Using Linux to Build Custom Topo Maps and Load Them Into Your Garmin GPS

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0 Introduction

These are my notes on building custom topographic maps under Linux and loading them into my Garmin GPS unit. I run Debian testing and I have a Garmin Legend Cx, and I have used these steps to load a detailed topo map covering 2,500 square miles. I hope that you find them useful as well. **I would welcome any suggestions or other feedback.** You can reach me at reid@reidster.net.[1]

Much of the information here comes from Jack Luers' excellent directions on doing the same thing (http://home.cinci.rr.com/creek/garmin.htm), but this page is shorter (believe it or not), better-organized, and directed to a Linux crowd.

Note that this process can takes **long time**, perhaps several days. A lot of that you don't have to be present for: waiting for the computer to process things and for the USGS to prepare data. I would set aside several days for your first time, to avoid risk of last-minute panic. Another thing to be aware of is that your maps **will not match the USGS quads**. Only water and elevation contours will be included, and

[1]

the contours will look different. You also need to be prepared to download tens or hundreds of megabytes of data, depending on the size of the map you create.

Why would you put up with this? Several vendors, including Garmin, are willing to sell you maps that you can upload into your GPS. Detailed data is not available from Garmin except for national parks, and for the others I know of, you get a limited amount free with your initial purchase and then you have to pay, pay, pay. The process I describe here costs you nothing. Also, vendor solutions only seem to work on Windows.

1 Update GPS Firmware

For the Legend Cx, you need **firmware version 2.50** or higher to put the device into USB Mass Storage mode, necessary to complete these steps. You can flash your device to a newer firmware, which I did, though I did it under Windows – I wasn't willing to risk bricking my brand-new GPS unit by trying such a touchy operation using Wine. (The remainder of the steps, however, are all possible under Linux.) Garmin has directions (`http://www.garmin.com/support/download_details.jsp?id=1385`) on updating firmware. My unit, purchased in September 2006, had version 2.40, and I updated it to 2.60.

If you have information on other units, please let me know (`reid@reidster.net`).

2 Create Water and Elevation Vectors

The first step is to get water and elevation information into a vector format. While USGS publishes vectorized versions of standard quads, called DLGs, availability of them seems very spotty as of October 2006. USGS has a website which claims to tell which areas are available as DLG (`http://statgraph.cr.usgs.gov/`), but it disagrees with what seems to be actually downloadable (`http://eros.usgs.gov/geodata/`). I would love enlightenment on this situation if you have any information.

This section explains how to download water data from the USGS's National Hydrography Dataset (which is already vector) and to convert the USGS raster elevation data (DEM) into elevation contour lines.

2.1 Download water data

You won't actually use this until later, but it takes a while for the USGS to package up your data.

1. Browse to `http://nhdgeo.usgs.gov`.
2. Set your popup blocker to allow popups from this site. (By default, Firefox blocks the download window.)
3. Use the web application to zoom to your area of interest. Be patient, and do not do anything the app is not expecting. It is rather finicky. Zoom in enough so that Subbasins appears under NHD High Res.

4. Under Hydrologic Units, tick both the checkbox and radio button for Subbasins. Click Redraw Map to update the view.

5. Observe that the map is divided into irregularly shaped areas labeled with 8-digit numbers. These are "Subbasins", and these are the chunks in which you download water data. (I'd be curious on how to download via rectangle rather than by subbasin.)

6. At the bottom of the left side, click on Polygon Extract.

7. Drag a box over your area of interest. This works, but it's kind of strange – Firefox thinks you are dragging a link. You may have to click a second time to make it go. You can also click on each subbasin invididually, in which case you'll repeat the following steps for each.

8. The subbasins you've intersected will turn blue, and a window will pop up. Tick High Resolution and Shapefile. Enter your email address. Click Extract.

9. You should get a dialog saying your request has been submitted and to expect an email. Click OK.

10. You may or may not get an email immediately, but regardless, it's not the one you want.

11. After some time (anywhere from a couple of hours to a few days), you'll get an email with a download link. When you do, download the linked files.

2.2 Download elevation data

In this step, you will download raster elevation data, i.e. a grid of elevations at approximately 10 meter resolution.

1. Browse to `http://seamless.usgs.gov` and click on View and Download United States Data.

2. Zoom in to your area of interest. Again, be gentle with the web app.

3. Click on Downloads on the *right*. Click on Elevation. Untick 1" NED and tick 1/3" NED

4. Under Downloads on the *left*, click on the Define Download Area tool (it's first).

5. Draw a rectangle around you area of interest. **You are defining the extent of your map** in this step.

6. A window will pop up. Click Modify Data Request.

7. Ensure that only NED 1/3 Arc Second is checked, and choose GeoTIFF and TGZ. I suggest that you leave the chunk size at 100MB rather than increasing it. Click Save Changes and Return to Summary.

8. Click Download for each chunk. The sizes listed are uncompressed; what you download will be smaller. For each, another window pops up. (The remainder of this document assumes that you downloaded only one chunk, but it should be easy to adapt if you have more than one.)

9. Be patient – the USGS stores this data in giant robotic tape libraries, and it takes a couple of minutes to gather it all.

10. Save and extract the resulting archive. It contains a pile of files; what we are interested in is the one ending in .tif: this is the file containing the DEM data.

Incidentally, all of this is your tax dollars at work. Taxes enable the creation of great community resources like these.

2.3 Create elevation contours with GDAL

To do this, you will need to install GDAL, which is beyond the scope of this document. Under Debian, just install the gdal-bin package; otherwise, see `http://www.gdal.org/` for more info. (Many thanks to Dylan Beaudette for pointing me to this tool. The old way involved installing the IDL Virtual Machine, a gargantuan tool which is hard to download and install, doesn't play nicely in a UNIX filesystem, and shows you advertisements.)

1. Navigate to the directory containing your GeoTIFF DEM file.

2. Convert the DEM elevation units from meters to feet (optional):

   ```
   $ gdal_translate -scale 0 10000 0 32808.399 29901365.tif feet.tif
   ```

3. Build major contours (200-foot interval, adjust to your preference):

   ```
   $ gdal_contour -a elev -i 200 feet.tif major.shp
   ```

4. Build intermediate contours (40-foot interval, adjust):

   ```
   $ gdal_contour -a elev -i 40 feet.tif inter.shp
   ```

3 Create Map

For this step, you will need GPSMapEdit (`http://www.geopainting.com/en/`) and Wine, the Windows emulator. GPSMapEdit version 1.0.32.0 and Wine version 0.9.30 worked for me (Wine 0.9.25 did *not* work). Installing and configuring Wine is beyond the scope of these notes, but make sure that the files above are in a place accessible from inside Wine.

Don't forget to save frequently as you carry out the following steps. Also, GPSMapEdit seems to crash during import for me if I am on a different desktop while it is working.

1. GPSMapEdit can't create a new, blank map, so you'll have to create one by a roundabout way:

   (a) Create a text file `gmapsupp.mp` containing the following:

   ```
   [IMG ID]
   ID=99999999
   Name=
   Preprocess=G
   LblCoding=6
   TreSize=512
   TreMargin=0.00000
   RgnLimit=1024
   Transparent=Y
   POIIndex=Y
   Levels=4
   Level0=22
   Level1=20
   Level2=18
   Level3=17
   Zoom0=0
   Zoom1=1
   Zoom2=2
   Zoom3=3
   [END-IMG ID]

   [RGN20]
   Type=0x4000
   Label=Dummy
   Data0=(37.7439815,-110.8137040)
   [END-RGN20]
   ```

   (b) Change the coordinates in Data0 to something in your region of interest. (You can get some by running `gdalinfo` on your `.tif` file.) Note that latitude comes first.

2. Fire up GPSMapEdit:

   ```
   $ wine /path/to/mapedit.exe gmapsupp.mp
   ```

3. Import major contours:

   (a) Choose File ⇒ Import ⇒ ESRI Shape and select `major.shp`.

   (b) A dialog box will pop up. Choose 0x0022 Major land contour. Click Next.

   (c) The next tab supposedly offers labels, but I couldn't get the widget to allow me to select any field. Untick Select field for labels and click Next.

(d) Choose Coordinate system of Latitude/Longitude (deg) and Datum of NAD83. (You should verify this against the metadata included in the download.) The two Bounding rectangles should match. Click Next.

(e) Tick levels 0 and 1. Click Finish. Do not be alarmed if nothing shows up – this is because the map zooms out far enough that nothing in the map is shown. Choose View ⇒ Levels ⇒ Level 0 to make everything show up.

Also, do not be alarmed if you zoom in and discover that the contours look terribly jaggy – this is a display artifact.

4. Unpack the zip file you got from NHD. Inside is a directory `hydrography`, and inside that are several files named `.shp`

5. Import streams from `NHDFlowline.shp`. Choose 0x0026 Intermittent stream/ditch or 0x0018 Stream and levels 0 and 1.

6. Import water bodies from `NHDWaterbody.shp`. Choose 0x0029 Blue-Unknown and levels 0, 1, and 2.

7. Import rivers from `NHDArea.shp`. Choose 0x0029 Blue-Unknown and levels 0, 1, and 2.

8. Examine your map carefully, to ensure that water and hypsography seem to match correctly.

9. Delete the water data which is outside your area of interest. Choose View ⇒ Full Map and then View ⇒ Levels ⇒ Level 0. You'll see a small brown square – your contour lines – surrounded by a great deal of water data. Use the Select Objects tool to select extra water and press Backspace to delete it. You may want to zoom in as you trim closer to your area of interest. Be careful not to delete things which extend into it, especially large water bodies, and don't worry too much if you don't trim particularly neatly.

10. Import the intermediate contours from `inter.shp`. Choose 0x0021 Interm. land contour and level 0 only.

11. Choose Tools ⇒ Remove Object Duplicates.

12. Quit GPSMapEdit.

4 Convert Map to Garmin Format

This step requires an application called cGPSmapper (`http://www.cgpsmapper.com/`). While the Linux version is a few revisions behind, it worked fine for me. (I emailed the author a couple of times, and he promised to upload a new Linux build, but I haven't seen anything yet.) You get an executable called `cgpsmapper-static`; if you run it with no arguments, it prints help.

1. Run cGPSmapper:

   ```
   $ cgpsmapper-static -q gmapsupp.mp
   ```

2. Wait. cGPSmapper will take a long time, perhaps hours, and it prints very sparse progress information.

3. You now have a file `gmapsupp.img`. This is the file your Garmin GPS will like.

5 Upload Map to GPS Unit

This step requires that your computer be configured to mount USB Mass Storage devices, which is beyond the scope of these notes.

1. On the GPS unit, go to Main Menu ⇒ Setup ⇒ Interface. Choose USB Mass Storage. The usual GPS interface should disappear and be replaced by a picture of a computer.

2. Mount the unit as a USB Mass Storage device. For me, that's:

   ```
   $ mount /mnt/garmin
   ```

3. Ensure that a directory called `garmin` exists at the top level of the GPS's filesystem. You may have to create it.

4. Place `gmapsupp.img` in that directory. It must be named and placed exactly like this, or the GPS won't see it.

5. Check that it worked, e.g.:

   ```
   $ ls -l /mnt/garmin/garmin/
   total 720
   -rwxr-xr-x 1 reid reid 734208 Oct  5 18:19 gmapsupp.img
   ```

6. Unmount the GPS and disconnect it. It will reboot back into normal mode.

7. Verify on the GPS that your map displays OK.

You're done. Enjoy your new map. I'd love feedback on these notes. Were they useful to you? How can they be improved? My email address is `reid@reidster.net`.

A Change History

- March 4, 2007. Update Wine version; fix a couple of minor errors.
- December 9, 2006. LaTeXify, drop DEM2TOPO in favor of GDAL.
- October 30, 2006. Initial publication.