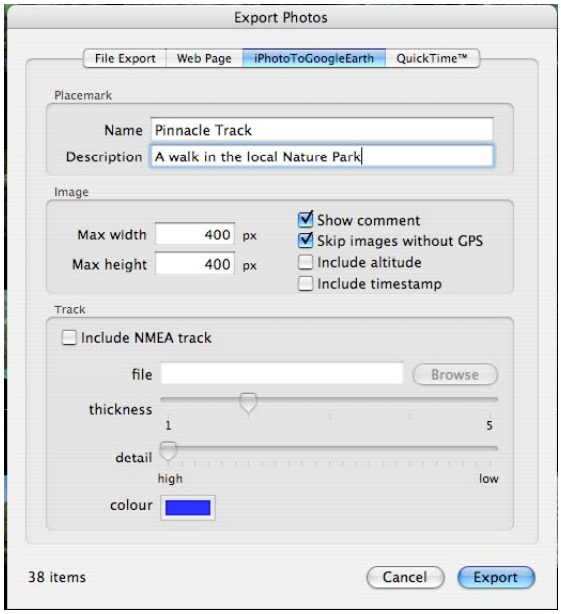
PhotoGPSEditor uses Google Maps to help you automatically geocode a collection of photos taken during a trip that you have a GPS Track File for. You need to be connected to the Internet to use the mapping components of the program.
Use the Wizard in PhotoGPSEditor. Open your original photos, load the GPX file from GPSBabel+, and set the offset. I find using Calculate the 'offset' using the map works: find a photo you know where you were when you took it (a reference photo of the GPS display is handy here), Add Marker to the map (or satellite image) where you were when the

photo was taken, and click the Offset button to calculate the offset for that photo (hint: click Pictures at the top of the list of photos to sort the photos by filename. If your camera creates files with sequential names the oldest pictures will be at the top, descending to the newest at the bottom).

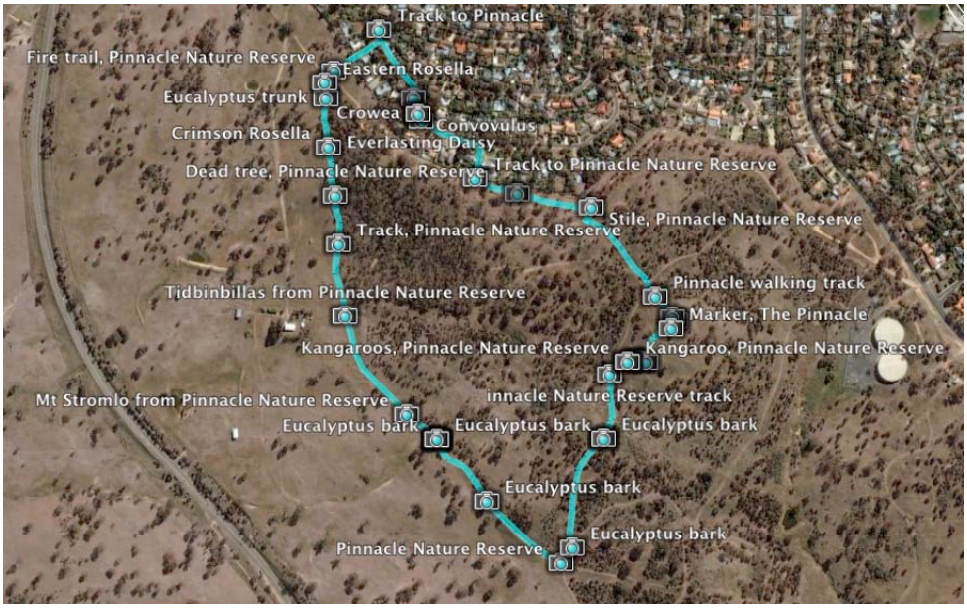


When you are satisfied you have the correct offset (the GPS data I use seems to be interpreted by PhotoGPSEditor as UTC: Coordinated Universal Time, aka Greenwich Mean Time, so the offset between the GPS data and the photo data is 10 hours), advance to the next screen in the wizard and apply the offset to all the photos.

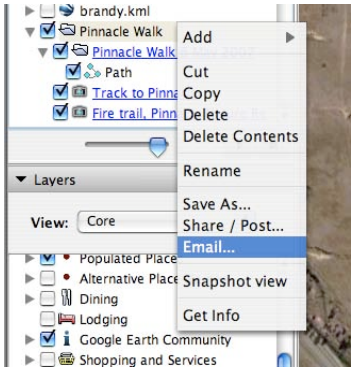
PhotoGPSEditor allows you to change the names of the files (in the first screen), add a Description and Comments to each photo, and edit the fields added automatically by the application. I leave this until the Google Earth stage, since you can't be sure the comments will be maintained, and will have to be re-entered to display in Google Earth and Google Maps anyway. The last step in the Wizard is to save your photos. PhotoGPSEditor does not overwrite your original files, so copies will be saved with the added data embedded. Re-import the geocoded photos into iPhoto. Export them using iPhotoToGoogleEarth.



I've found it best to add the track data to Google Earth separately rather than babelling yet another format of file that works every time with Google earth. You can use the GPX file that you created earlier for the geocoding, or export the Track Log from MacGPS Pro as a KML file.
iPhotoToGoogleEarth produces a KMZ file: a KMZ file is just a zipped KML file.
Open the KMZ file in Google Earth, and the photos should display, located where they were taken. Open the Track Log file, and the route you took should also display. I add the descriptions and so on here before saving the photos and track in Google Earth.
Note that when you open the files in Google Earth, they are held in Temporary Places. Save them to My Places before you leave Google Earth.

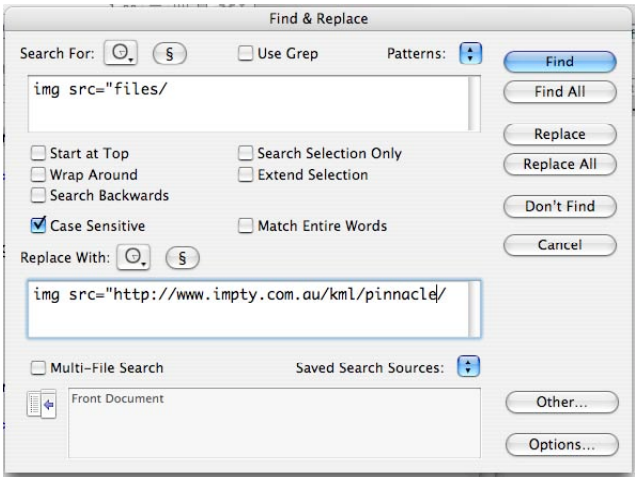


Once the photos and track are in Google Earth, you can share them through the KMZ file. I've found the easiest way to do this is through the Email… option (Right-Click, or Control-Click, the collection, and select the Email… option in the contextual menu).



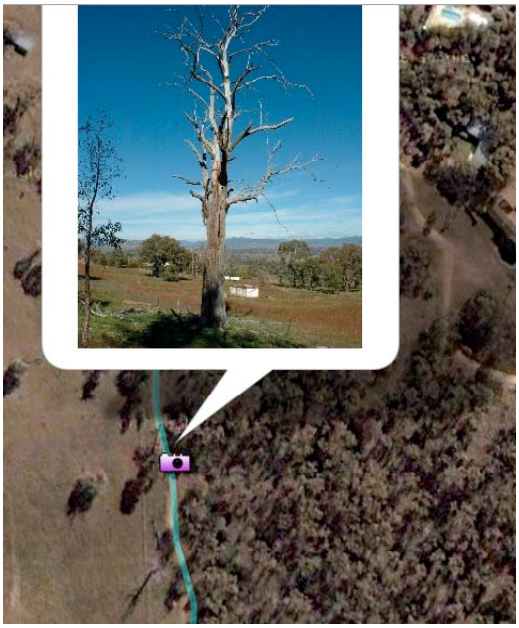
Attached to the email that is created is a KMZ file containing the track and the photos, and all the data you've added to the photos. Send the file to anyone you want to share it with: they can open it in Google Earth and see your track and photos.

To share the data simply through Google Maps, you will need to host the data files on a web server you have access to. Since Google Maps won't let you share large files (like the archived KMZ files), you will have to unpack the KMZ file and host the KML and photo files on your own server.
Drop the KMZ file on Stuffit Expander to recover the KML file and the photos. Since you are extracting the files from the archive you will have to redefine the file paths to the photos relative to your server. Use the full absolute path rather than the relative path that works with the archive to simplify the process. In the example below I've replaced the relative files path with the absolute path to the photos on the server I host them on. The KML file is also hosted there as well.



Use a text editor to fix the file paths. TextWrangler is free

Upload the files, and search http://maps.google.com/ with the url of your KML file. You can also put the query in the url: for example http://maps.google.com/?q=http://www.impty.com.au/kml/pinnacle_walk.kml will display the track and location of the photos on Google Maps using data from impty.com.au.



If you look at the KML file, it's easy to see how you can add other text and data (like video, for example) to the display. See http://code.google.com/apis/kml/documentation/ for Google's documentation of KML.

6. Possibilities

Time and date, latitude and longitude, and maybe altitude (height), are ok, but what about azimuth (direction), altitude (angle from the horizon), angle of view, and zoom (foreshortening)? All these will add to contextualising media within the environment. Imagine being able to move through a space not only as it is, but as it was: see images, still and motion, hear sounds, "see" data, with a CoverFlow effect on the computer.

7. Conclusion

This has been an explanation of how I've developed a workflow to present geocoded media. Your mileage might vary, and ever since I started the project a year ago there have been new tools coming out all the time. Some of my procedures might now be more easily done using Google Maps and Google Earth; other applications are coming out that do several of the steps themselves. You could write the KML files from scratch using the help Google now provides for the KML specification. It will certainly become easier to geocode photos than I've had to learn how to do, but at least I've had to understand just about every step along the way in order to make it work, with still plenty of things to learn.

Tools

1. NSW Department of Lands *TopoView Raster 2006* http://www.lands.nsw.gov.au/survey_mapping/maps_and_aerial_photos/topoview [about AU$275]
2. SWSoft Parallels *Parallels Desktop 3.0 for the Mac* http://www.parallels.com/en/products/workstation/mac/
3. James Associates *MacGPS Pro* http://www.macgpspro.com/ [US$49.99]
4. GPSBabel *GPSBabel* + http://www.gpsbabel.org/
5. MMISoftware *PhotoGPSEditor* http://www.mmisoftware.co.uk/pages/photogpseditor.php [nagware up to £30]
6. Apple Inc. *iPhoto* http://www.apple.com/ilife/iphoto/ [part of iLife '06 AU$ 119.00]
7. iCraig *iPhotoToGoogleEarth* http://craig.stanton.net.nz/software/iPhotoToGoogleEarth.html [freeware]
8. Bare Bones Software *TextWrangler* http://www.barebones.com/products/textwrangler/ [freeware]
9. Google *Google Earth* http://earth.google.com/ [freeware]
10. Google *Google Maps* http://maps.google.com/ [free]
11. SmithMicro Software *Stuffit Expander* http://www.stuffit.com/mac/expander/index.html [free]