Using your own map data on an Android device

A tutorial for Windows 7 users.

Suppose you have a map as a graphic file (maybe you downloaded it, or scanned a paper map). You want to use this on your Android device with GPS. Here's how. Please note that I am not a mapping expert, and this tutorial is not comprehensive. It is just what worked for me after a lot of trial and error….

I do this basically because I like maps, and it's fun to wander round an area with a hundred-year old map of the place as well as the modern one. "Look, there used to be a creek right here…". If they are old enough, old maps are out of copyright, and you can do what you like with them. Also there are lots of specialist maps which are not old, but which you can download freely, particularly from US Government sites. The example I'm going to use is a very pretty map of the San Francisco Bay area showing fault lines and past earthquake epicentres. It is on the Library of Congress (LOC) Site. Here is where to find the map:

http://www.loc.gov/item/2004633858/

Before you go any further, check the permissions. This is what it says on the LOC site:

Maps

Earthquakes and faults in the San Francisco Bay Area (1970-2003) / by Benjamin M. Sleeter ... [et al.].

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More maps like this

That looks good enough for me. If you want to use the map for commercial purposes you might want to find out more.

I downloaded this as a tif to Y:\BrianArcive1\LOC Maps

SanFranciscoBayEarthquakes ct001847.tif

Always start with a tif if you can – jpeg can do nasty things to the edges in schematic images like maps and charts. A bmp or png should also be OK – png is compressed, but is lossless.

There are three stages to preparing the file for use on your Android

1. Georeference the file, that is add information about the latitude and longitude of the map. This step creates a new file with the map transformed to correspond to the equirectangular projection (WSQ84) used by GPS software.
2. Convert to a set of map tiles. These are small images of square bits of the map which the device uses to put together the screen image. Android devices can't handle large image files in one go, and the ones we use are often pretty large – the Earthquake file is about half a gigabyte.
3. Assemble the tiles into an atlas, with all the information bundled together in a form the map application can use. The details of this step depend on what map application you will be using.

You will need two software packages, QGIS and MOBAC. QGIS is here. This tutorial uses the 32-bit version 2.6 standalone.

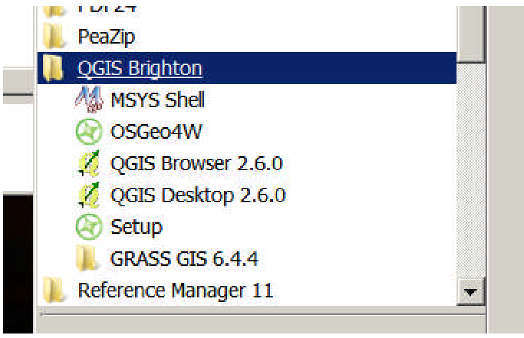
https://www.qgis.org/en/site/forusers/download.html

MOBAC is here. I downloaded the "latest stable version", 1.9.16.

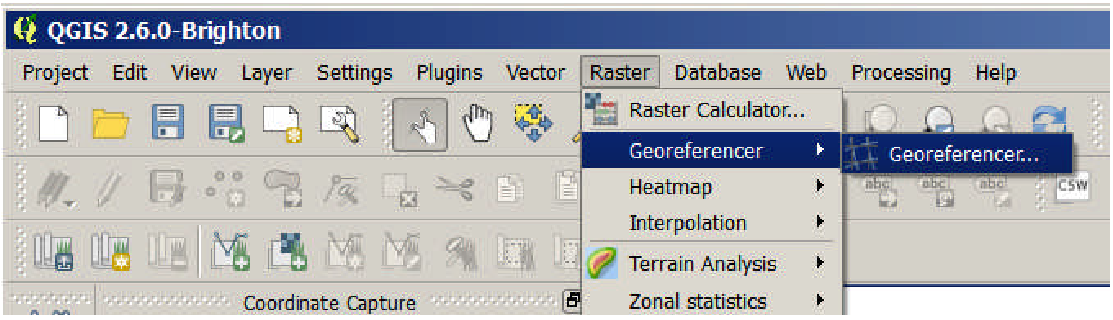
http://mobac.sourceforge.net/

Georeferencing

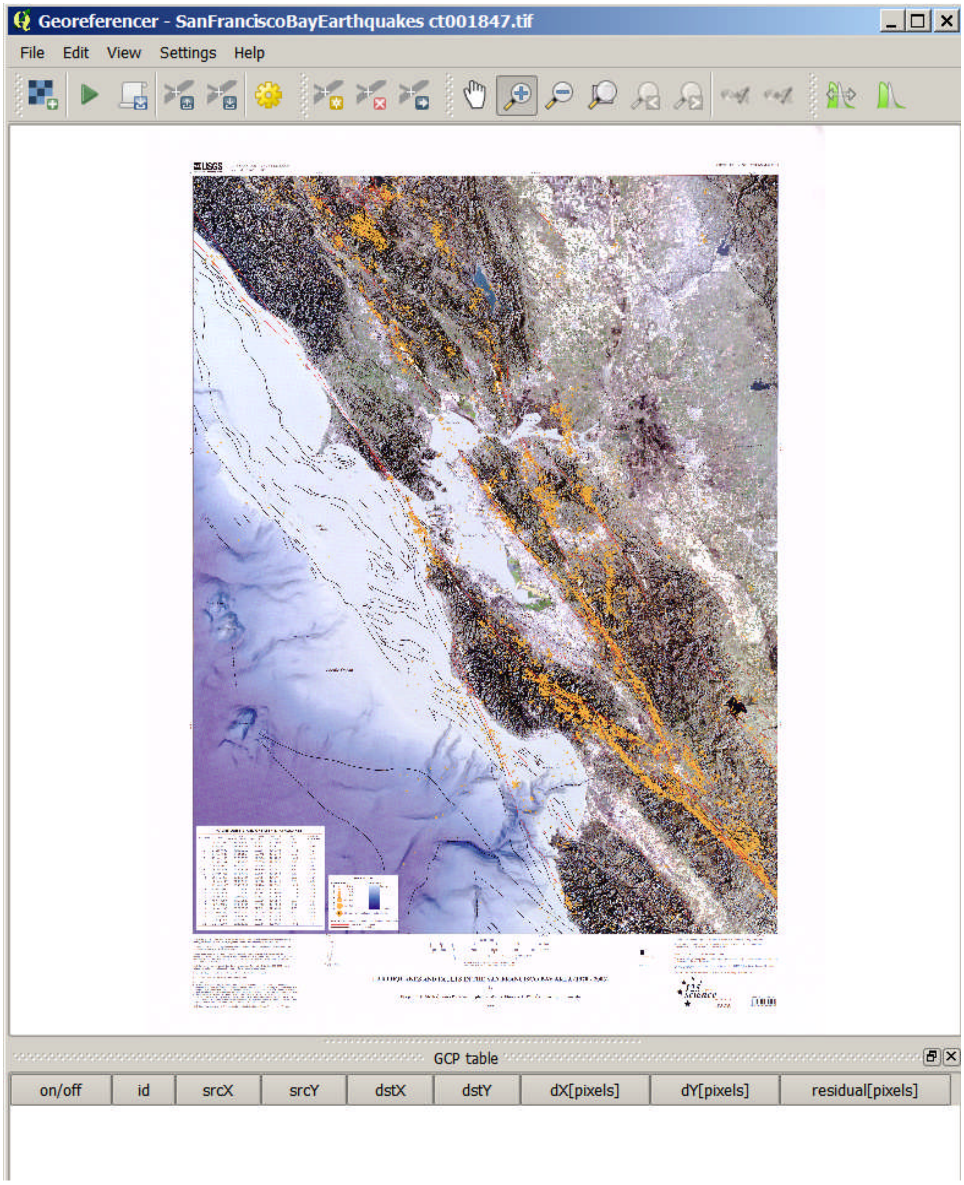
Open QGIS Desktop, from the Start Menu



then select Georeferencer from the Raster Menu



Once you are in the Georeferencer, Select File|Open Raster or click on the Open Raster button , and navigate to the .tif file. The Coordinate Reference System Selector will open. We want WGS84, which is what should be selected by default. Click OK. The map will now be visible in the Georeferencer.



Take a few minutes to work out the navigation controls. You move around by grabbing the map with the Pan tool  and zoom in and out with the zoom tools . There may be a bit of delay between doing something and seeing the result, especially with a large file like the one we are using (0.5 GB) , Be patient!

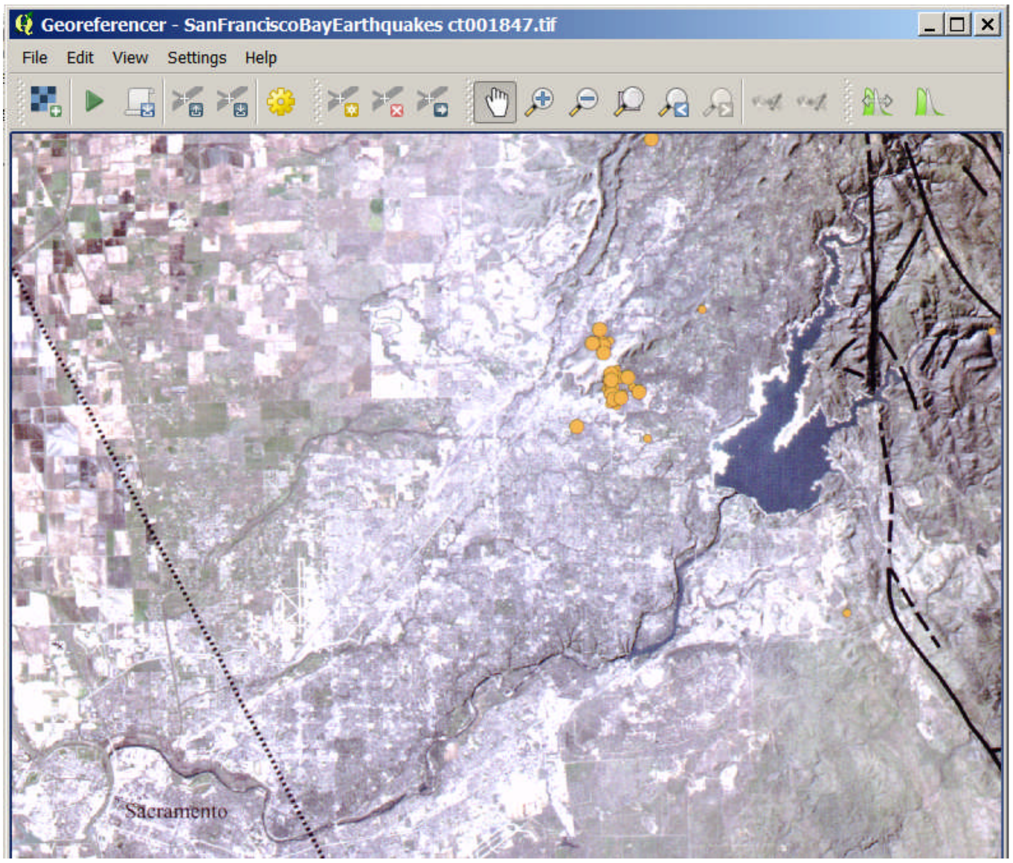
We will now add location information to the file. We need a number (usually 4-10) points on the map of known longitude and latitude. There are several ways of doing this.

1. If the map is a modern one with lines of longitude and latitude marked (such as a navigation chart) we can use points at which latitude and longitude lines cross. With older maps, they probably won't use WGS84, the system used by modern satnavs, so corrections will be needed.

2. The second method is to find clearly defined features on the map, and find their latitude and longitude in, say, Google maps, or from another map or chart.

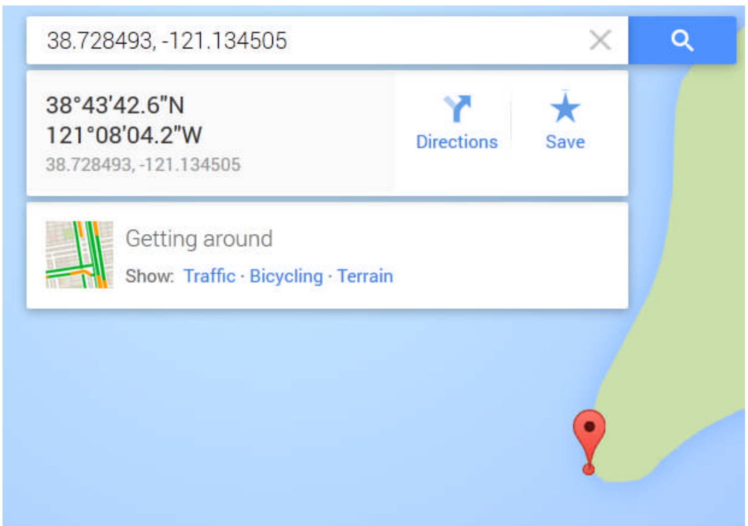
3. Finally, if you are referencing a local map, you can take your satnav out, and stand in a few places that are clearly marked on the map and get the latitude and longitude of each location directly from the GPS device.

We shall use the second method. In the top right of the map, to the north-east of Sacramento is a lake:

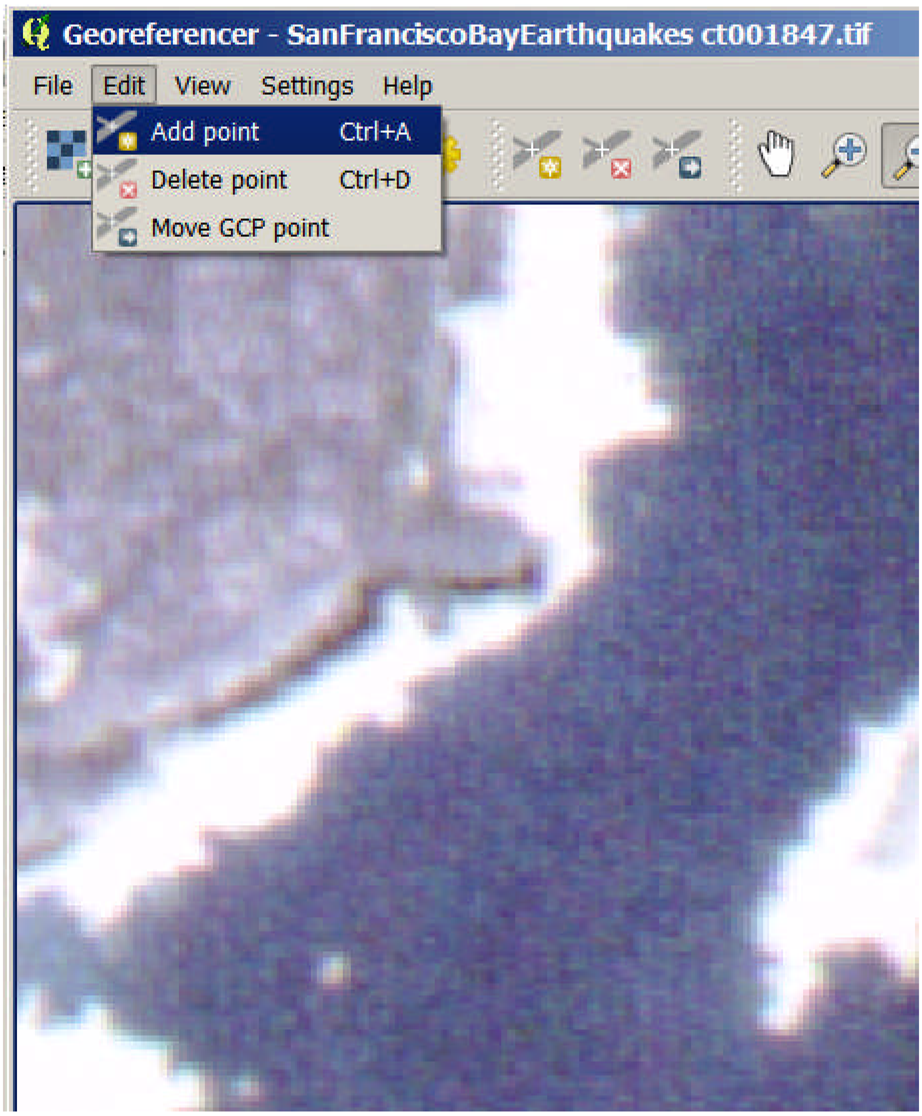


Zoom in on this

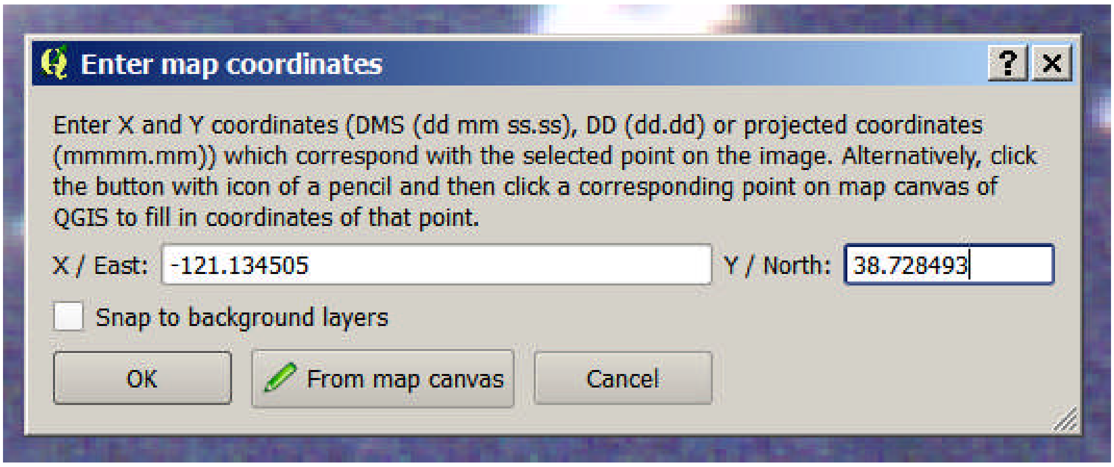
We're going to use the tip of the promontory in the middle of the lake as the first reference point. Find the lake in Google Maps, zoom in, and click on the tip of promontory. A location in latitude and longitude will appear. Click on this location to see the exact point you have selected.



Now select Edit|Add Point in the QGIS Georeferencer.

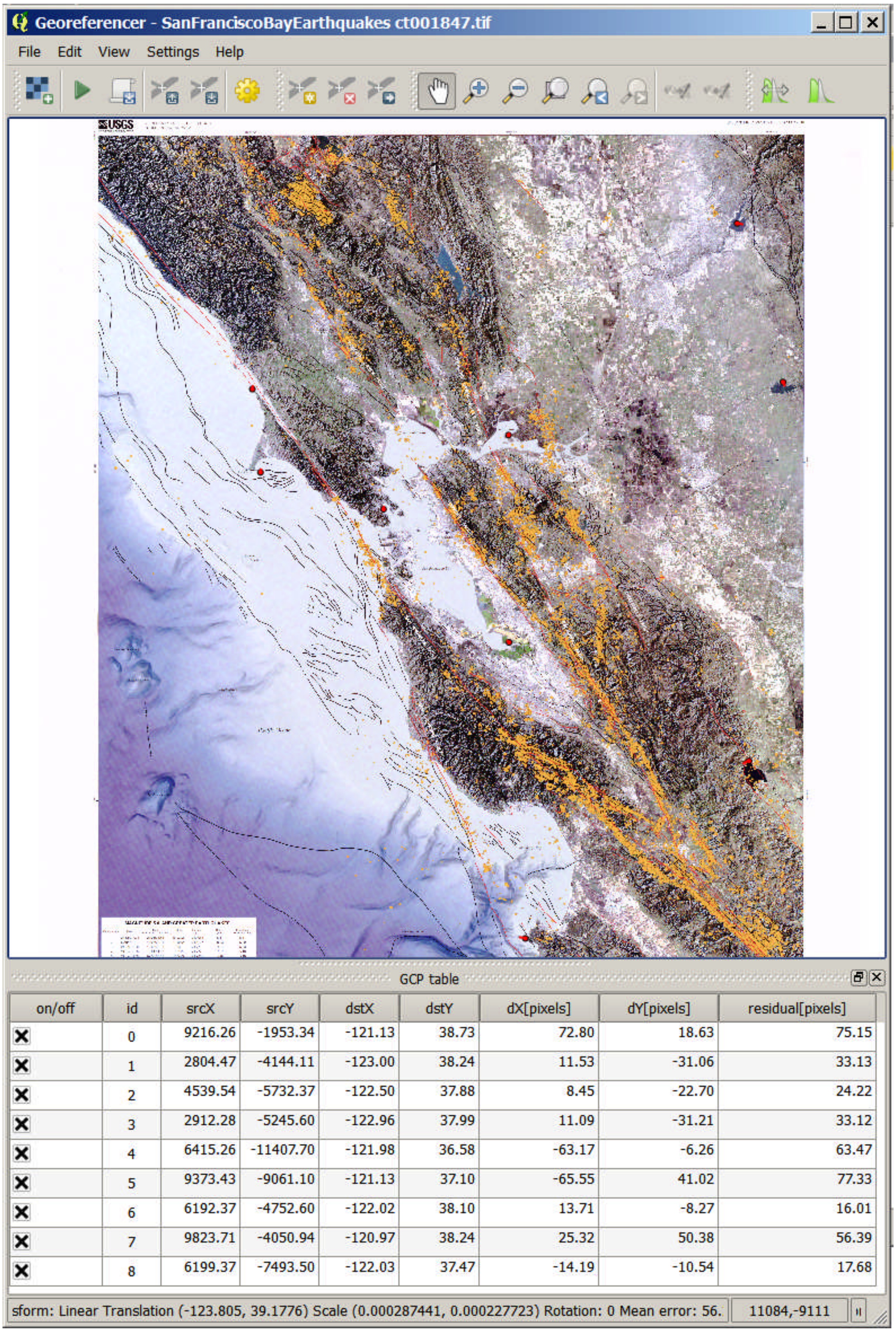


A cross-hairs pointer will appear. Click on the tip of the promontory, then enter the coordinates that Google Maps gave you into the dialog box.



Note the X and Y are the opposite way round to Google Maps… Also that West and South are negative, East and North are positive.

Now find at least 3 and preferably 6-8 more points. They should be well spread across the map. Each point will be shown on the map and in the GCP table at the bottom of the display. When you have done, the display should look something like this

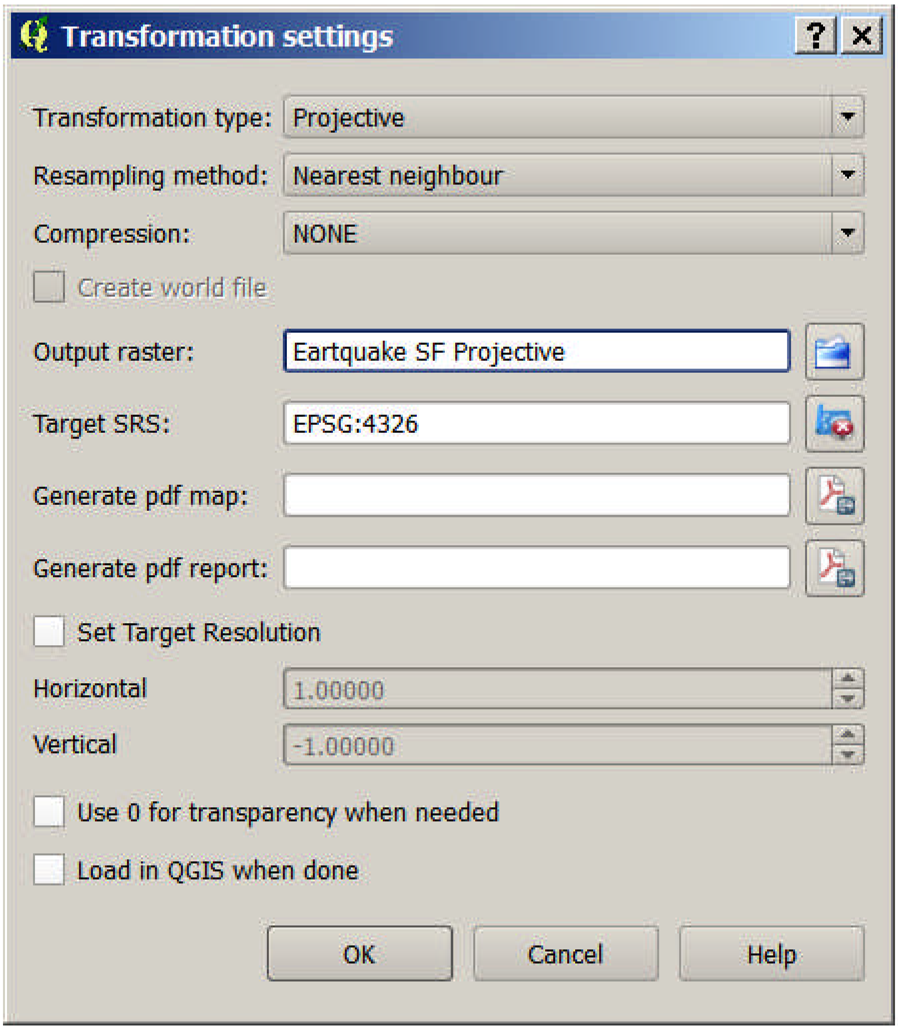


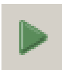
Tip: The GCP table only shows your latitude and longitude to two decimal places. But it does store the full precision that you just added. To see it, use the File|Save GCP points as... option in the Georeferencer. This creates a file with the GCP information. It has a .points file extension. You can open this with a text editor and see the full information.

Now select Settings|Transformation Settings. We need to select a transformation. The Default is Linear . This would be appropriate for a starting file with longitude and latitude represented as straight lines, such as the Standard Mercator Projection. But our starting file is Transverse Mercator, which does not have this property, so it won't be linear. Let's try Projective… when you choose a transformation, you can see in the GCP table how large the errors for each defined point will be. The chart also shows a red line for each point indicating the direction and size of error. So you can see how good each option will be without having to do the full transformation.

Tip: If you use the thin point spline transformation, this will always give you zero error. Sounds good. But be careful, this can be at the cost of extreme distortion of your map. Always take a look at the transformed tif file before going further.

Also choose a name for the Output raster file.



Then click Start Georeferencing . The program is not just adding in the reference information, it is transforming the entire graphic file into a layout that corresponds to the WSQ84 coordinate sytem. This may take a while!

Once you are done you will have a new tif, which will be in the same directory as the starting file unless you specified otherwise in the Transformation settings. This is a georeferenced tif or GEOTIFF. The location information is in the header, and you can open and view this file. If you do, you will see that the map appears a bit distorted (or maybe it is undistorted) but has all the same information as the original.

Convert to a set of map tiles

The simplest way to generate the map tiles is to use a program called MapTiler. But this has a limit of 10K X 10K pixels unless you fork out over £100, which seems rather a lot for a single task which is only one part of the process. Fortunately there is a free utility called GDAL This is a command-line utility, but is still pretty straightforward. It comes as part of the OSGeo4W package, which is bundled in with QGIS. Select OSGeo4W from the start menu, and you get a command line window.

You may wish to check the information available in the file header. You can do this with gdalinfo. I moved the tif and renamed it so it is now

`C:\GDAL\EarthquakeSF.tif.`

The command to get information is

```
gdalinfo C:\GDAL\EarthquakeSF.tif
```

OSGeo4W

```
C:\>gdalinfo C:\GDAL\EarthquakeSF.tif
Driver: GTiff/GeoTIFF
Files: C:\GDAL\EarthquakeSF.tif
Size is 12658, 13287
Coordinate System is:
GEOGCS["WGS 84",
    DATUM["WGS_1984",
        SPHEROID["WGS 84",6378137,298.257223563,
            AUTHORITY["EPSG","7030"]],
        AUTHORITY["EPSG","6326"]],
    PRIMEM["Greenwich",0],
    UNIT["degree",0.0174532925199433],
    AUTHORITY["EPSG","4326"]]
Origin = (-123.820196738841620,39.210772635395379)
Pixel Size = (0.000249866082996,-0.000249866082996)
Metadata:
  AREA_OR_POINT=Area
Image Structure Metadata:
  INTERLEAVE=PIXEL
Corner Coordinates:
Upper Left  (-123.8201967,  39.2107726) (123d49'12.71"W, 39d12'38.78"N)
Lower Left  (-123.8201967,  35.8908020) (123d49'12.71"W, 35d53'26.89"N)
Upper Right (-120.6573919,  39.2107726) (120d39'26.61"W, 39d12'38.78"N)
Lower Right (-120.6573919,  35.8908020) (120d39'26.61"W, 35d53'26.89"N)
Center      (-122.2387943,  37.5507873) (122d14'19.66"W, 37d33' 2.83"N)
Band 1 Block=12658x1 Type=Byte, ColorInterp=Red
Band 2 Block=12658x1 Type=Byte, ColorInterp=Green
Band 3 Block=12658x1 Type=Byte, ColorInterp=Blue

C:\>
```

To make the map tiles, the syntax we need is

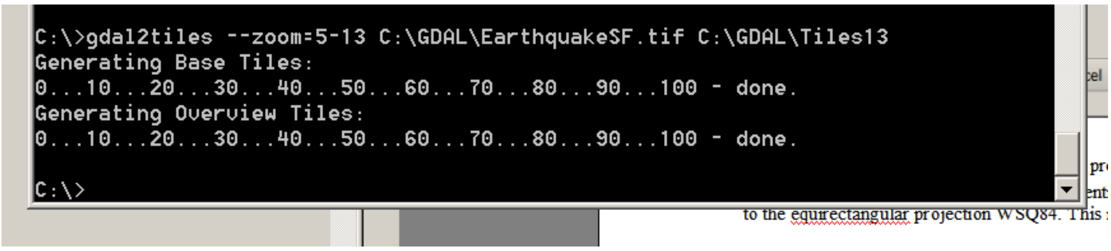
```
gdal2tiles [--z zoom] input_file [output_dir]
```

The command I used is

```
gdal2tiles.py --z=5-13 C:\GDAL\EarthquakeSF.tif C:\Tiles13
```

Enter this and press <return>. This will take a while…. Note that if your file or folder names have spaces, you will need to surround the path with quotes.

The option --z=5-13 sets the zoom levels that will be available on the device. If you leave this out, you will get a default range, which may well be OK. C:\Tiles13 defines the directory for output. You can leave this out, and GDAL will make up a directory name for you.



If all has gone well, you now have a directory called Tiles13, which will have a series of folders numbered 5 to 13, one for each zoom level (or whatever range of zoom you have selected).

Tip: You can check if your zoom range is good by looking at the individual tiles. Open the folder with the tiles, and you will see a set of numbered folders, each corresponding to a zoom level. Open the one for the largest zoom, and open one of the next level folders, and you will see a lot of .png files. Open one of these - if the image is similar in resolution to your original you are about right. If the image has less resolution than you want, add a zoom level. If the image is too detailed, remove a zoom level.

Assemble the tiles into an atlas

The final stage is to create the atlas using MOBAC.

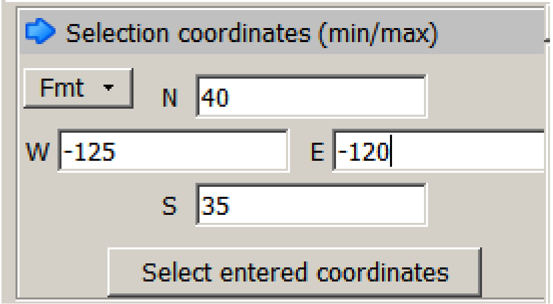
You need to tell MOBAC where to find the map tiles you just generated. MOBAC looks for this information in an xml file in the mapsources folder. If you installed MOBAC to C:\MOBAC, then the folder will be C:\MOBAC\mapsources. Use your favourite text editor to create a file called, for example, sources.xml. (It doesn't actually matter what you call it, so long as it is an .xml file and located in mapsources.) Our file should look like this:

```
<localTileFiles>
<name>SanFrancisco1859</name>
      <sourceType>DIR_ZOOM_X_Y</sourceType>
      <sourceFolder>C:\GDAL\Tiles13</sourceFolder>
      <invertYCoordinate>true</invertYCoordinate>
      <backgroundColor>#000000</backgroundColor>
</localTileFiles>
```

The name (I used "SanFrancisco1859") can be anything you like. This is what will appear in the MOBAC source list. The sourceFolder will be the same as you specified in gdal2tiles. DIR_ZOOM_X_Y tells MOBAC what folder structure to expect. InvertYCoordinate tells MOBAC to use the TMS system rather than the XYZ system. (TMS vs XYZ is one for you to work out on your own...)

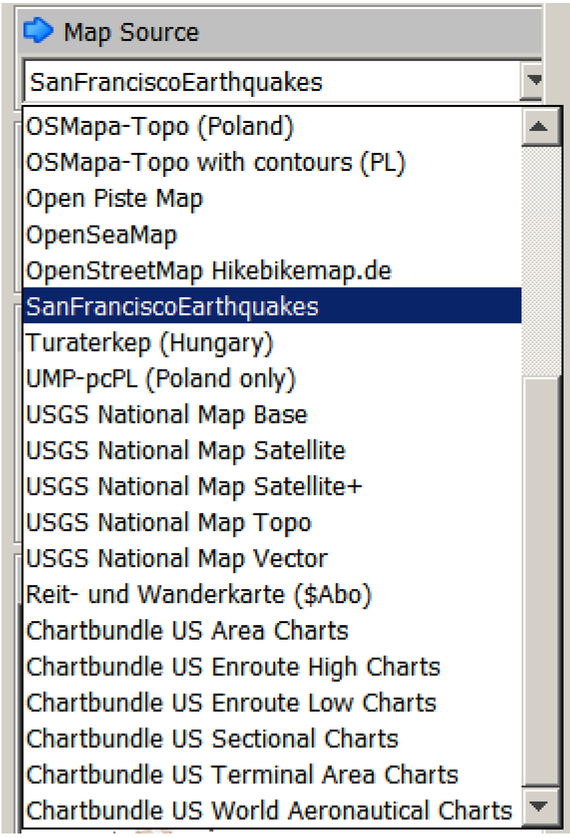
Create and save this, then open MOBAC.

You will now need to specify where the map is in the world. To do this, set an area that includes your map in the coordinates box at top left

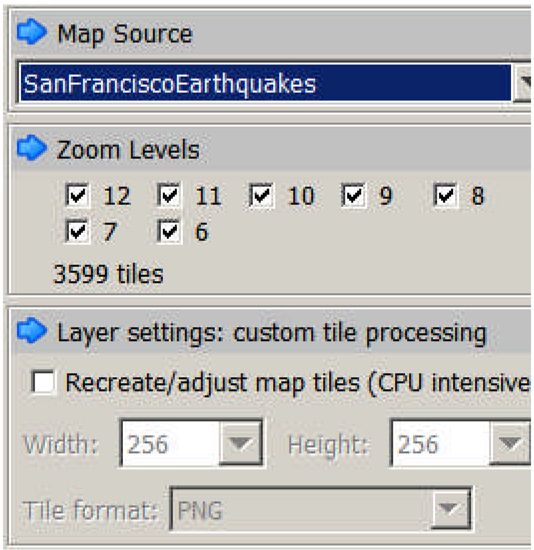


As before, negative coordinates are west of Greenwich, so the left box will have a larger absolute number than the right box. The coordinates don't need to be exact - so long as you specify a box that includes your map you will see it. (Quite why MOBAC needs you to do this isn't clear. You will specify your map files in a moment, and they have location information, so this seems redundant. But if you don't do this correctly, you probably won't see your map!)

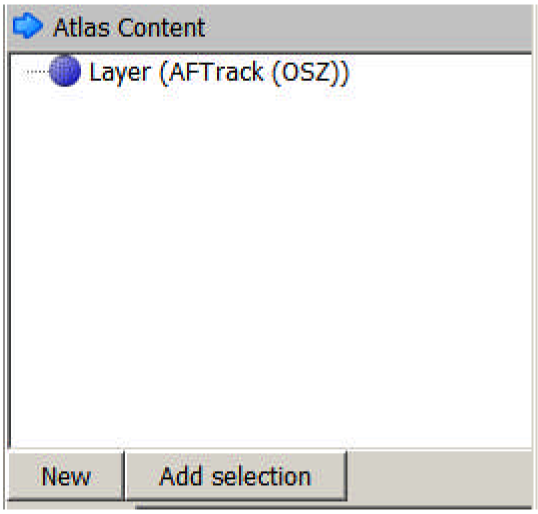
Now go to the Map Source drop-down. You will see a lot of standard sources, and also your custom map. Select it.



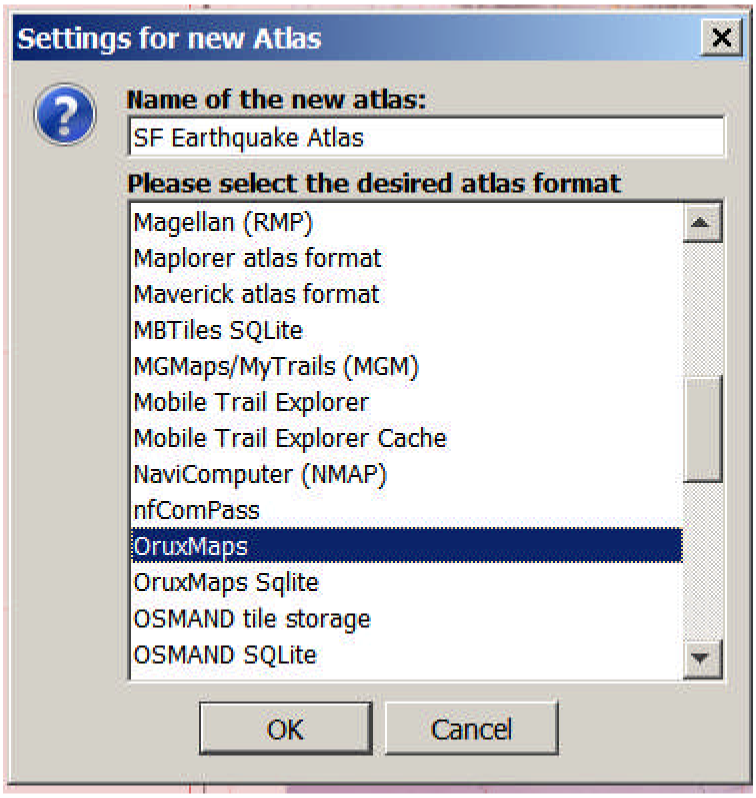
After you have selected your map source, you will then see a set of tick boxes with the available zoom levels. You probably want to tick all of them. Any you don't tick won't be in your atlas.



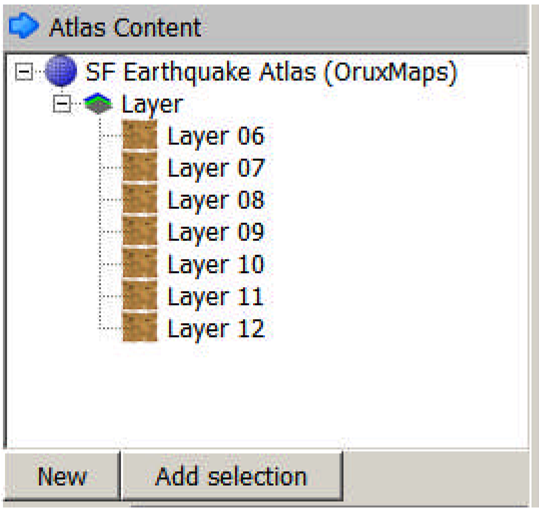
Now define an Atlas name, and specify an output format. Click on New under Atlas Content



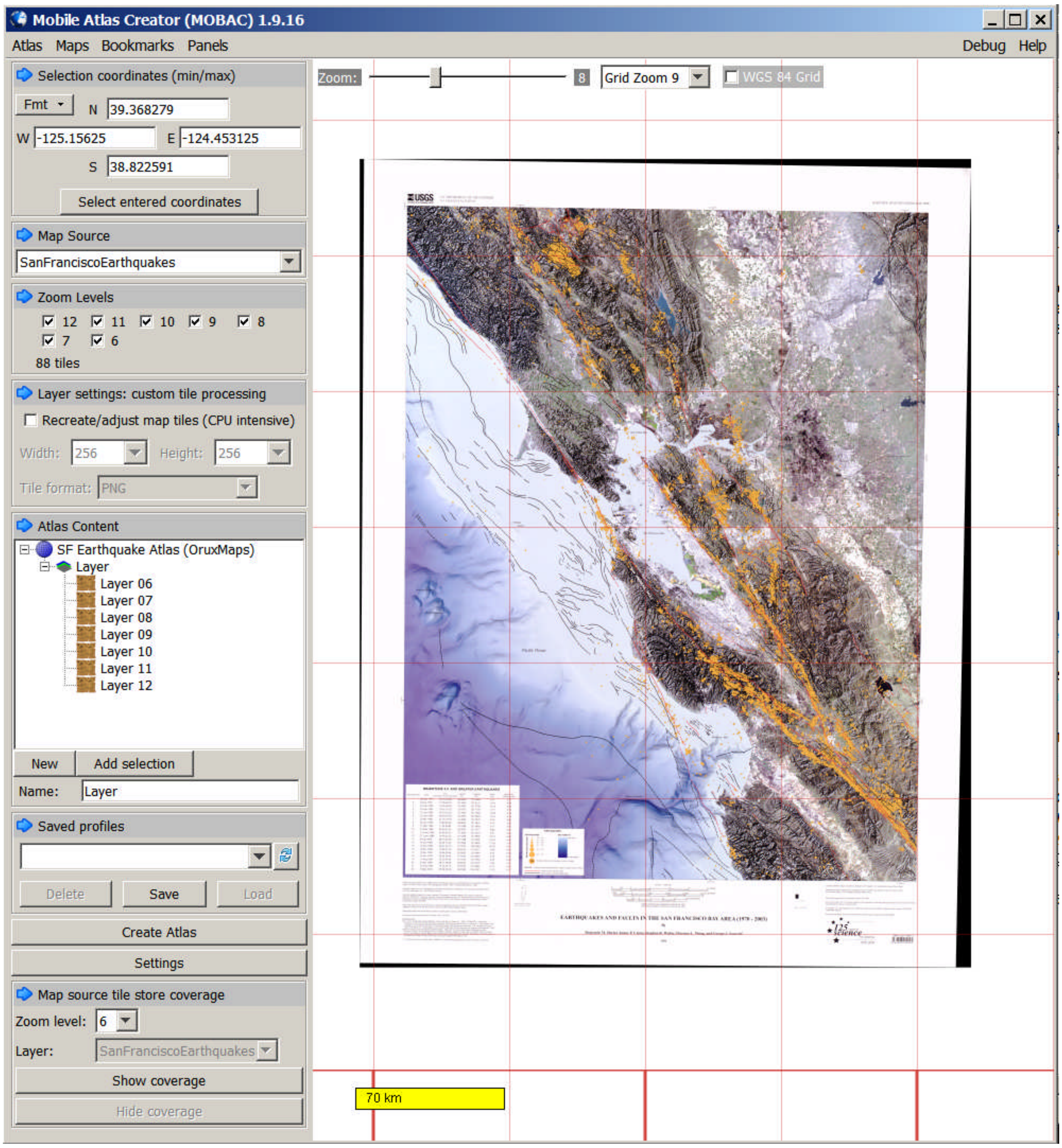
Enter the name of your Atlas and the format you want. We will use Orux Maps. Then click OK



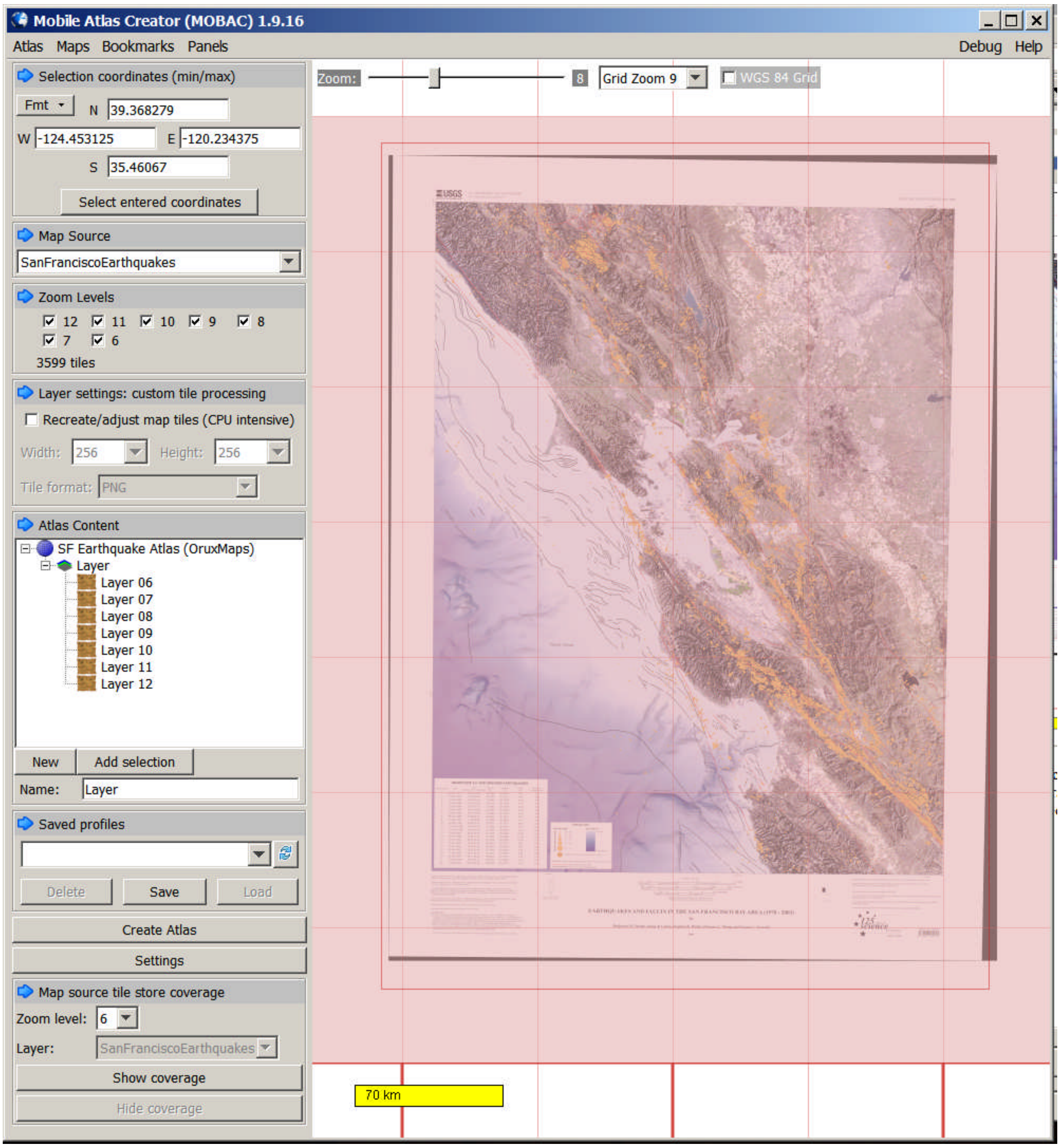
Then click Add Selection, and you will see your zoom layers



Here's your map ready to turn into an Atlas



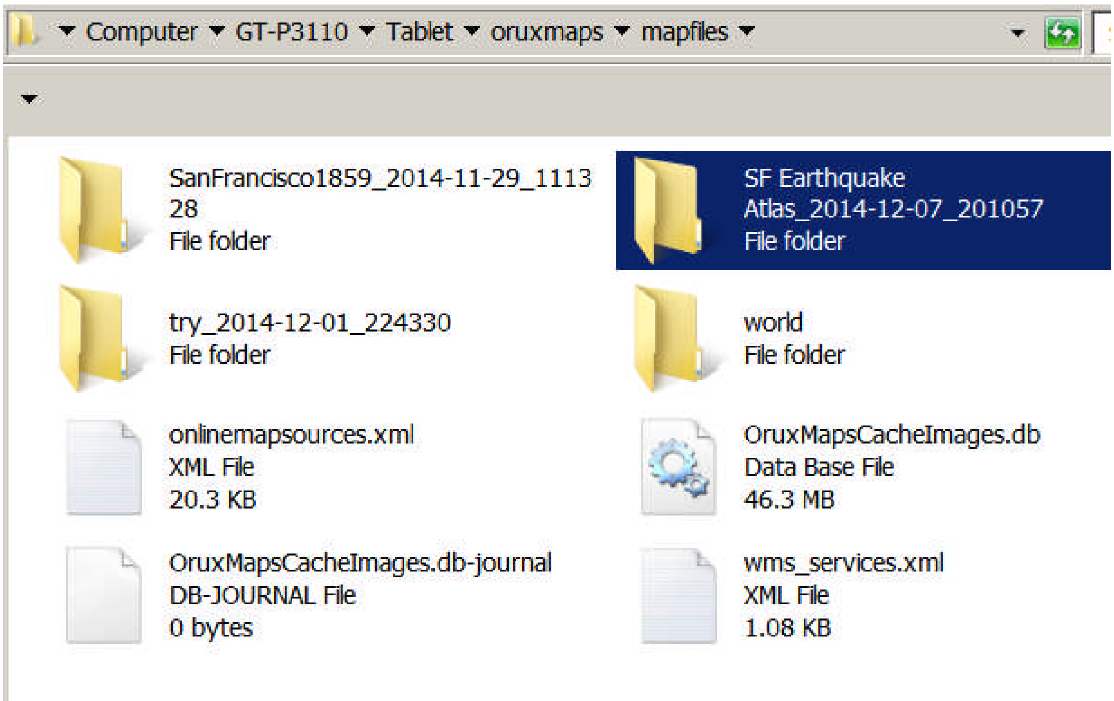
You may need to zoom and pan to see the whole map, or to get the size right. Zoom with the slider control at the top, pan with the arrow keys or drag the image with the right mouse button. Then select your map area with mouse click and drag
. It will be highlighted (in pink, if your settings are the same as mine)



You may want to change settings, using the button towards the bottom on the left. The main thing here is the directory in which your atlas will be created. Once your settings are OK, click Create Atlas.

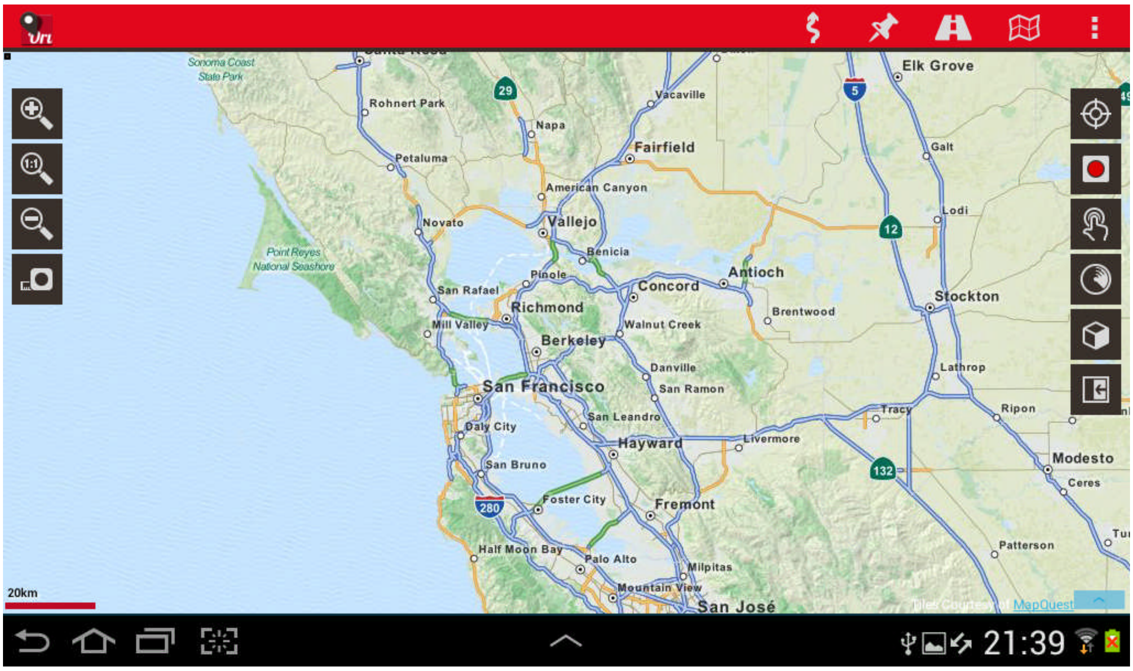
Again, be patient. Once all is competed, you will have a folder within the MOBAC Atlases folder with the name you just gave to the Atlas (plus some reference information).

Find the folder that has just been created, and copy the folder and contents to the Orux Maps folder on your Android device (by default this is /mnt/sdcard/oruxmaps/mapfiles/), and you are done. On my device, it looked like this. The folder I just copied is highlighted : SF Earthquake Atlas_2014-12-07_201057

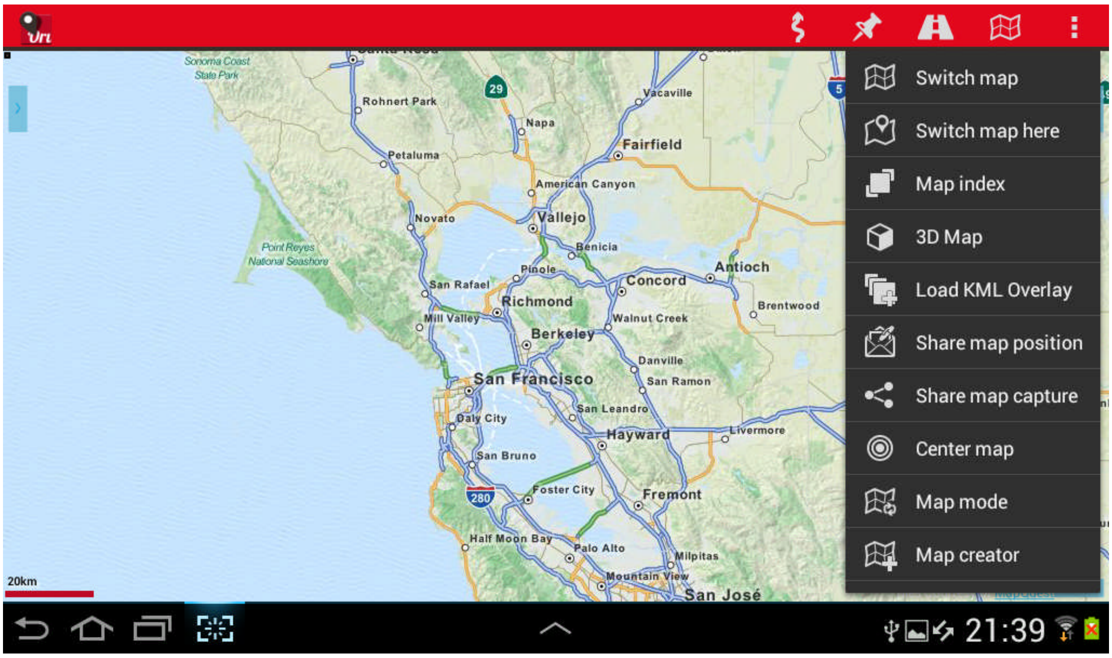


To check all works, go into OruxMaps

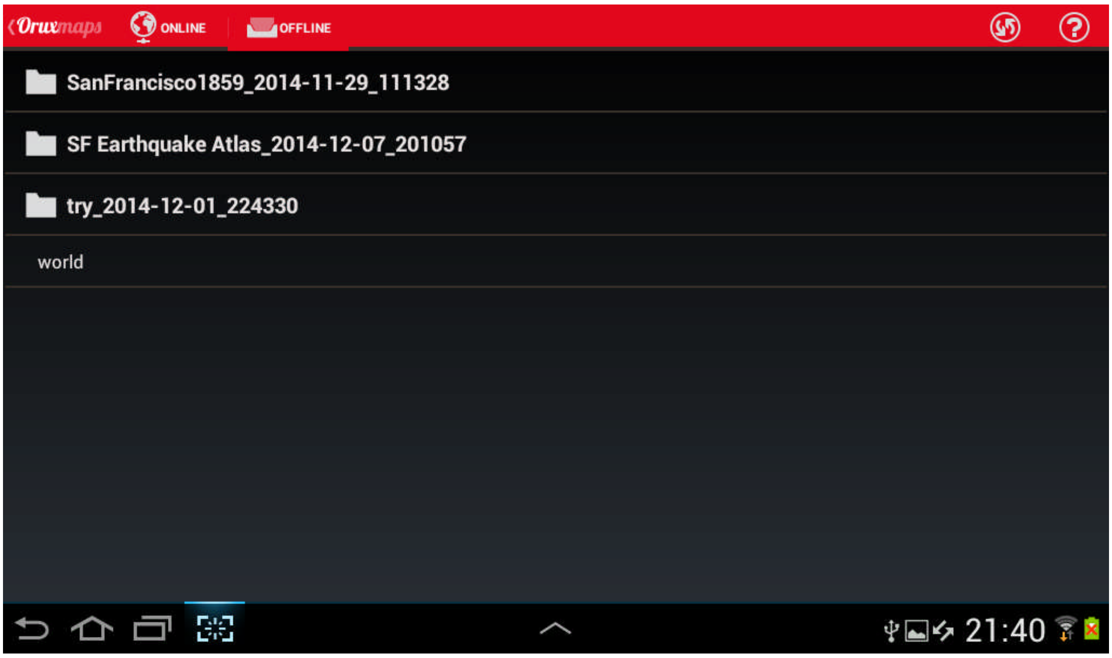
Then find the San Francisco Bay area on Open Street Map (online).



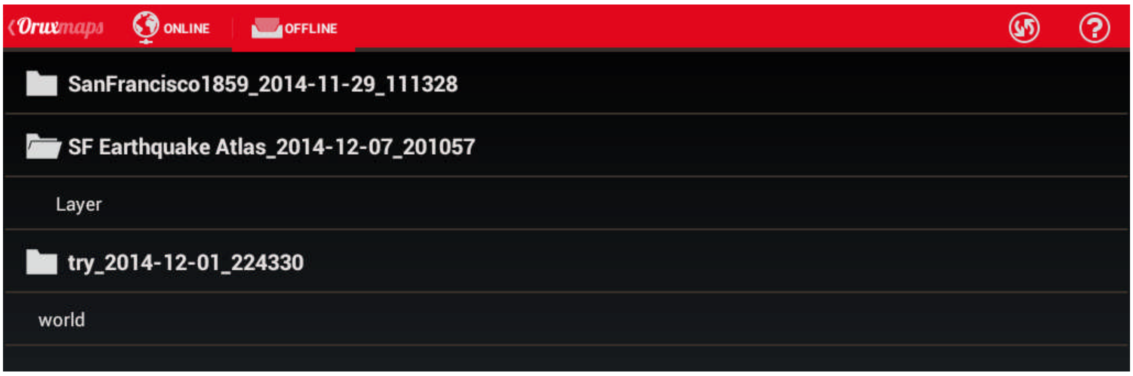
Then select Change Map|Switch Map



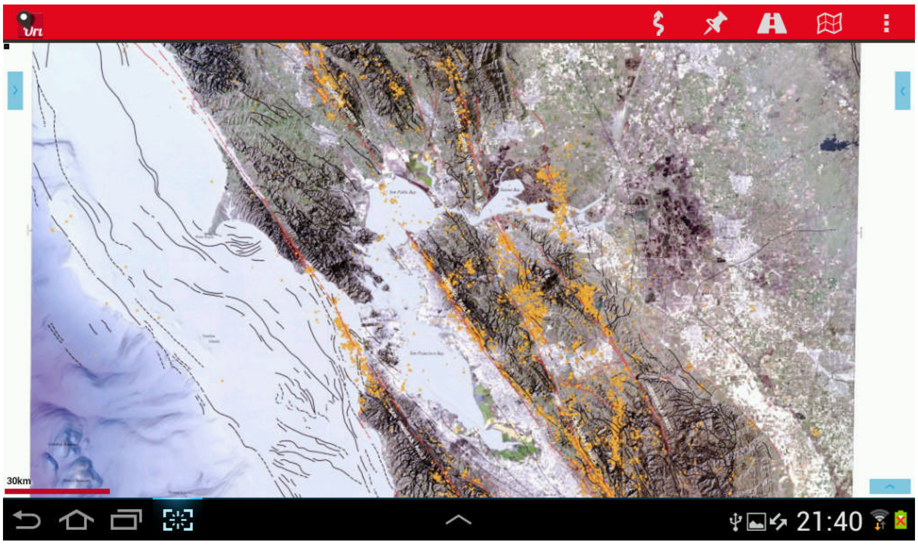
Tap on OFFLINE. If you can't see the map you loaded, tap on the refresh button



Tap on the map file you've just downloaded, then on Layer



And your map appears. Check it pans and zooms like any other map….



And if you are lucky enough to be in San Francisco, you can turn on GPS to show your current location on the map, and see how close the nearest recorded earthquake was to where you are standing.... Enjoy!