

# Tutorial: How to merge land and bathymetry data, using free commonly available resources

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## 1. Introduction

It has been a long standing wish by scenery developers to be able to merge freely available "land" data with freely available "depth" data. This tutor attempts to show you how to accomplish such, only using freely available software.

After using the steps outlined here, the resulting .bin and .hdr files will accomplish the best resolution land and water experience in Ilan Papini's VSF (or VS) simulator(s).

The only thing you have to do is download a couple of (free) applications and follow the instructions outlined in this document.

Don't be daunted by having to use 3 applications to accomplish the objective, it is very simple once you get the "hang" of it. To create a merged file, after a bit of practice, only take minutes!

## 2. Applications to download and install first

### 2.1 3DEM

3DEM is the application we will use to create the map.bin and map.hdr files which we will save into a VSF (VS) scenery directory.

get it here:

[http://www.hangsim.com/files/3dem\\_setup.exe](http://www.hangsim.com/files/3dem_setup.exe)

if not available on above link, just Google for '3DEM download' and it should be easy to find.

Install the application.

### 2.2 Landserf 2.3

Landserf is the application we will use to merge the land and water data and to export it as a text file which 3DEM will accept. We also use this application to select the exact area we are interested in from the bathymetric data file.

get it here:

<http://www.soi.city.ac.uk/~jwo/landserf/download/>

Now, you have to submit your e-mail address (use your Google e-mail if you are paranoid about using your personal one, I wasn't, no harm done).

The download will install a java application, use the windows version and follow the install instruction (double click on the downloaded .jar file)

### 2.3 MicroDEM 12

MicroDEM is the application we will use to separate land data from bathy data and export it to a format Landserf will accept.

get it here:

<http://www.usna.edu/Users/oceano/pguth/website/microdem/microdemdown.htm>

Nothing extraordinary to report, just download and install the "complete" version.

### 2.4 3 applications installed

By now you should have the 3 applications we need installed, so we can progress to the next section, how to obtain the data.

## 3. How to download data

Lets start with the "land" data, we will use the cgiar data available here:

<http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp>

The data is in a 5 degree grid, click under the tile you are interested in and after that press "click here to begin search". The result will be several download options, I always choose HTTP.

This will download the data, I'd care to think that you are smart enough to have created a directory to download this data into. How to create a "work" directory is not part of this tutorial. I typically would give that directory a name of the area (like La\_Paz, part of this tutorial later as the example implementation).

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Secondly we need the depth data, it is available here:

[ftp://topex.ucsd.edu/pub/srtm30\\_plus/srtm30/data/](ftp://topex.ucsd.edu/pub/srtm30_plus/srtm30/data/)

This data holds the best available (commonly) depth data. You can always Google for better bathy data, like US estuarine data is also commonly available. The source doesn't matter, between the 3 applications you should be able to load the data.

## 4. Apply the data

I think the best way to describe how to use the data is to use an example. To start we'll just use 4 tiles of the CGIAR data for the La Paz scenery (care of Alfredo, with his permission).

Going onto the CGIAR download site we select these 4 tiles:

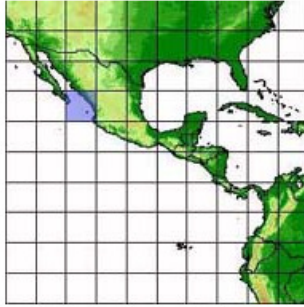
The tiles are highlighted in blue, we selected them by clicking on the tile directly below those.

Next we press "Click here to Begin Search" and we will get these options:

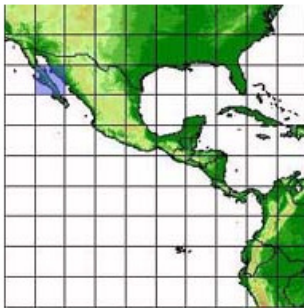
Description	Location
<p>Product : SRTM 90m DEM version 4</p> <p>Data File Name : srtm_14_08.zip</p> <p>Mask File Name: srtm_mk_14_08.zip</p> <p>Latitude min: 20 N max: 25 N</p> <p>Longitude min: 115 W max: 110 W</p> <p>Center point : Latitude 22.50 N Longitude 112.50 W</p>	

CSI Server : Data Download (FTP) Data Download (HTTP) Data Mask Download (FTP)

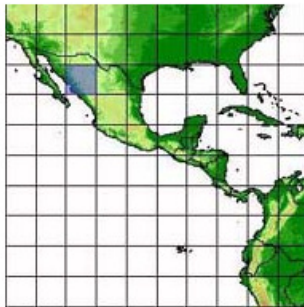
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Description	Location
<b>Product :</b> SRTM 90m DEM version 4 <b>Data File Name :</b> srtm_15_08.zip <b>Mask File Name:</b> srtm_mk_15_08.zip <b>Latitude min:</b> 20 N <b>max:</b> 25 N <b>Longitude min:</b> 110 W <b>max:</b> 105 W <b>Center point :</b> Latitude 22.50 N Longitude 107.50 W	

CSI Server :  [Data Download \(FTP\)](#)  [Data Download \(HTTP\)](#)  [Data Mask Download \(FTP\)](#)

Description	Location
<b>Product :</b> SRTM 90m DEM version 4 <b>Data File Name :</b> srtm_14_07.zip <b>Mask File Name:</b> srtm_mk_14_07.zip <b>Latitude min:</b> 25 N <b>max:</b> 30 N <b>Longitude min:</b> 115 W <b>max:</b> 110 W <b>Center point :</b> Latitude 27.50 N Longitude 112.50 W	

CSI Server :  [Data Download \(FTP\)](#)  [Data Download \(HTTP\)](#)  [Data Mask Download \(FTP\)](#)

Description	Location
<b>Product :</b> SRTM 90m DEM version 4 <b>Data File Name :</b> srtm_15_07.zip <b>Mask File Name:</b> srtm_mk_15_07.zip <b>Latitude min:</b> 25 N <b>max:</b> 30 N <b>Longitude min:</b> 110 W <b>max:</b> 105 W <b>Center point :</b> Latitude 27.50 N Longitude 107.50 W	

CSI Server :  [Data Download \(FTP\)](#)  [Data Download \(HTTP\)](#)  [Data Mask Download \(FTP\)](#)

I use the download option "Data Download (HTTP)". In the save dialog that follows I select the directory of my choice, in this case I've named La\_Paz in a directory I use for the purpose of map creation named C:\Mapdata\.

Download the four files there.

It should look like something like this: C:\Mapdata\La\_Paz\srtm\_14\_07 (plus 14\_08, 15\_07 and 15\_08) .zip, should you explore using the Windows Explorer.

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So we now have the land data downloaded and we'll do the depth data next.

We open the link to the bathymetry FTP site:

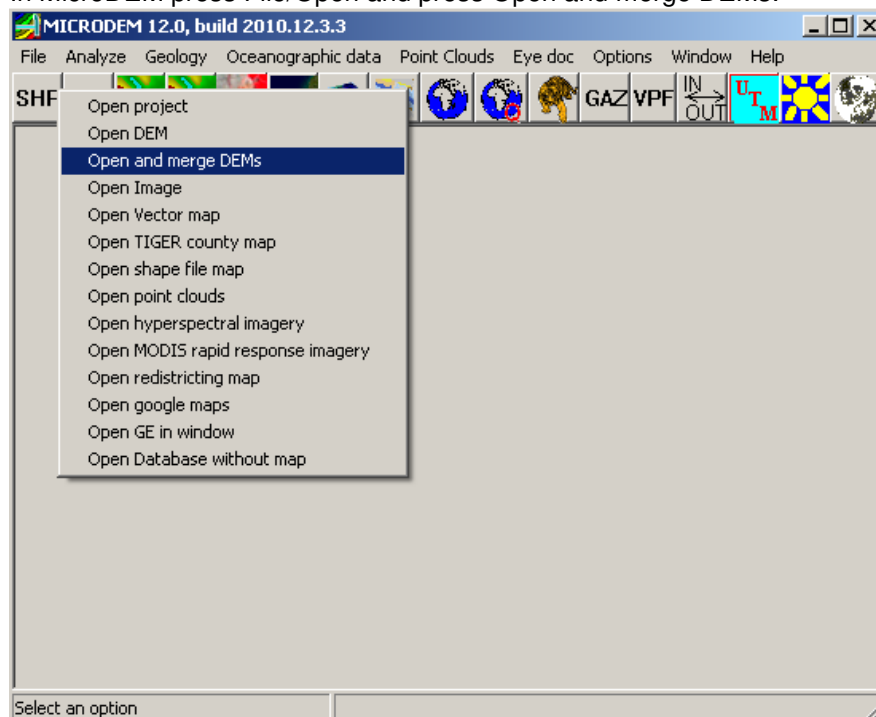
11/28/2009 12:00	57,600,000	<a href="#">w060n90.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w060s10.Bathymetry.srtm</a>
11/28/2009 12:00	51,840,000	<a href="#">w060s60.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w100n40.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w100n90.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w100s10.Bathymetry.srtm</a>
11/28/2009 12:00	51,840,000	<a href="#">w120s60.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w140n40.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w140n90.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w140s10.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w180n40.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w180n90.Bathymetry.srtm</a>
11/28/2009 12:00	57,600,000	<a href="#">w180s10.Bathymetry.srtm</a>
11/28/2009 12:00	51,840,000	<a href="#">w180s60.Bathymetry.srtm</a>

The file we select is w140n40.Bathymetry.srtm as that area contains the La Paz tiles we downloaded earlier, click it and download it into the same directory as where you downloaded the land data (C:\Mapdata\La Paz\)

We now have all the data we need and we'll work with these files to create the .bin and .hdr files VSF (VS) require to create a scenery.

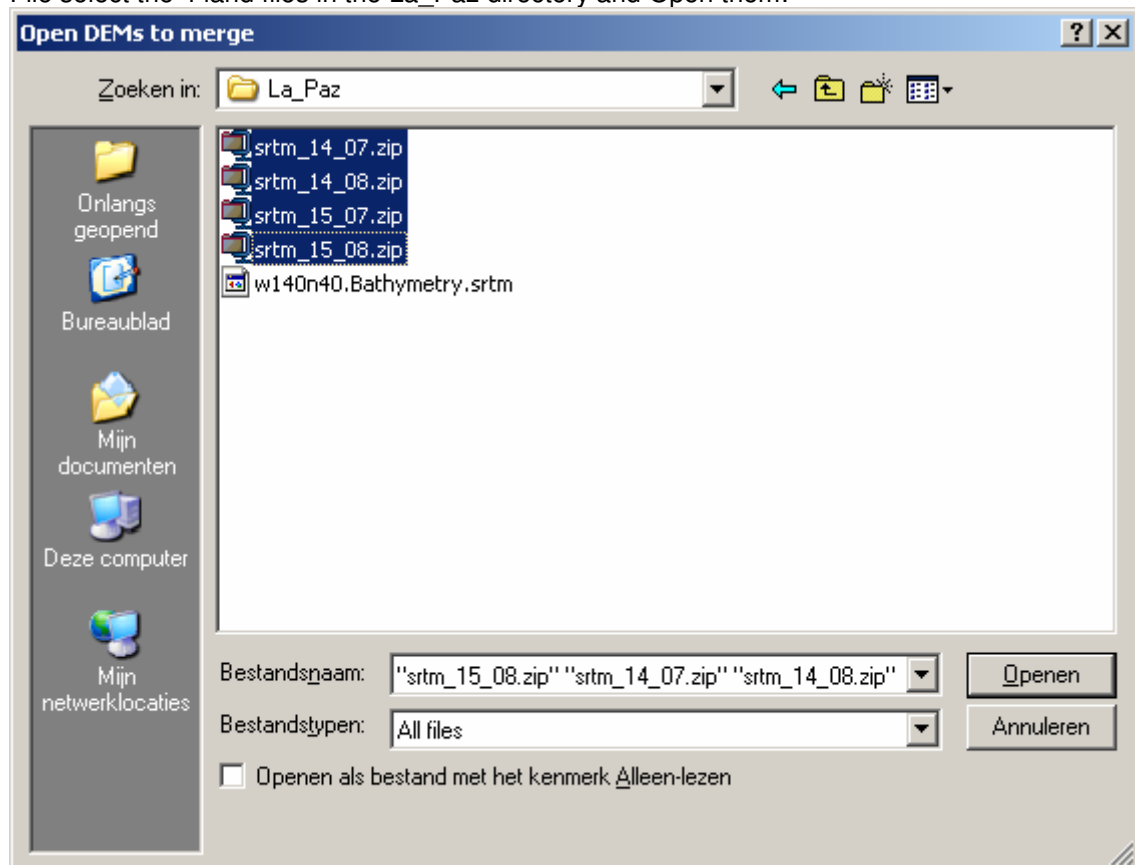
Let us start with the land data. We are going to use MicroDEM to open the 4 files we downloaded earlier.

In MicroDEM press File/Open and press Open and merge DEMs:



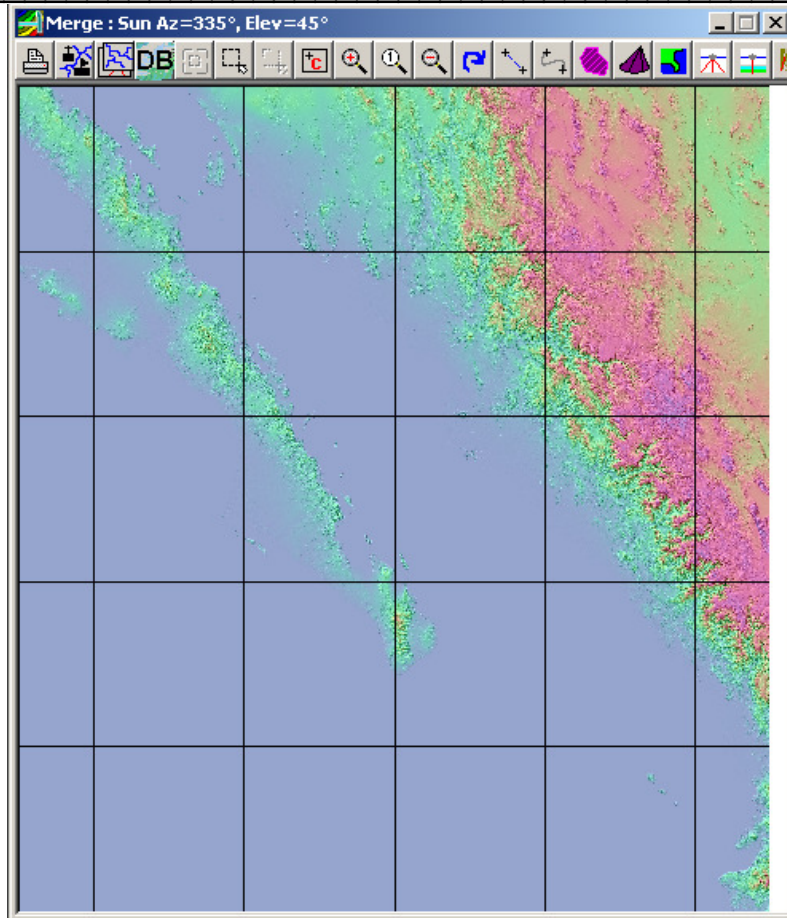
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File select the 4 land files in the La\_Paz directory and Open them:



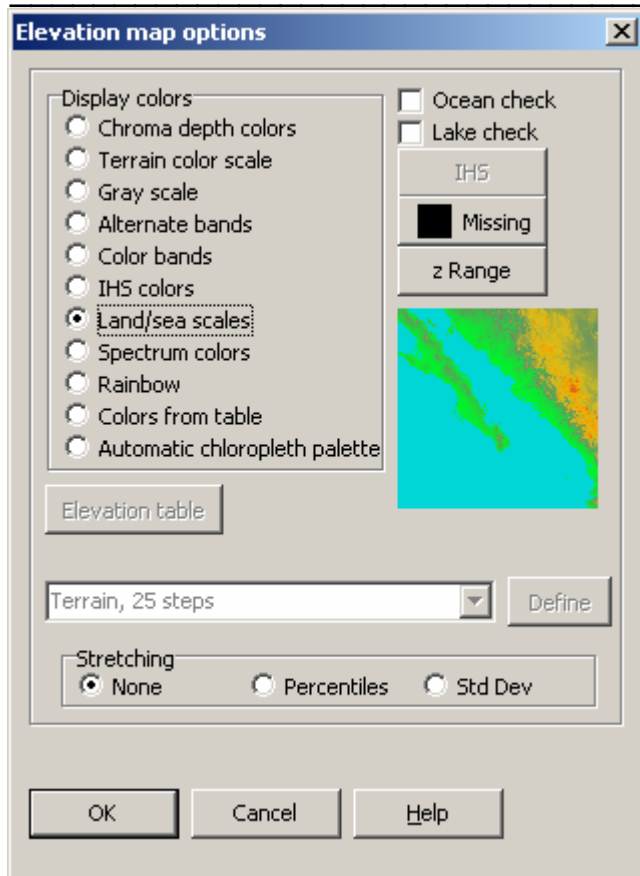
This is how they will open:

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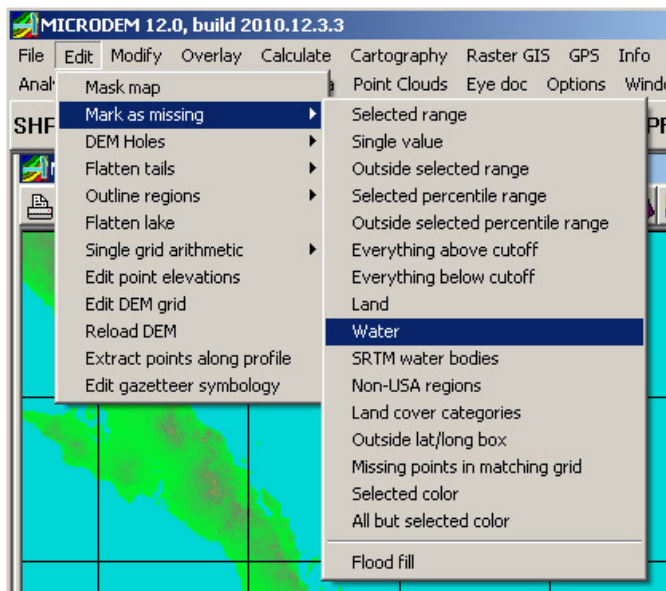


The screen displayed is not exactly what we want to look at so we Modify\Elevation the view:

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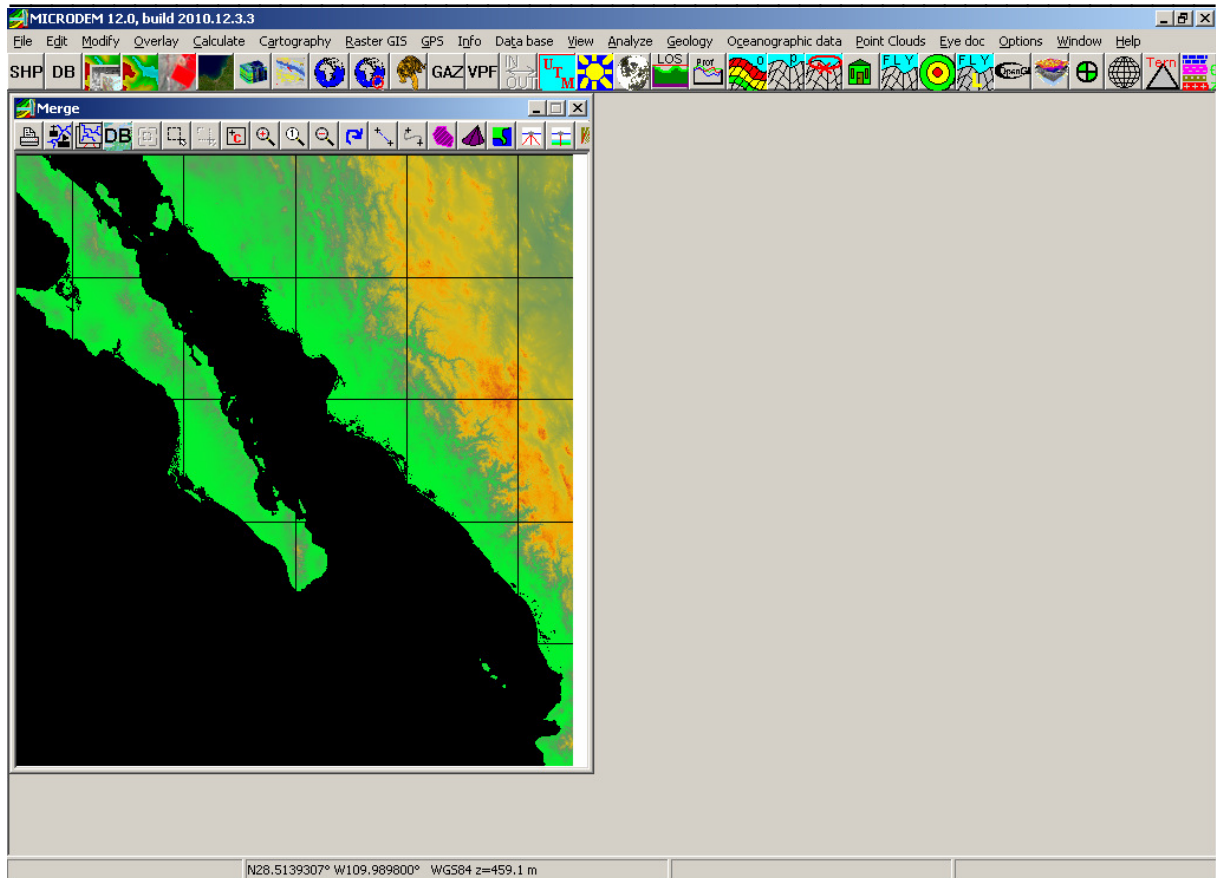


Now, that is better. Since this is the land data, we make sure we only have the land by removing everything that isn't such: We go into Edit/Mark as missing/Water



The result will show you the "grid" in black lines, don't worry about that:

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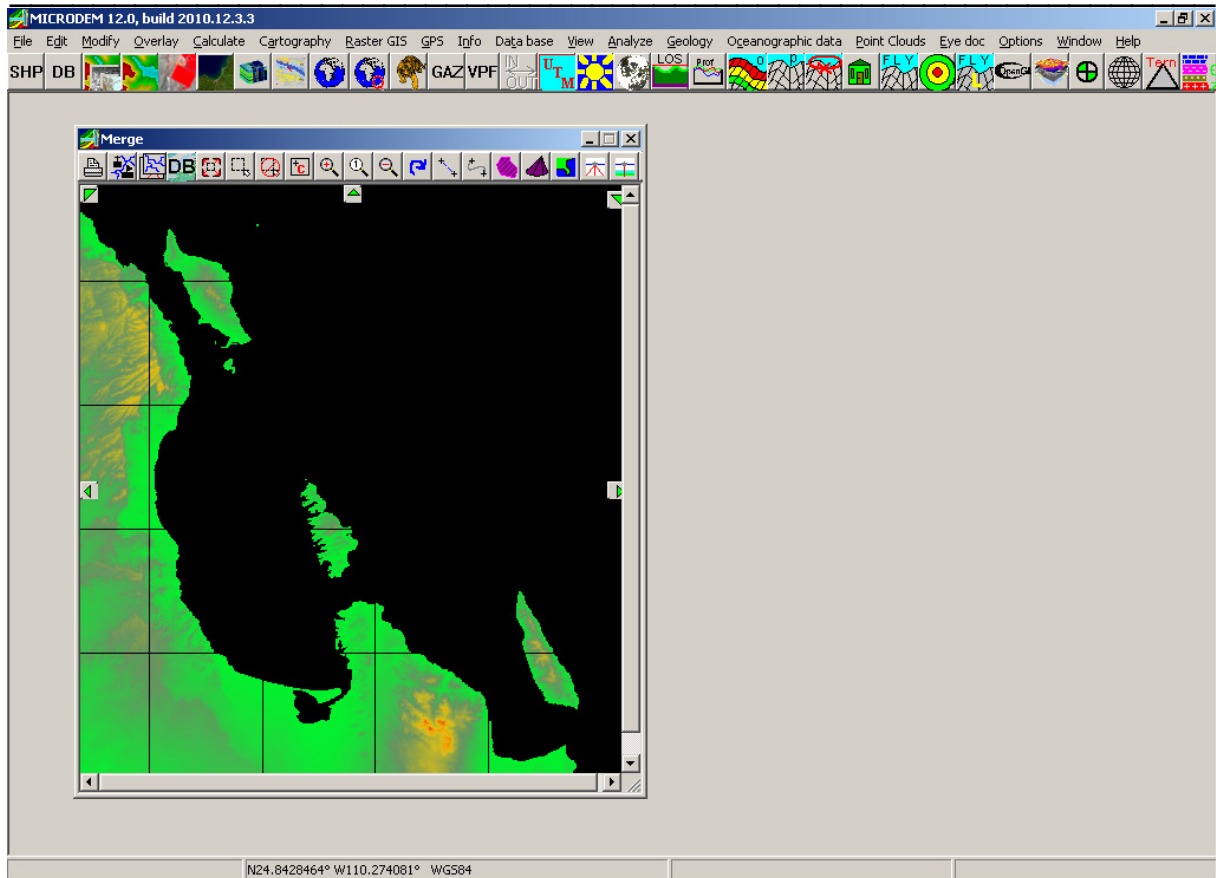


Remember the area we are after is La Paz only, it is a section of what we see here, we will select that section in the next step.

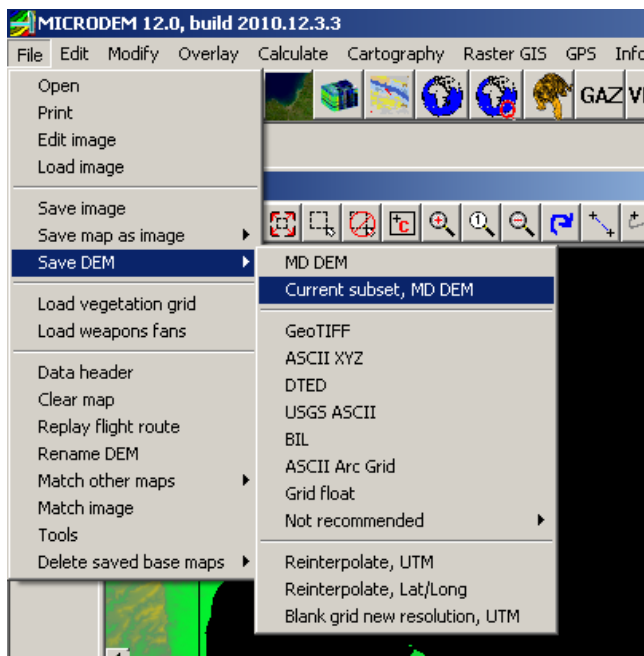
We use the menu item Modify/Map Area/ click, subset, draw the box and click. We don't have to be precise just now, we just roughly select the area.



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Now we save our map in C:\Mapdata\La\_Paz\.. as a DEM by:

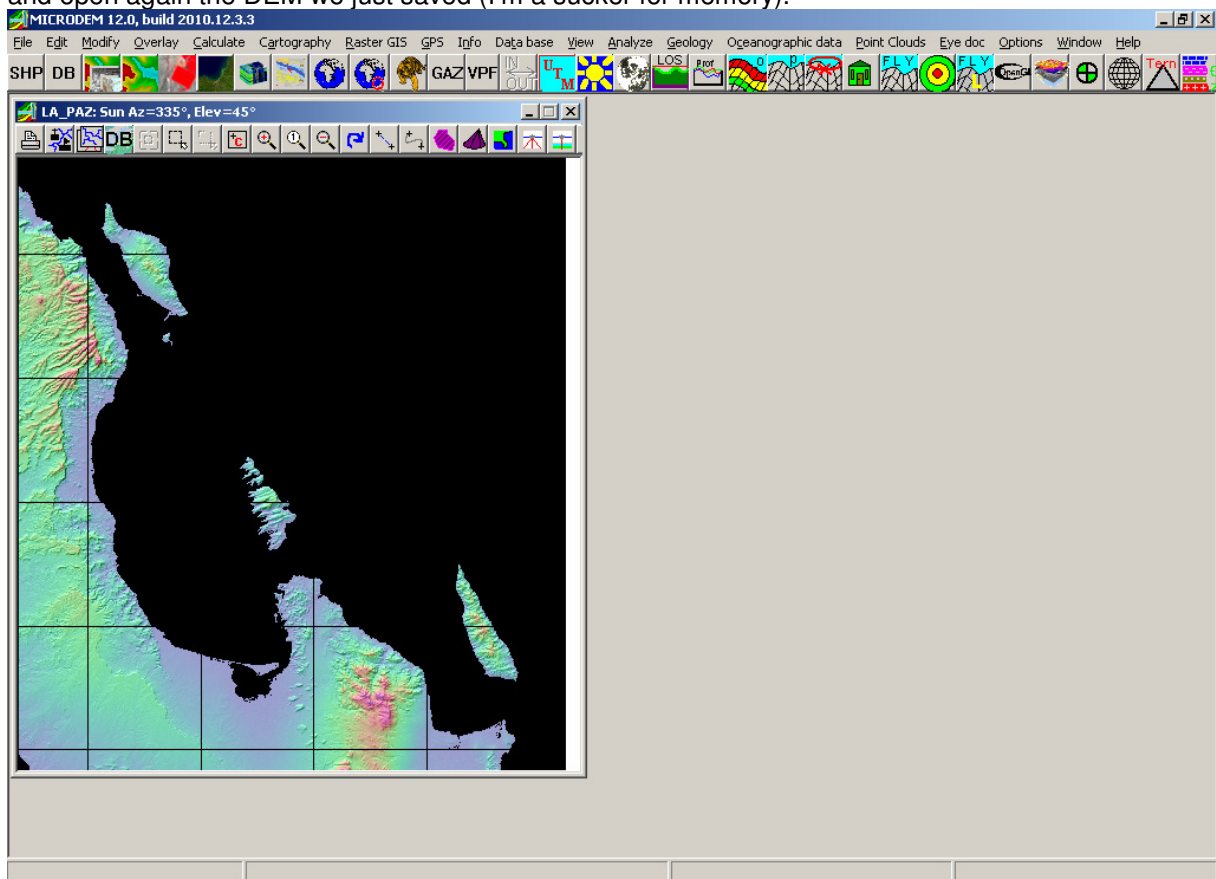


and we save it in our La\_Paz directory as LA\_PAZ.DEM.

Now, I exit MicroDEM (just so I'm sure nothing remains in memory) and I open MicroDEM once again

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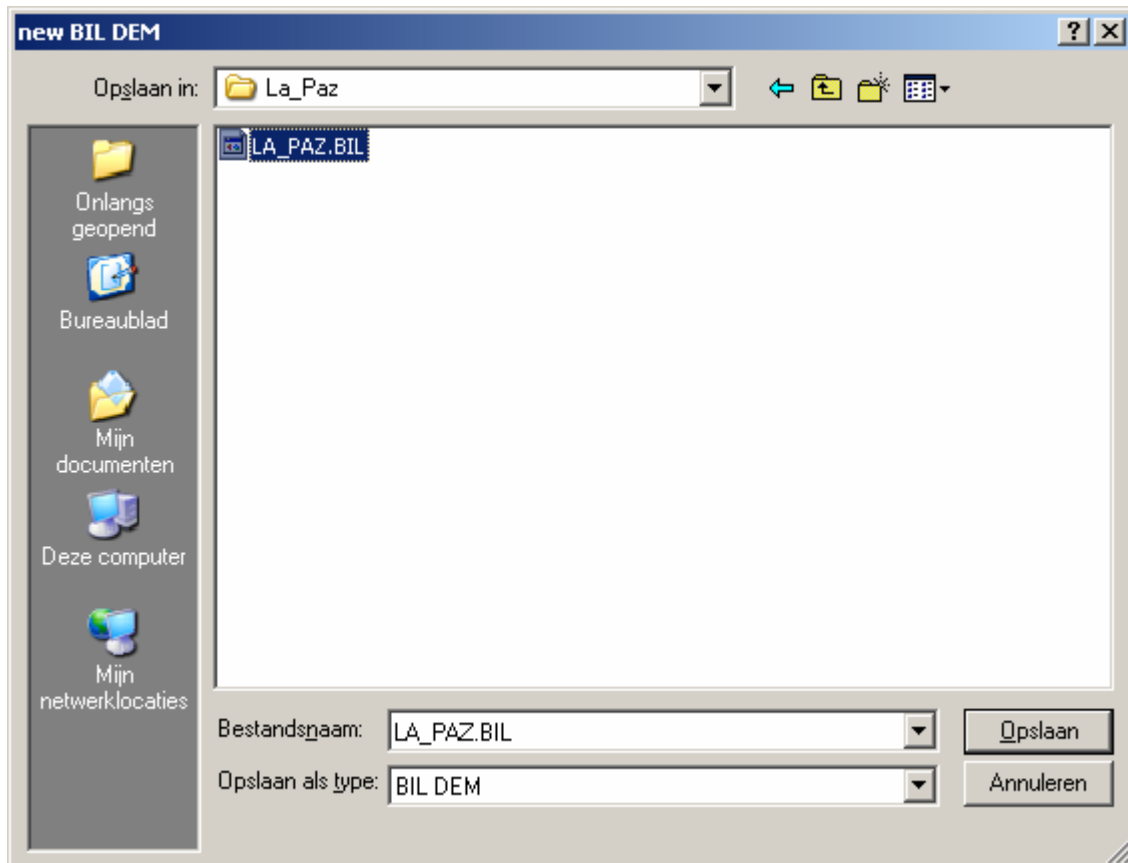
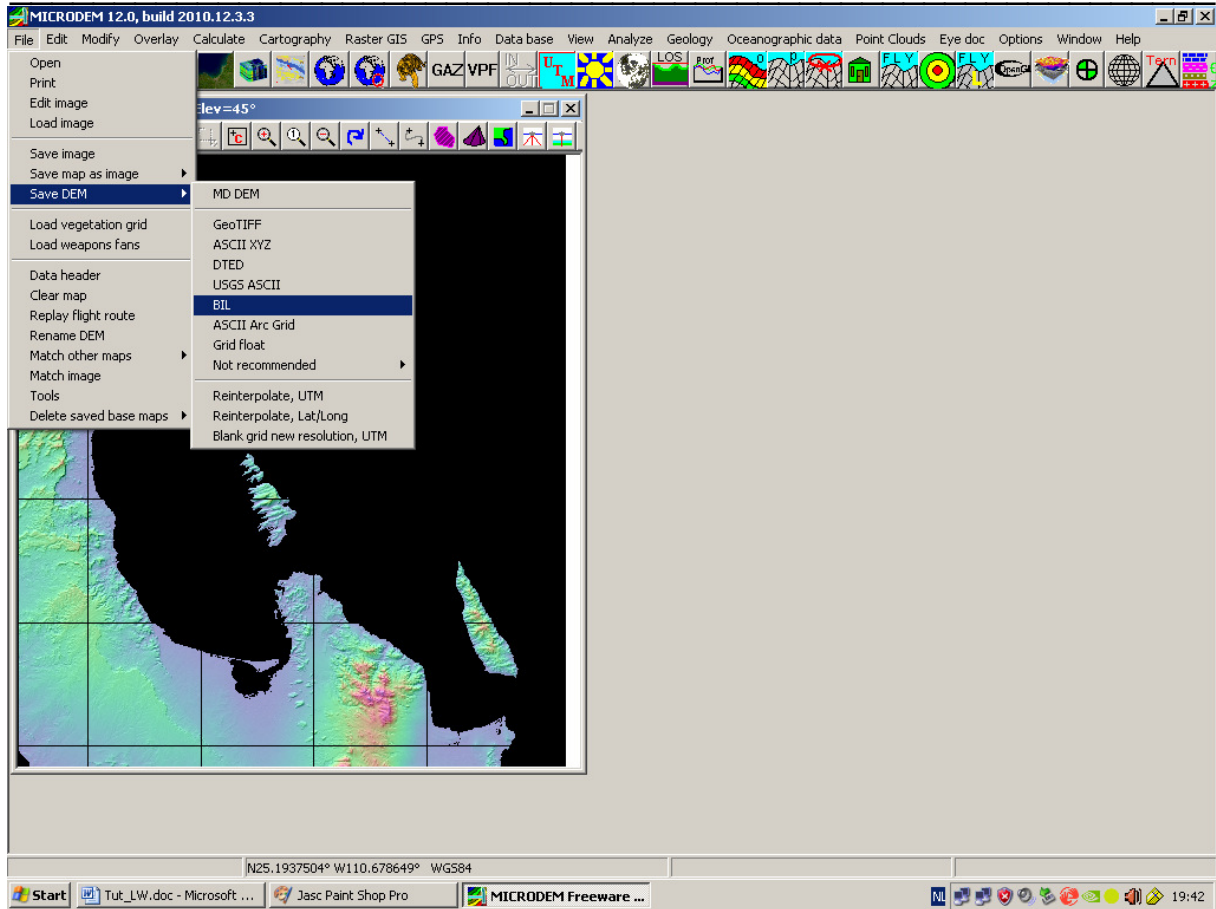
and open again the DEM we just saved (I'm a sucker for memory).



Here we go, we have narrowed our selection. Next we'll save it for Landsat to read it in.

The file type to save our work in is BIL

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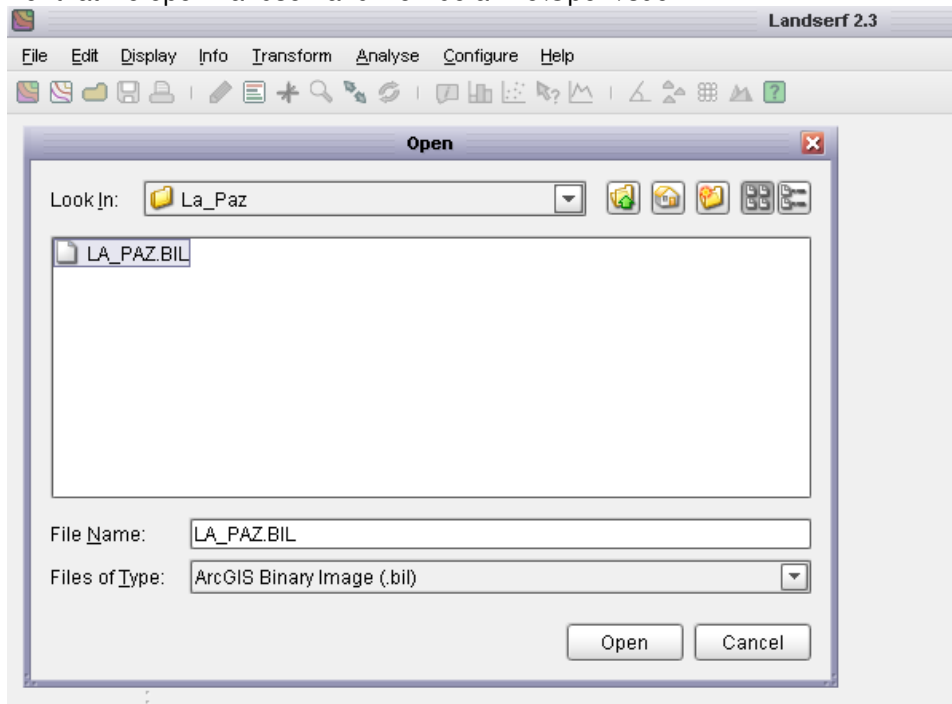


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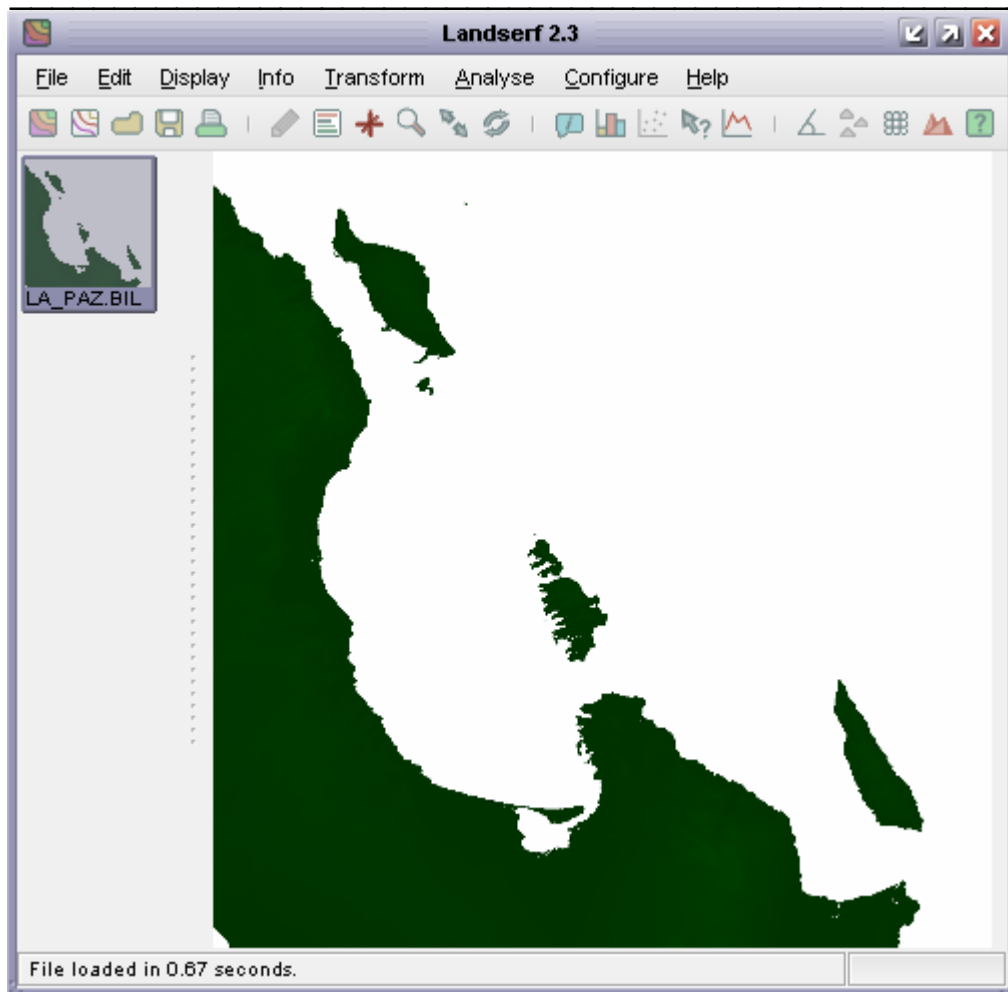
We are now done with MicroDEM, we'll go to the next step and select the area we are after.

For that we open Landsat and we'll do a File\Open\ such:



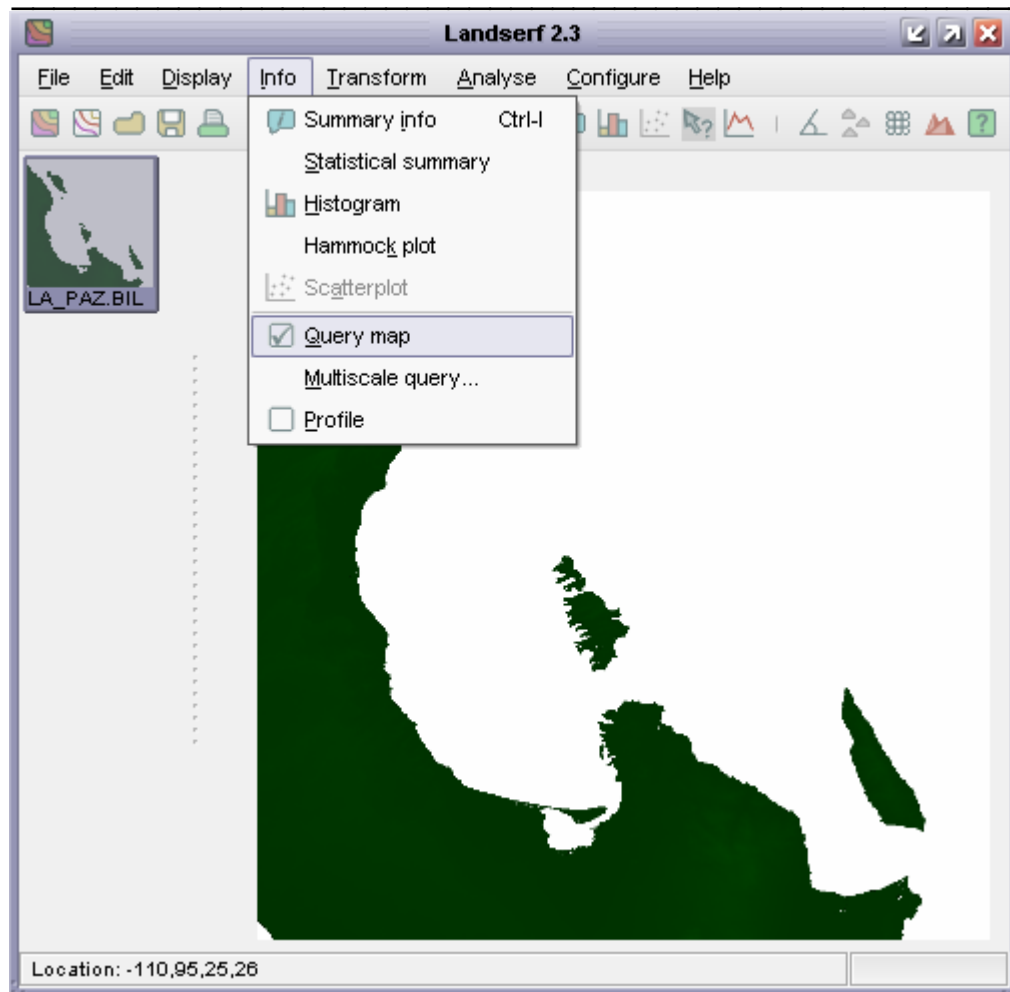
The file will open like this:

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The next thing we have to do is to select the area we are interested in, keep pen and paper ready, we have to record the coordinates (as we are going to make a selection).  
To be able to select the area, we need the screen display to show coordinates as we move the mouse across the screen?  
For that we enable Info\Query map

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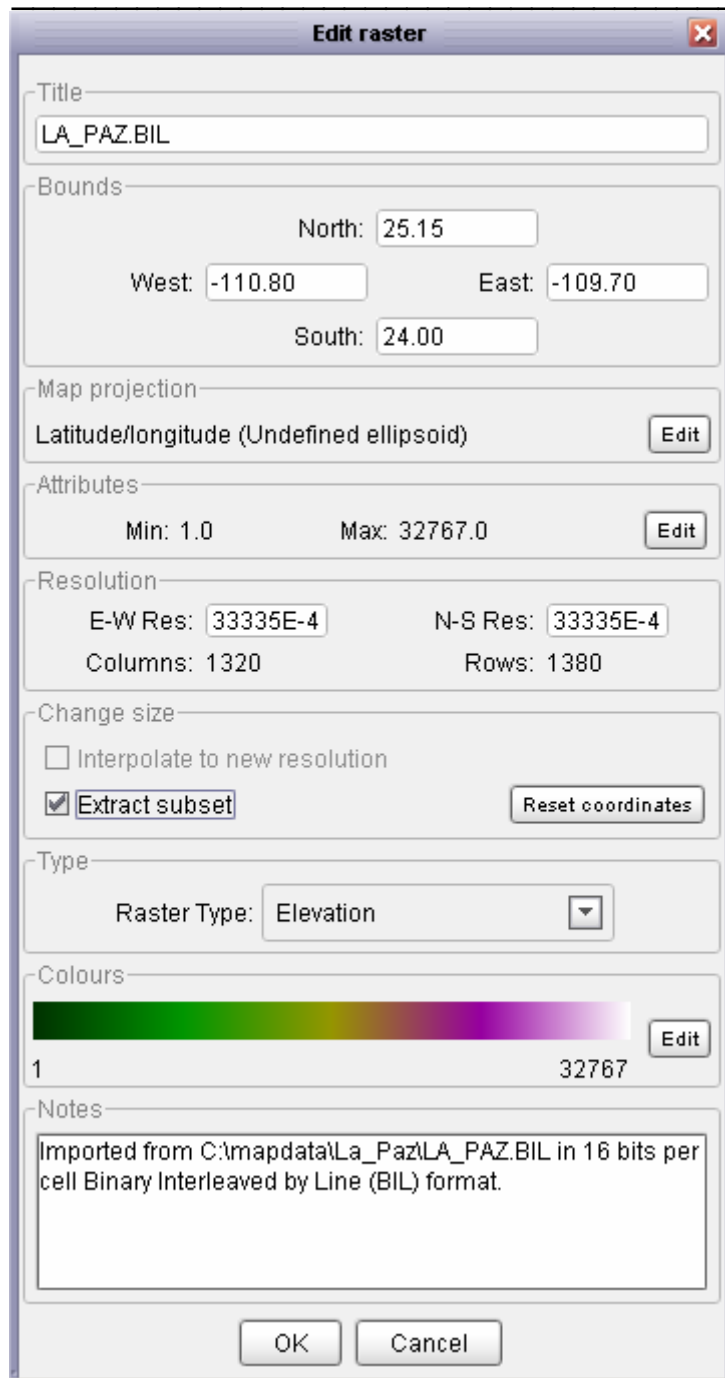
We have to find a north border, a south border, a west border and an east border, it is not difficult, just move the mouse and find those coordinates you'd like to use.

In this case, by moving the mouse around the screen I have noted these boundaries:

North border: 25.15N  
South border: 24.00N  
East border: 109.70W  
West border: 110.80W

Now we will select that area in Landserf, Edit, Edit raster:

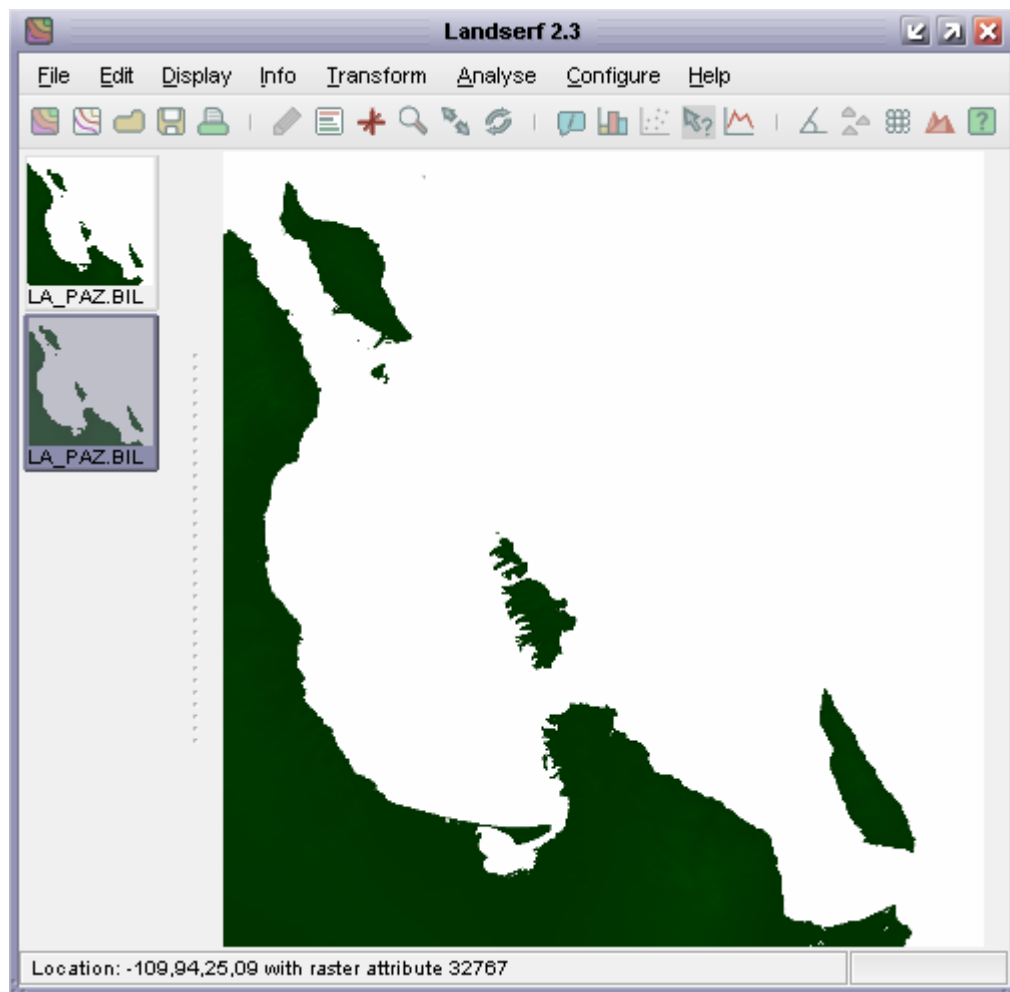
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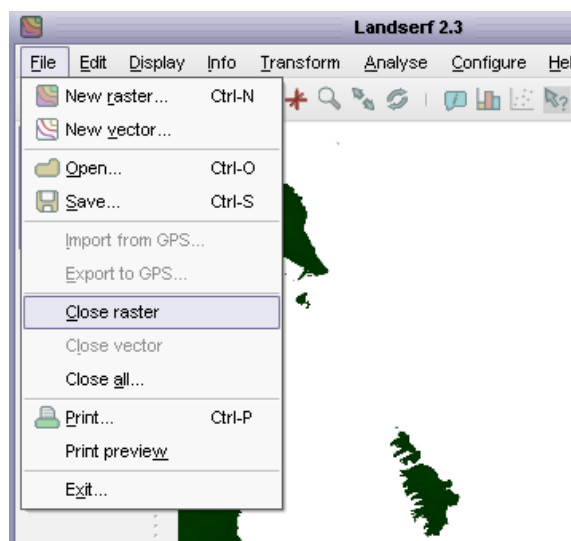
note the tick in Extract subset.

The resulting file shows like this:

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Exactly what we wanted. Notice you have 2 icons in the left menu panel, click the top one to activate it, this one is our original file and we can remove it.



So now we are left with the exact tile for the land, there is one final action we have to perform. Landserf treats all "invalid/missing data with a value 32767, see it here when you double click on the



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single remaining icon:

**Edit raster**

Title: LA\_PAZ.BIL

Bounds: North: 25.15, West: -110.8, East: -109.7, South: 24.0

Map projection: Latitude/longitude (Undefined ellipsoid) [Edit]

Attributes: Min: 1.0, Max: 32767.0 [Edit]

Resolution: E-W Res: 33335E-4, N-S Res: 33335E-4, Columns: 1320, Rows: 1380

Change size:  Interpolate to new resolution,  Extract subset, [Reset coordinates]

Type: Raster Type: Elevation [v]

Colours: [Color ramp from green to purple] [Edit], 1, 32767

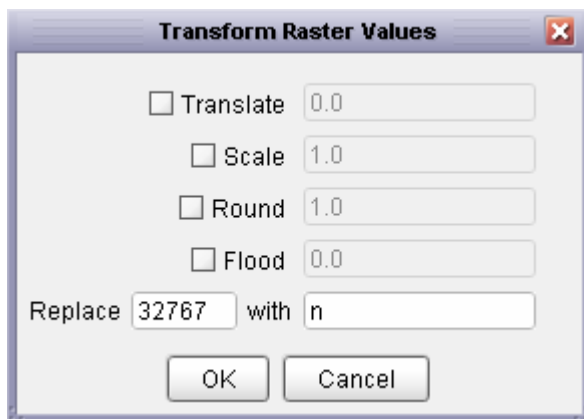
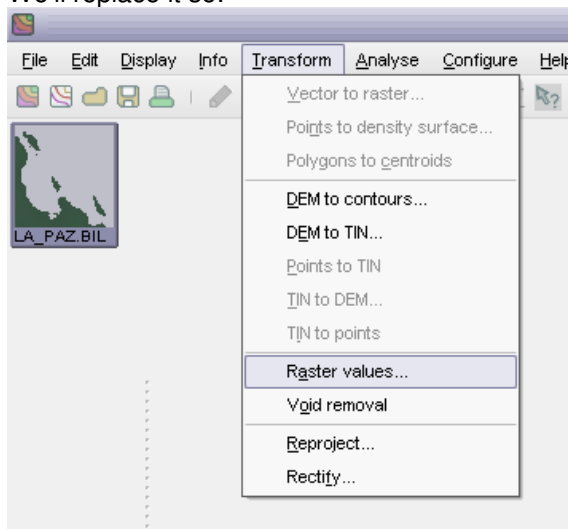
Notes: Imported from C:\mapdata\La\_Paz\LA\_PAZ.BIL in 16 bits per cell Binary Interleaved by Line (BIL) format.

[OK] [Cancel]

Of course we know that the max altitude isn't 32767 meters, we need to replace that value to what Landsat understands to be "missing", in Landsat that value = n

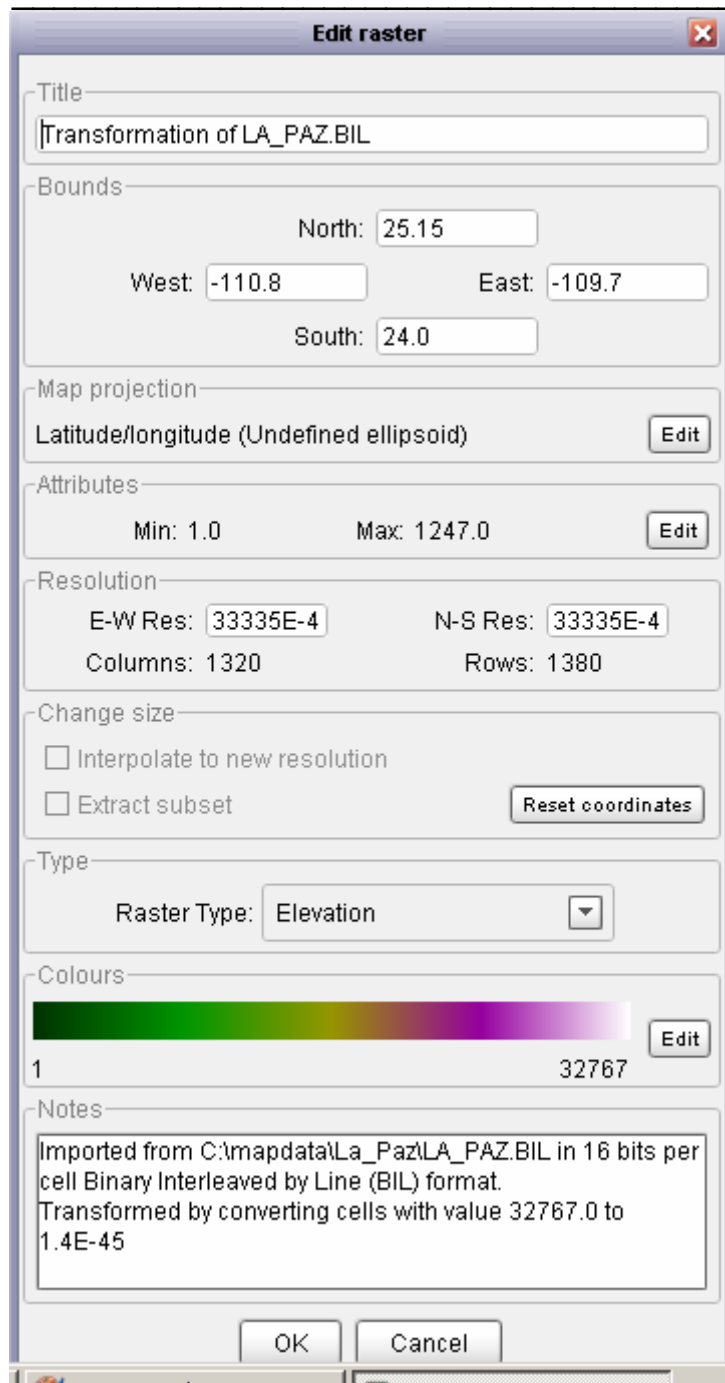
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We'll replace it so:



After you have done that you can once again delete the original (top) icon. If you double click on the one remaining icon you'll get the true values:

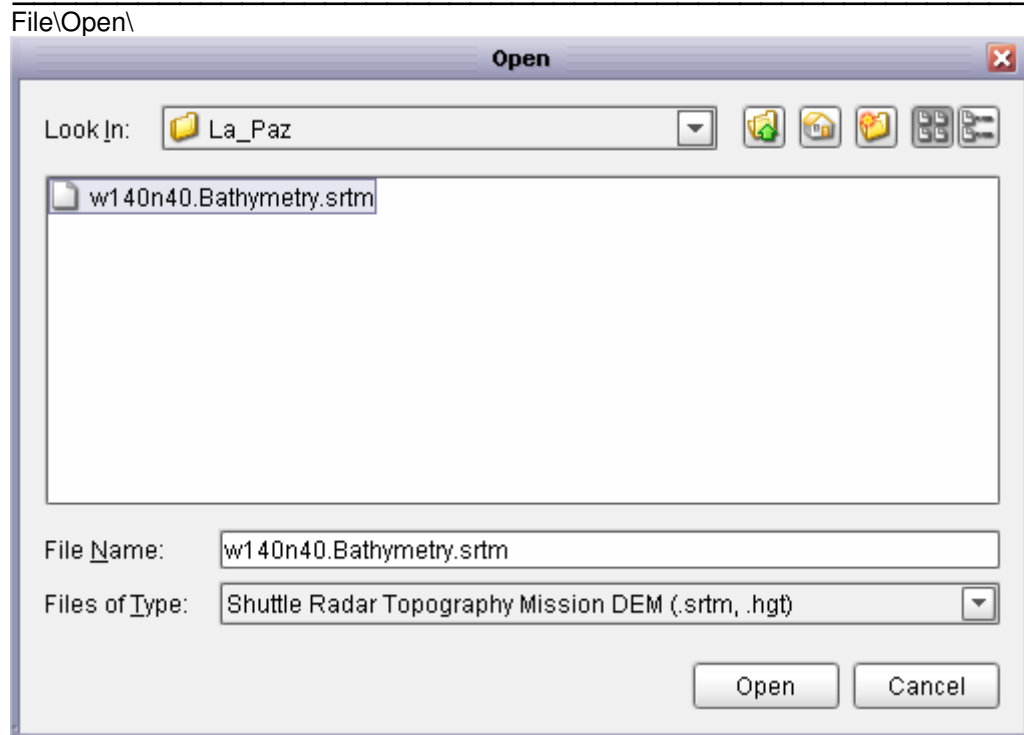
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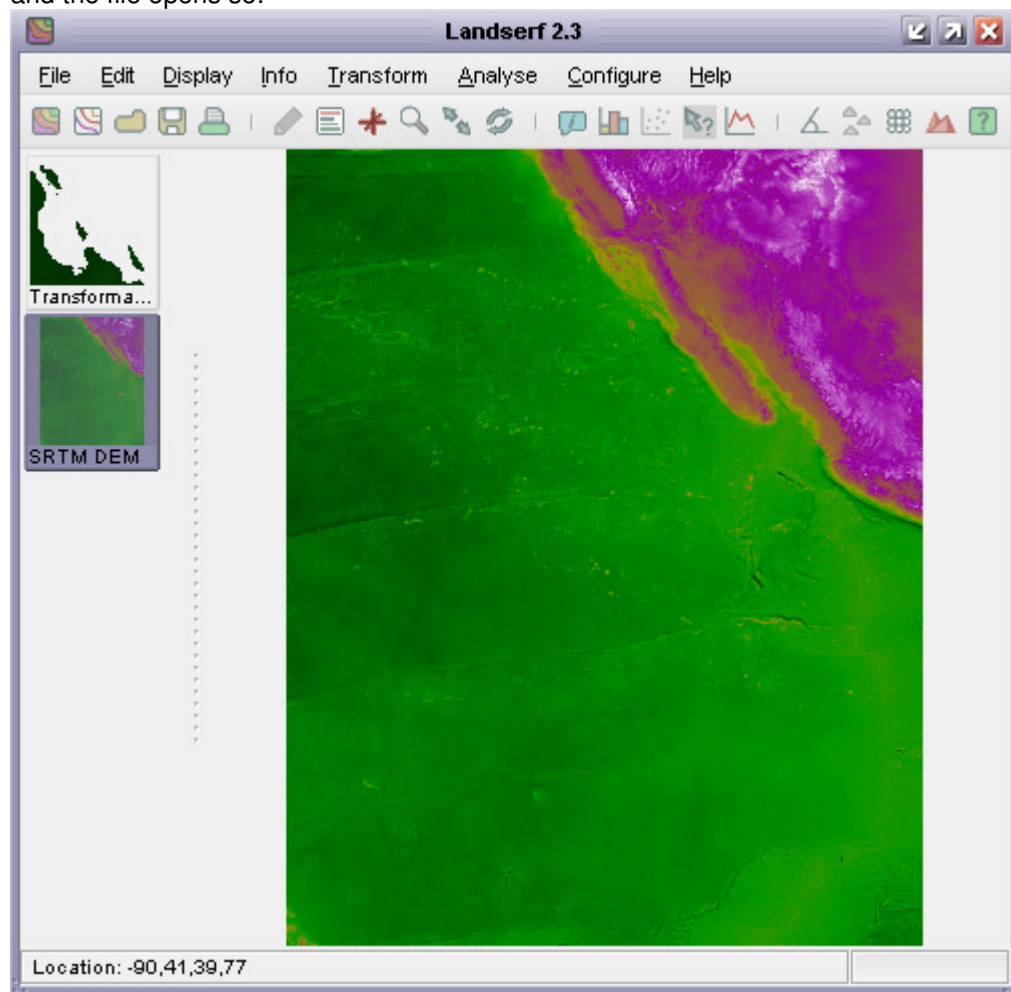
See how the height (Max) has changed to the correct value? (1247 meters).

We now have the land values as an icon in Landsat.  
Next we'll get the water in.

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and the file opens so:



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Of course the area is much too large but we now know how to select the area we are after, wasn't it:

North border: 25.15N

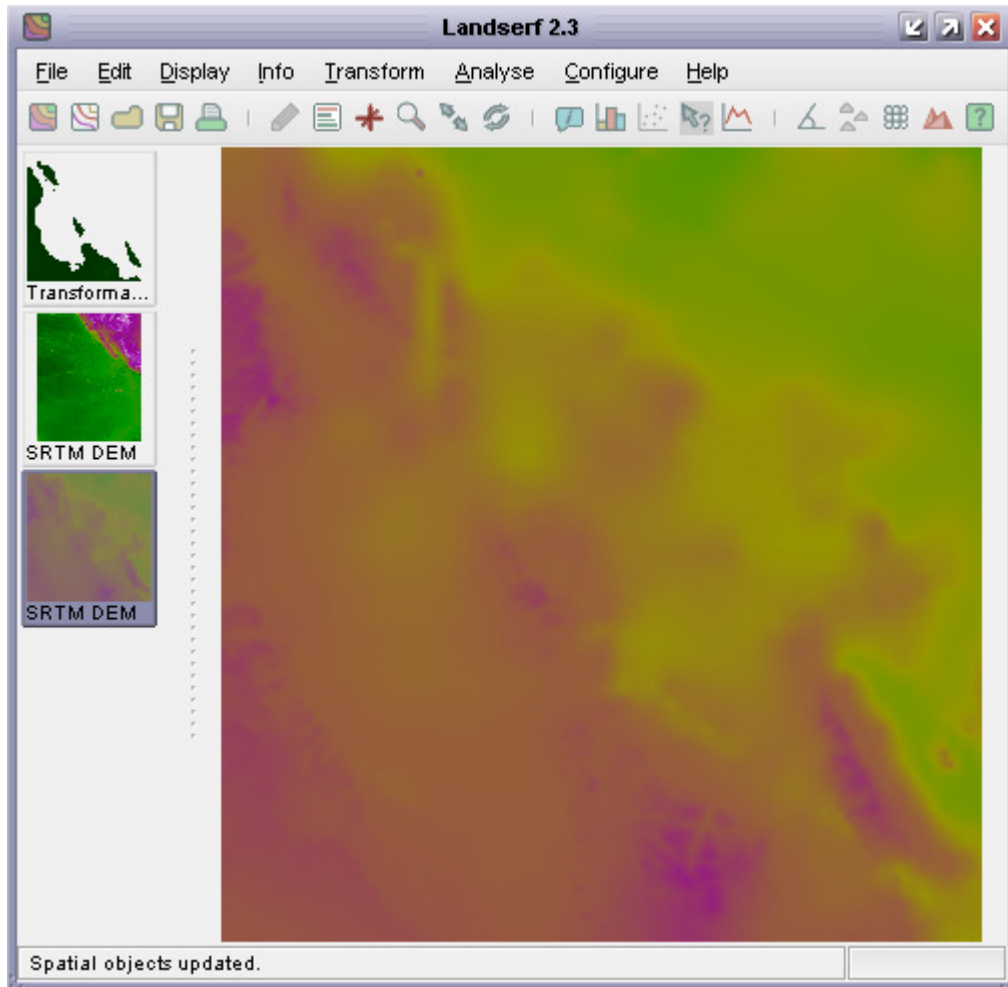
South border: 24.00N

East border: 109.70W

West border: 110.80W

Sure, so that's the area we'll select by doing Edit\Edit raster and enter these above values, we've done it before.

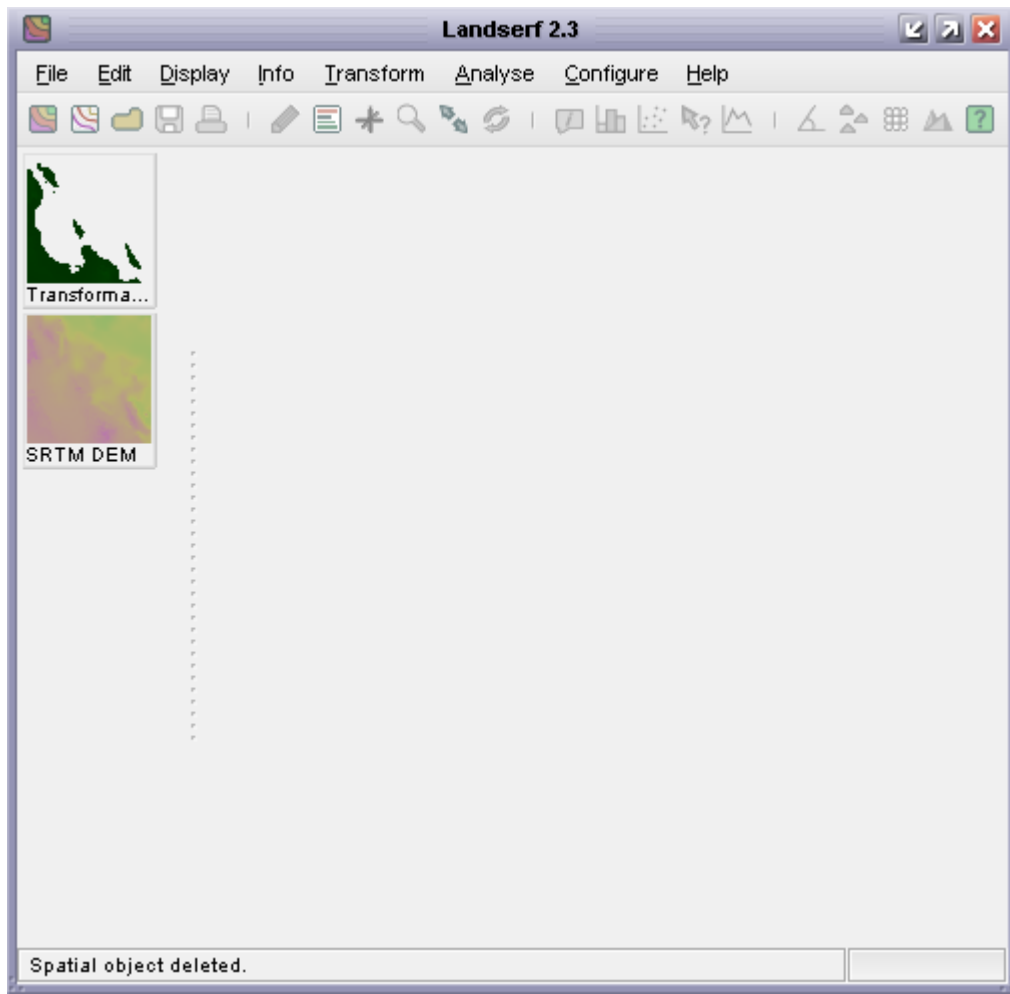
Result:



We can click on the middle icon and remove the data, we've done it before so you know how to.. (File\Close raster).

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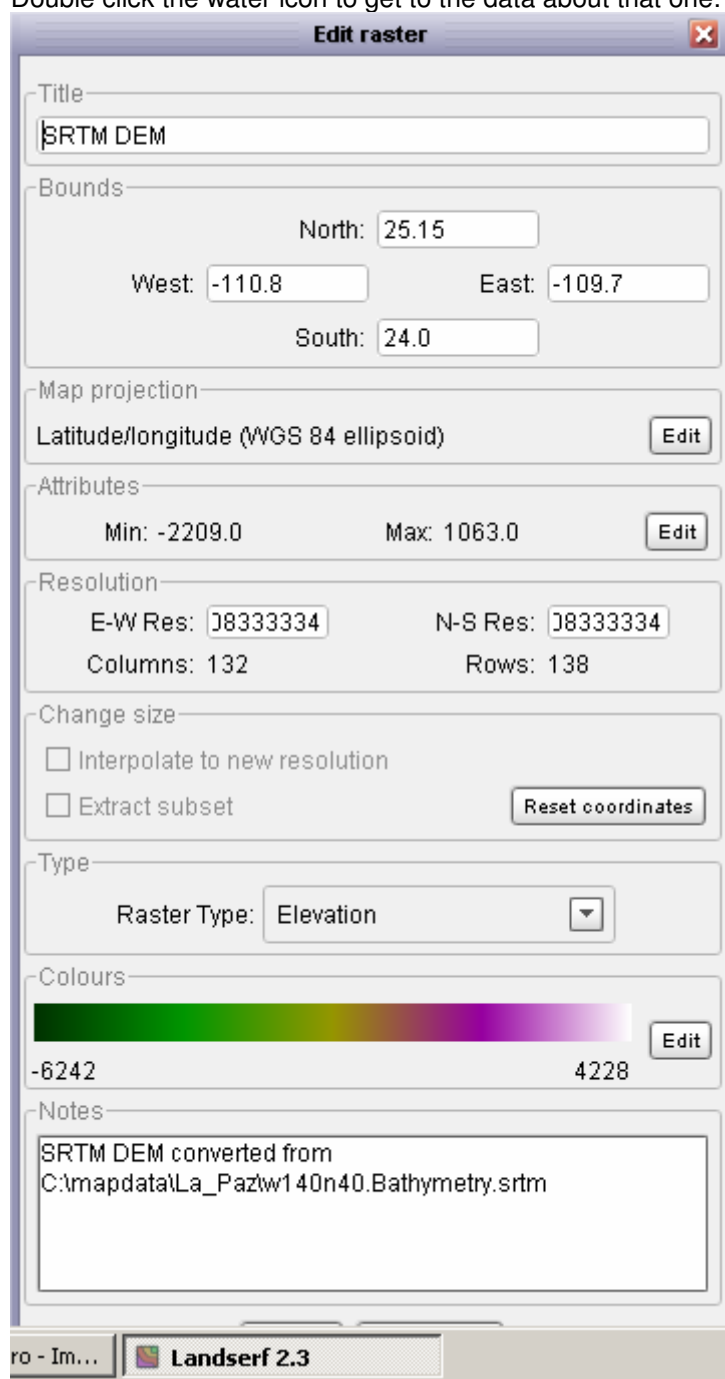
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What we are left with now is 2 icons, the one is showing land only, it is in a high resolution. The other is water PLUS land data in a lower resolution. We now need to remove the low resolution land data from our water file, for obvious reasons (we only want the best available data)  
We have to do some manipulation to achieve our objective.

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Double click the water icon to get to the data about that one:

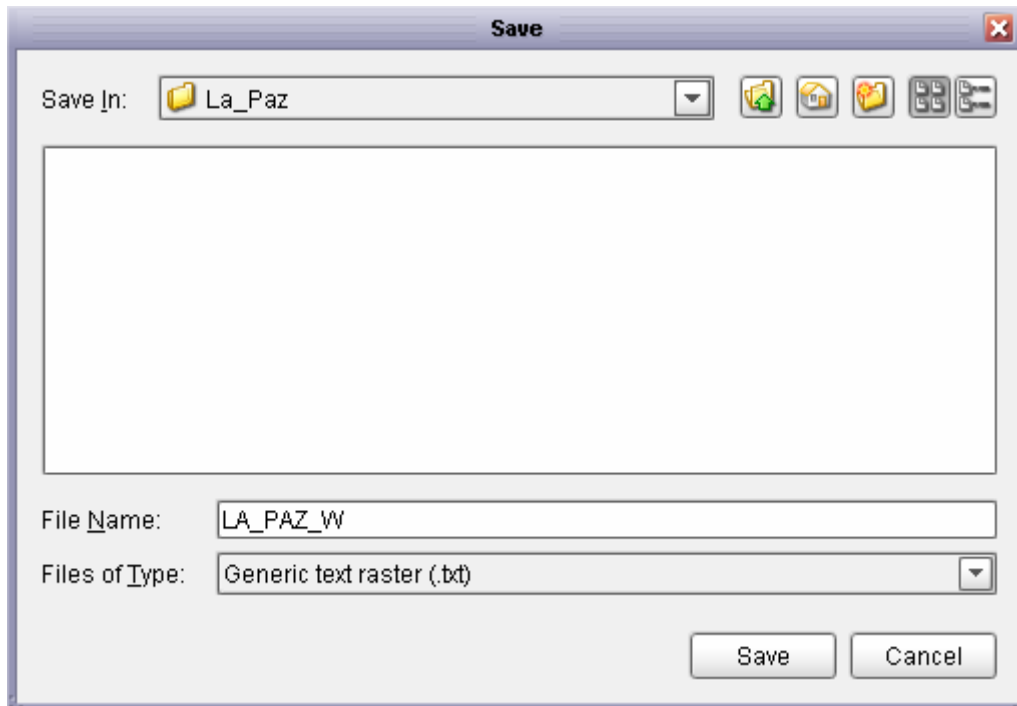


Note and record, columns 132, rows 138.  
We'll now save this one as a text file for 3DEM to import:

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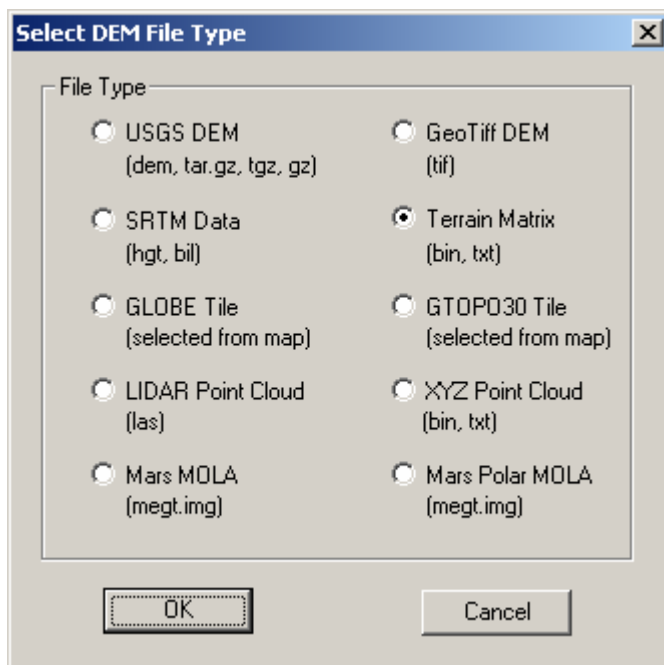
---

As we know this is the water file I have added **W** to the file name when saving:



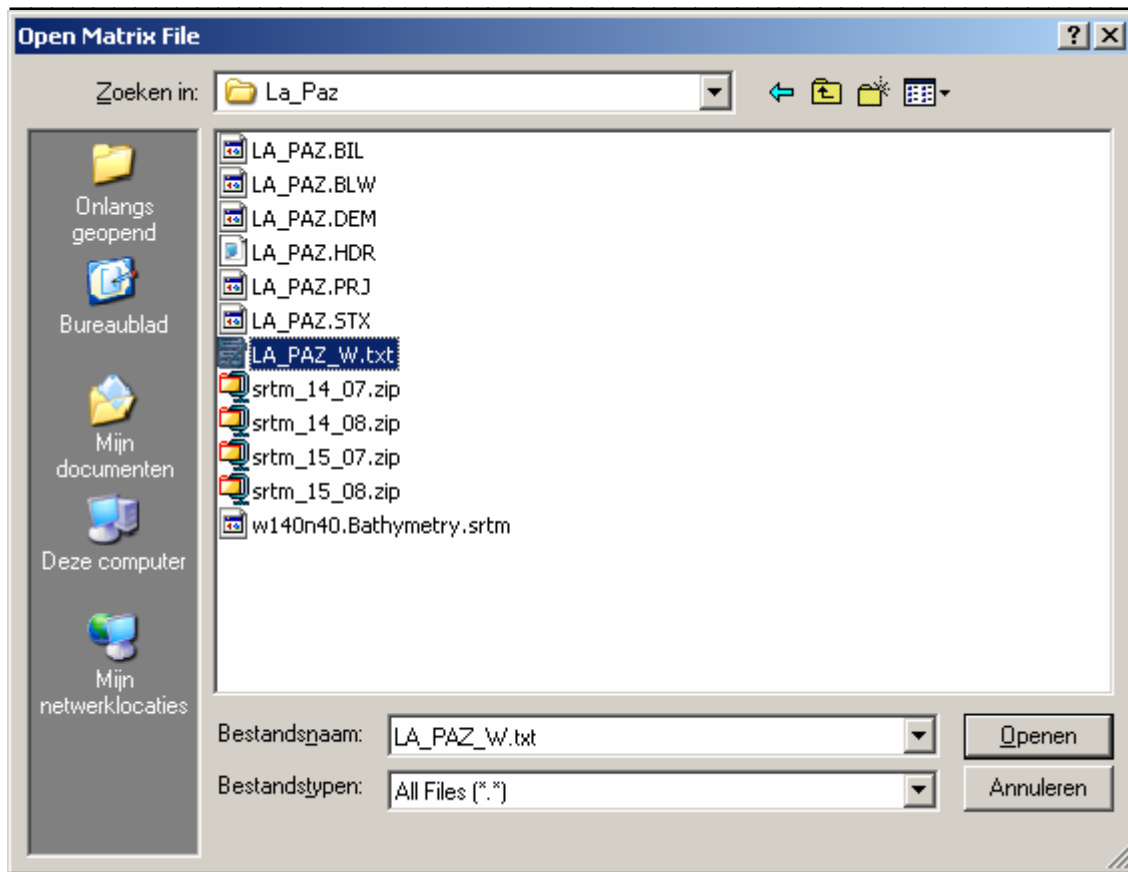
We can now remove that second icon from our Landsat as shown before (click and file/close raster) Left now is the single land icon.

We open 3DEM and choose txt to open our file:

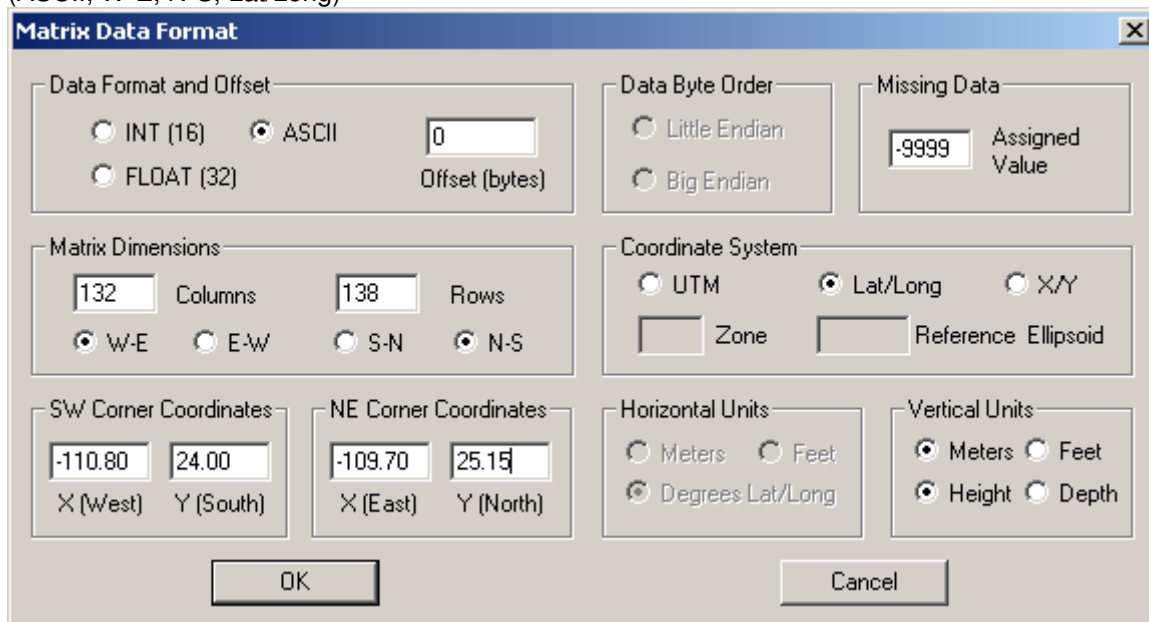




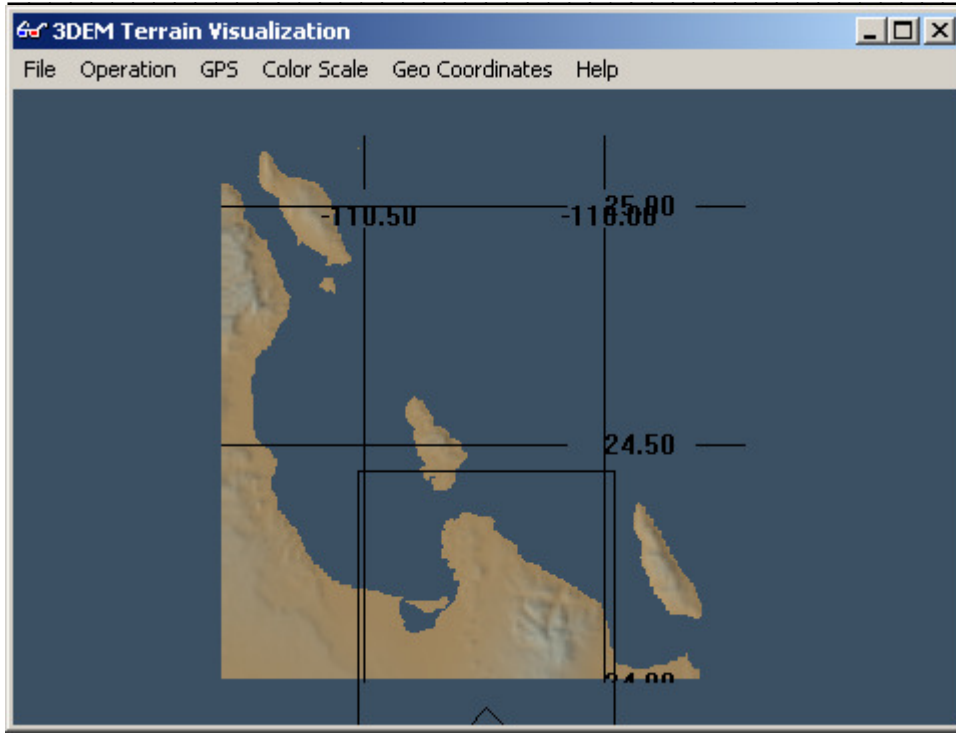
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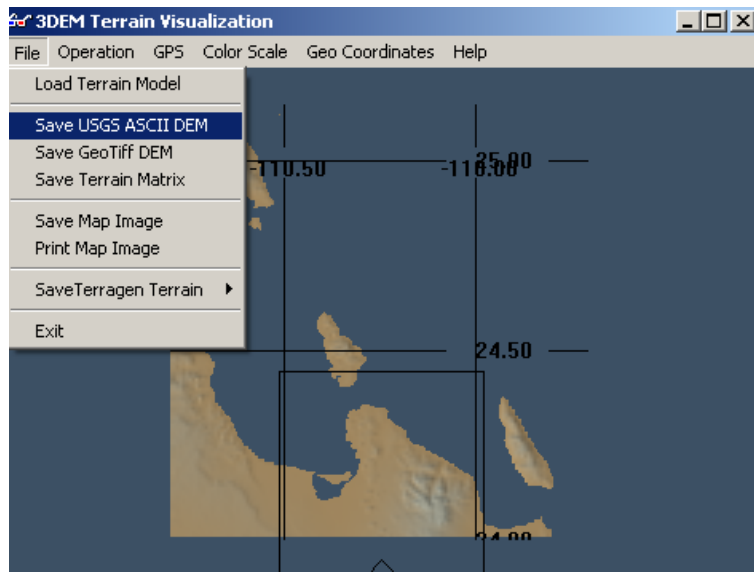
and we open the LA\_PAZ\_W.txt file, a dialog box opens up, enter the values we know, please observe all the boxes ticked, they are essential for the map to display correctly: (ASCII, W-E, N-S, Lat/Long)



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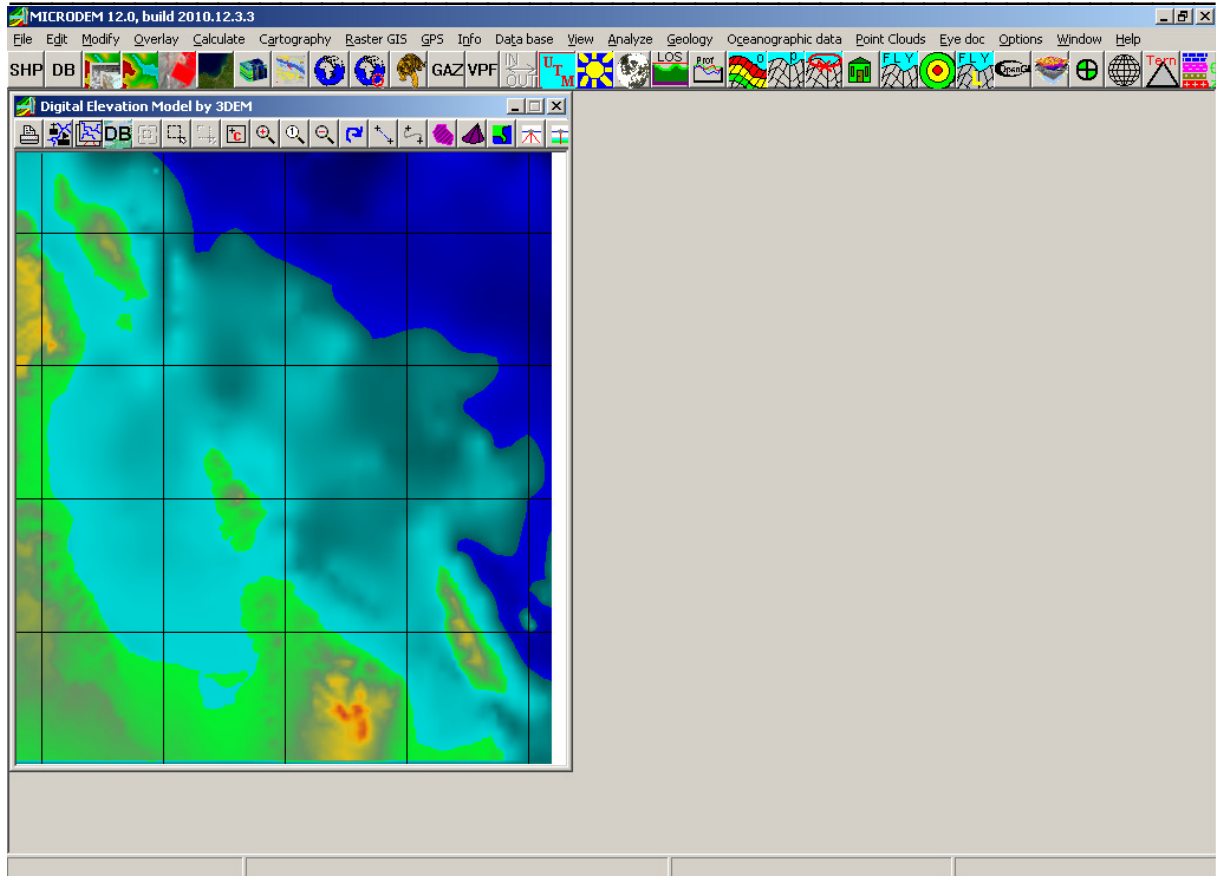
Here now is the file loaded in 3DEM and we'll save it as a DEM for MicroDEM to manipulate on:



I save as LA\_PAZ\_W.dem (again I use the W to indicate this is the file containing the water data)

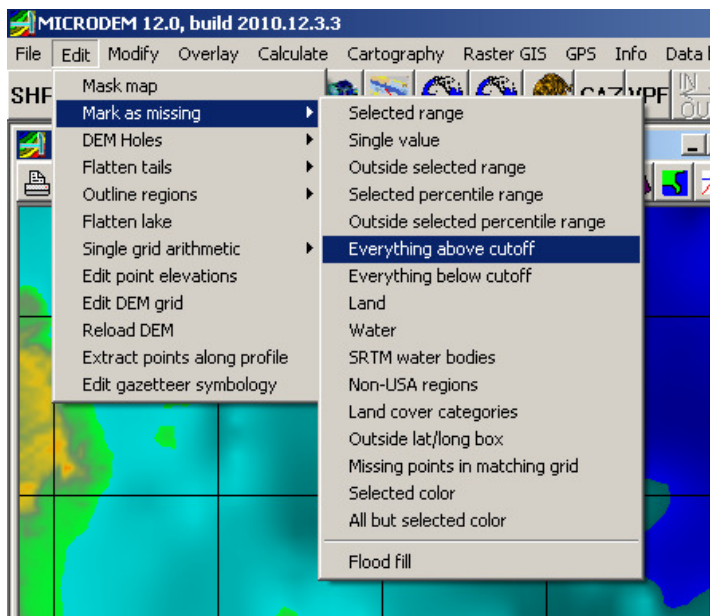
We go into MicroDEM once again and open up the file we just saved:  
Also we do the Modify/Elevation/Land Sea scales once again to get a nice view:

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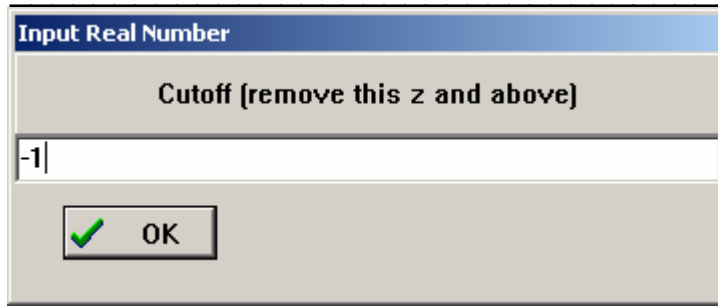
This is what we do next to just get the water, we remove the land data:

Edit/Mark as missing/Everything above cut-off/



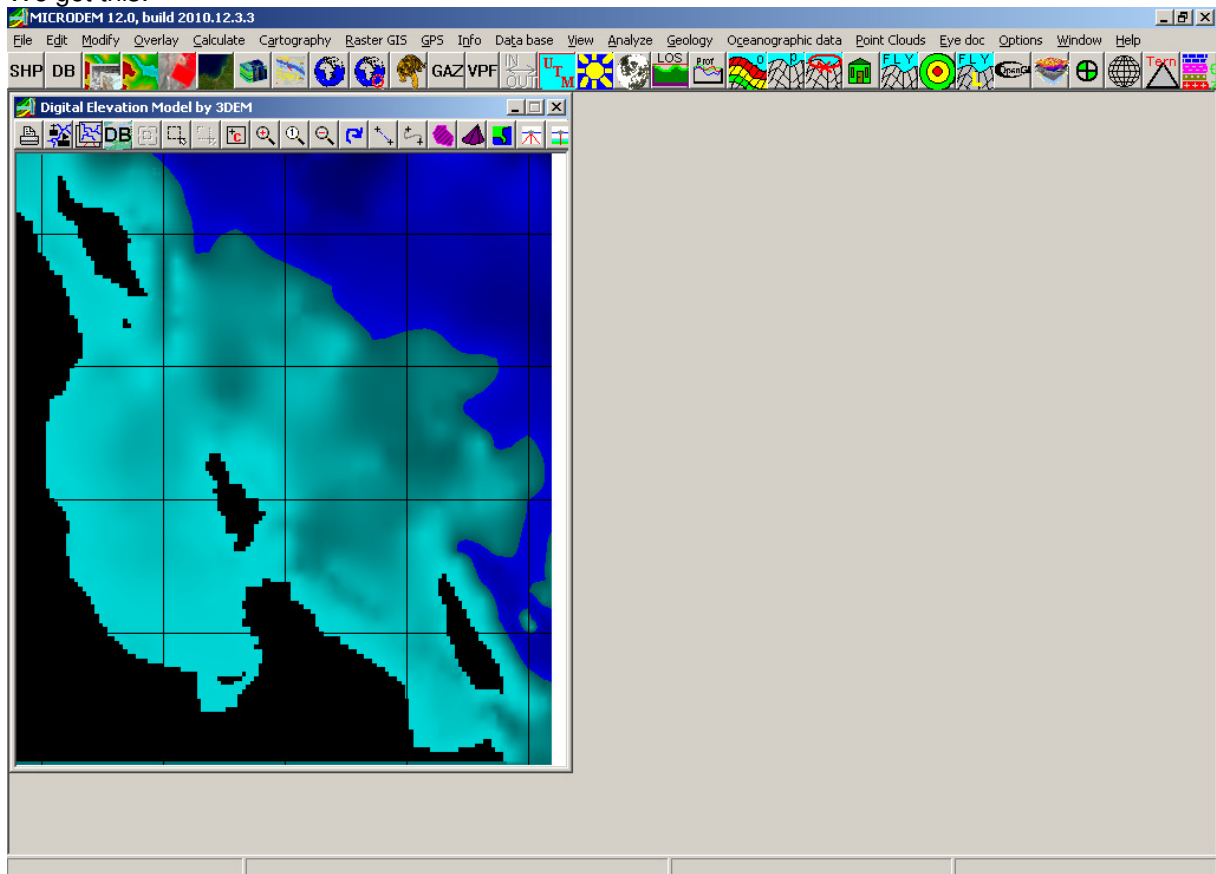
and we enter -1, don't worry, we'll get those (lost depth) back in a later stage....

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OK it

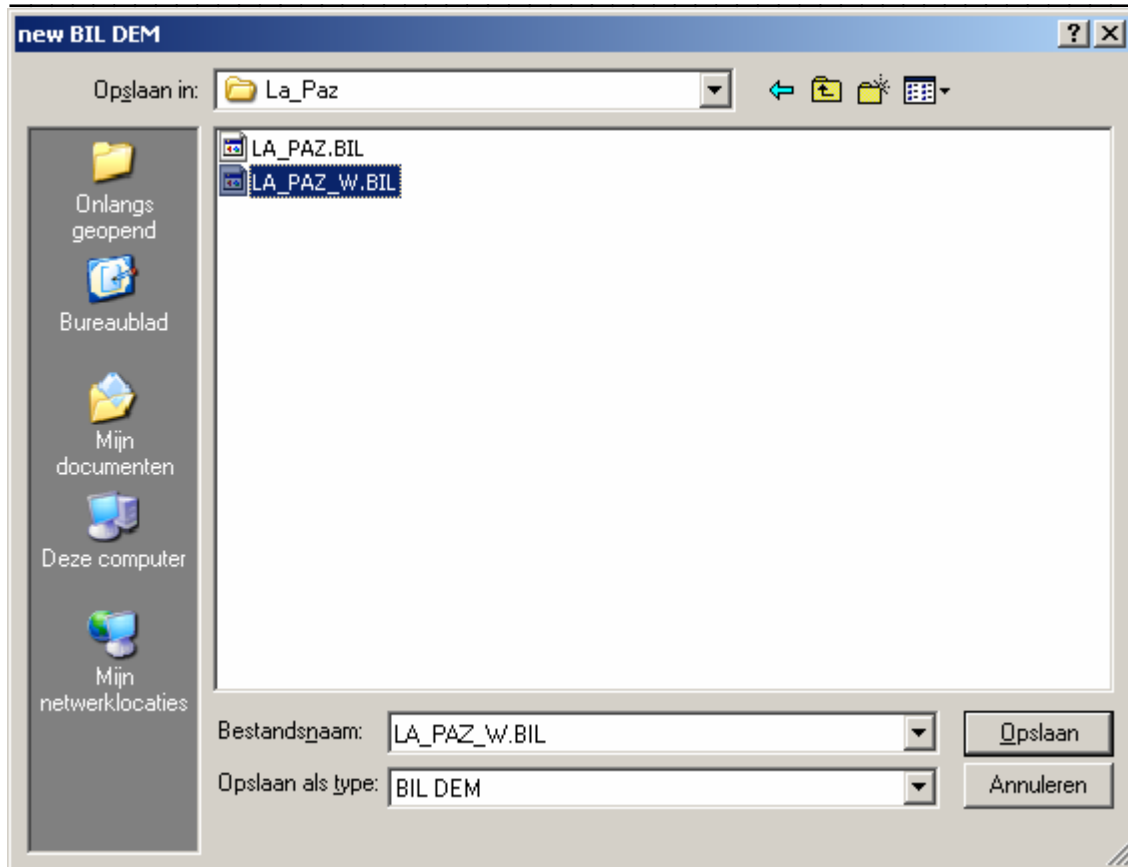
We get this:



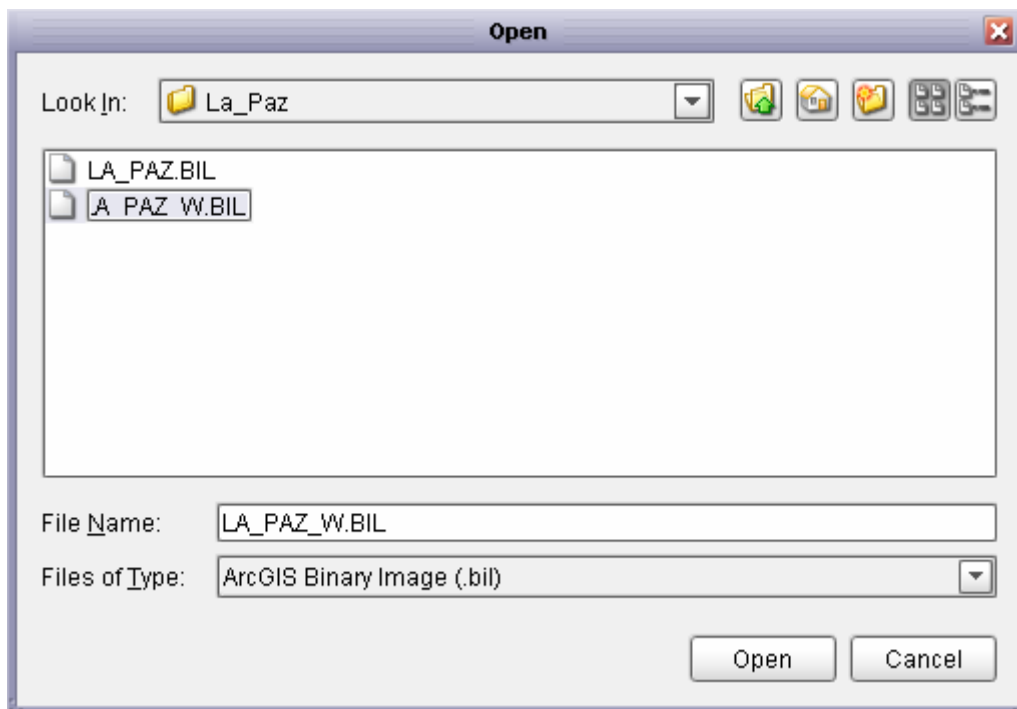
every height above -1 meters is now removed from the file, we have to save our work now.

In File/Save DEM/ choose the option BIL, I save it as LA\_PAZ\_W.BIL, you should end up such in your working directory:

## Tutorial: How to merge land and bathymetry data, using free commonly available resources

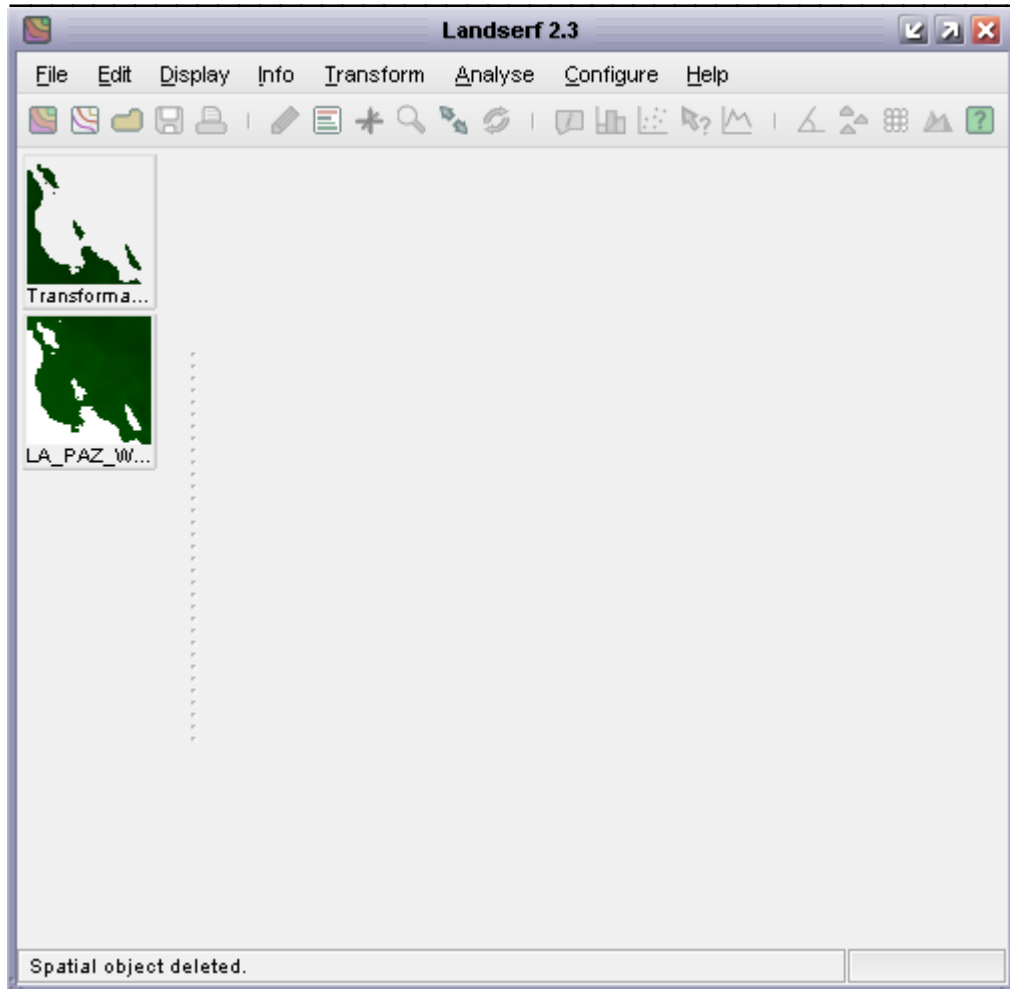


As you can see we now have 2 BIL files, the first one is still loaded in Landserf (it is the single icon there), next we will load the water file onto it.

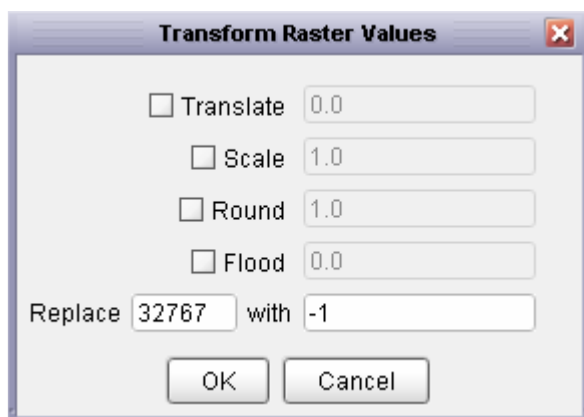


and we end up with 2 icons loaded in Landserf:

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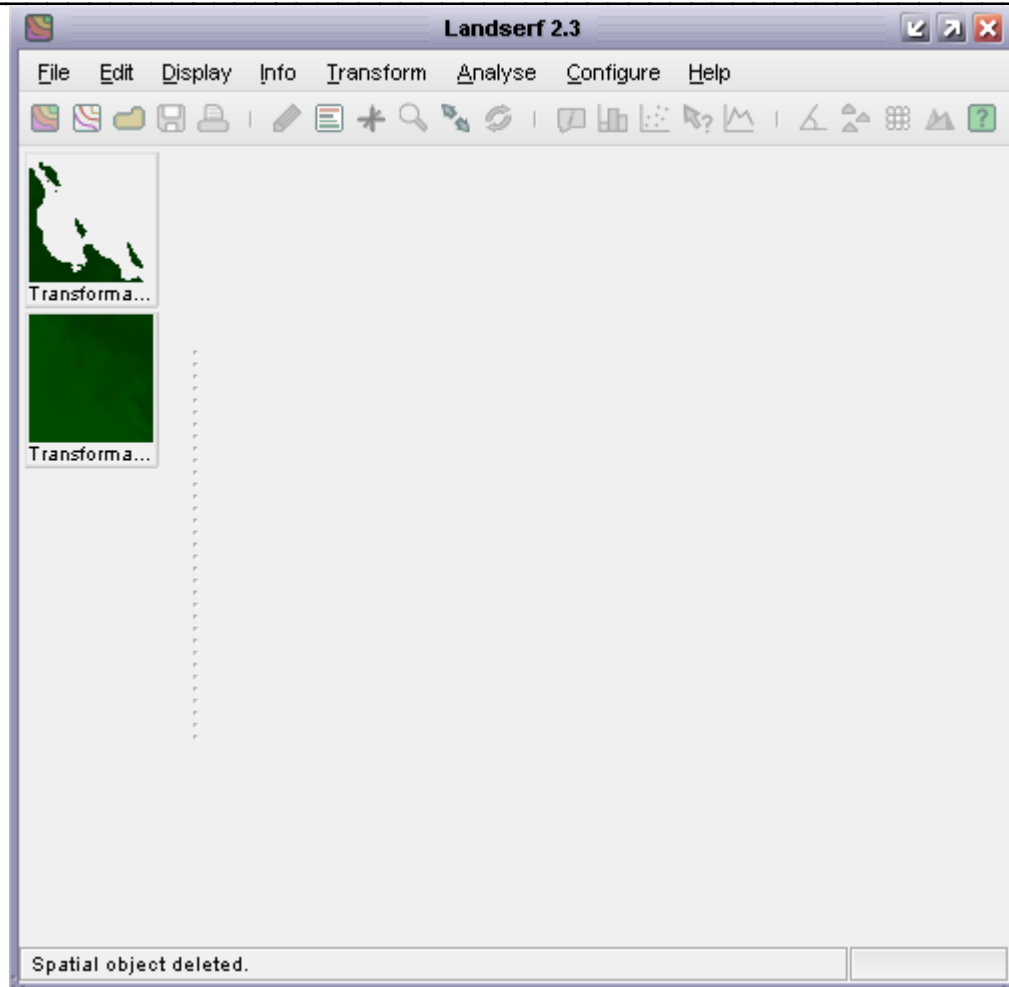


See how the one has the land and the other has the water? The land file is okay, we've worked that one before, we have to replace all the invalid data (32767) from the water file, same as we did for the land file earlier. Click the water icon to activate it and go into Transform/Raster values click it, remember we removed everything above -1? We'll bring it back:



We end up with 3 icons again, you can remove the middle one (File/Close raster):

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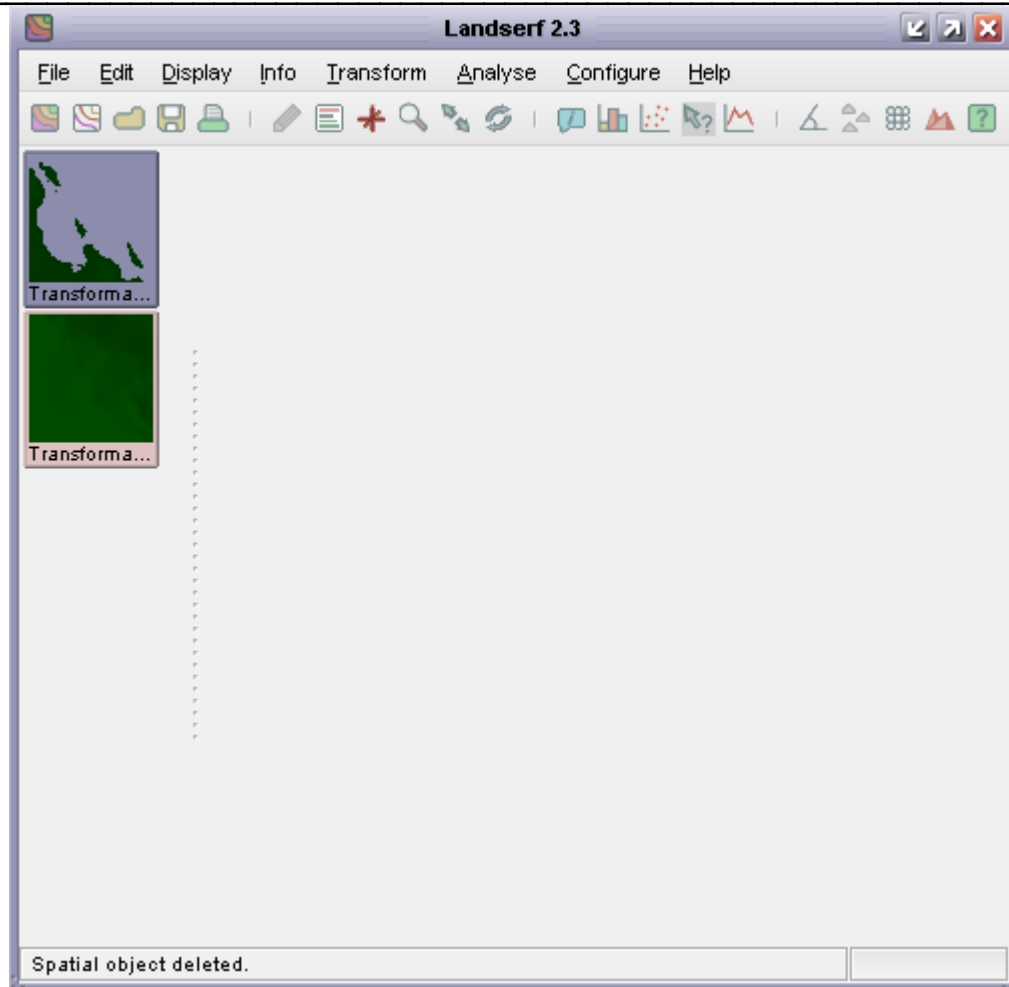


Here we finally are, 2 files absolutely to our liking, one with land and one with water!  
Let's merge the 2 into one file which we can load into 3DEM to create the final.

It is self explanatory, what we want to do is create a union between the 2 files and replace all the null values in the land file with the depth values from the water file.

To do that we give the land icon (the top one) a click, and give the water icon a click holding the "SHIFT" key.

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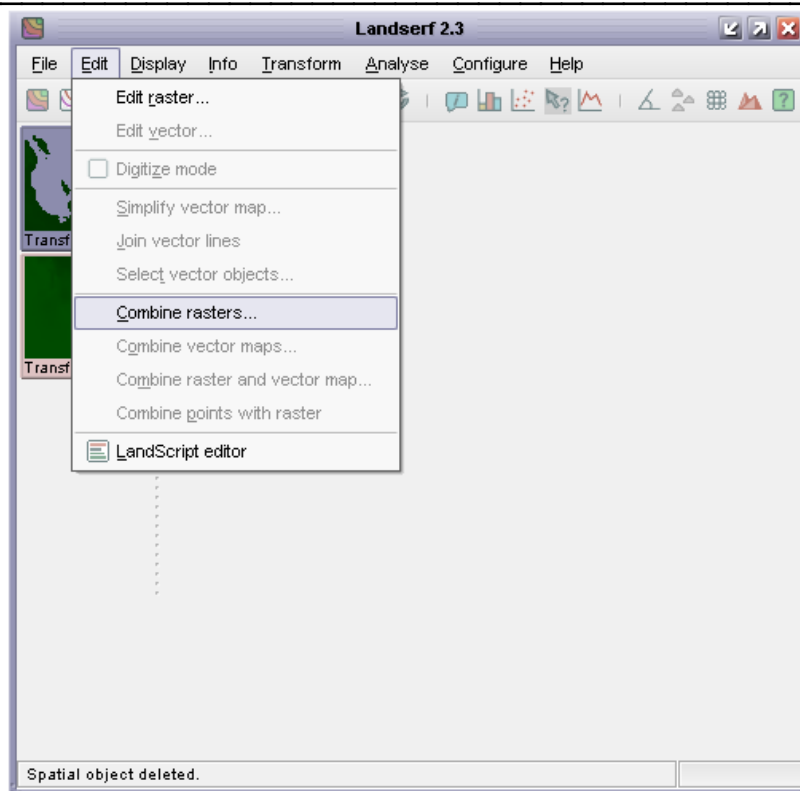


See how the land icon has a grey aspect and the water icon has a pink one? (primary/secondary)

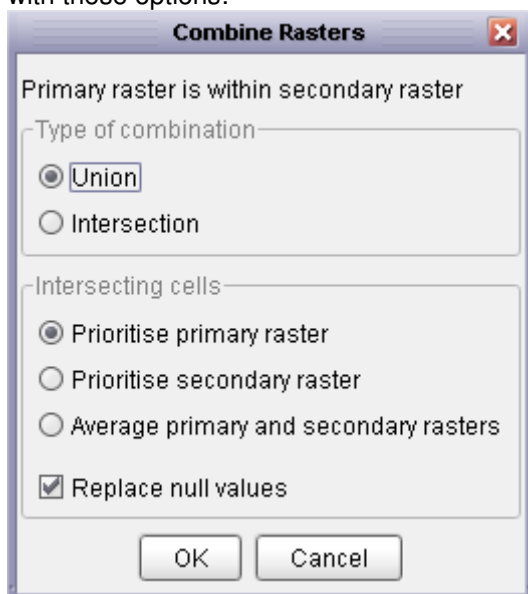
Next we go into the “edit/combine” dialog:



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with these options:



Press okay to end up with 3 icons again, remove the top 2 ones, I'm not going to tell you how, you've done it before.....

Once you have the single icon left, press edit/edit raster to get some essential data:

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**Edit raster**

Title  
Combined raster

Bounds  
North: 25.154535  
West: -110.804825 East: -109.696495  
South: 23.996202


Map projection  
Latitude/longitude (Undefined ellipsoid) Edit

Attributes  
Min: -2209.0 Max: 1247.0 Edit

Resolution  
E-W Res: 33335E-4 N-S Res: 33335E-4  
Columns: 1330 Rows: 1390

Change size  
 Interpolate to new resolution  
 Extract subset Reset coordinates

Type  
Raster Type: Elevation

Colours  
  
1 32767 Edit

Notes  
Union of Transformation of LA\_PAZ.BIL and Transformation of LA\_PAZ\_W.BIL prioritising attributes in Transformation of LA\_PAZ.BIL where rasters intersect.

OK Cancel

Note that columns are 1330 and rows are 1390.

We will now save our work as a text file for 3DEM for the final leg, I use LA\_PAZ.txt

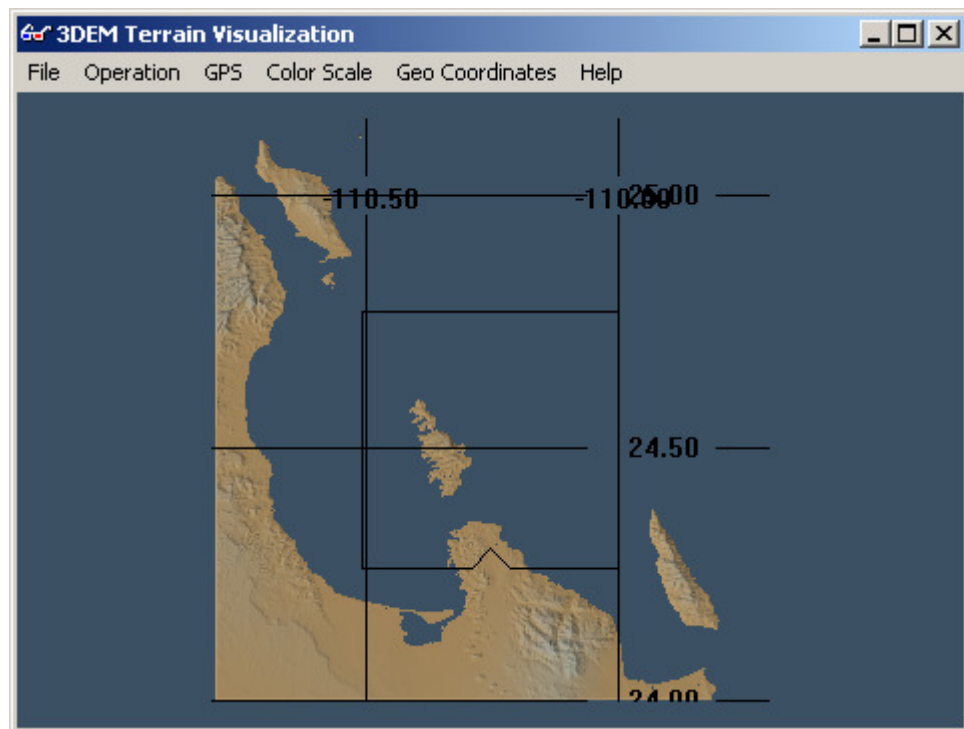
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We are done with MicroDEM and Landserf, close those 2.  
Onto 3DEM to open our text file. Use the detail you see in the above to open it:

The screenshot shows the 'Matrix Data Format' dialog box with the following settings:

- Data Format and Offset:**  INT (16),  ASCII, Offset (bytes): 0,  FLOAT (32)
- Data Byte Order:**  Little Endian,  Big Endian
- Missing Data:** -9999, Assigned Value
- Matrix Dimensions:** Columns: 1330, Rows: 1390,  W-E,  E-W,  S-N,  N-S
- Coordinate System:**  UTM,  Lat/Long,  X/Y, Zone: [empty], Reference Ellipsoid: [empty]
- SW Corner Coordinates:** X (West): -110.804, Y (South): 3.996202
- NE Corner Coordinates:** X (East): -109.696, Y (North): 5.154535
- Horizontal Units:**  Meters,  Feet,  Degrees Lat/Long
- Vertical Units:**  Meters,  Feet,  Height,  Depth

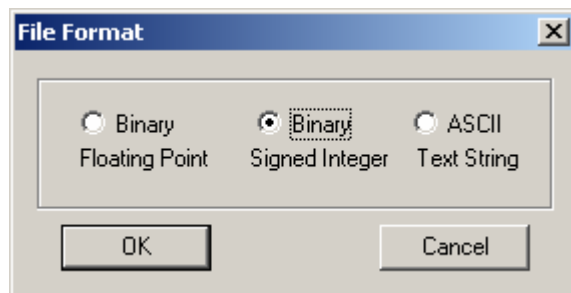
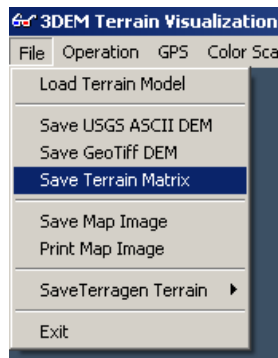
Buttons: OK, Cancel



Here we have the best available land data merged with the best available depth data in one single file, let's save it for VSF/VS to use:  
File/Save terrain matrix

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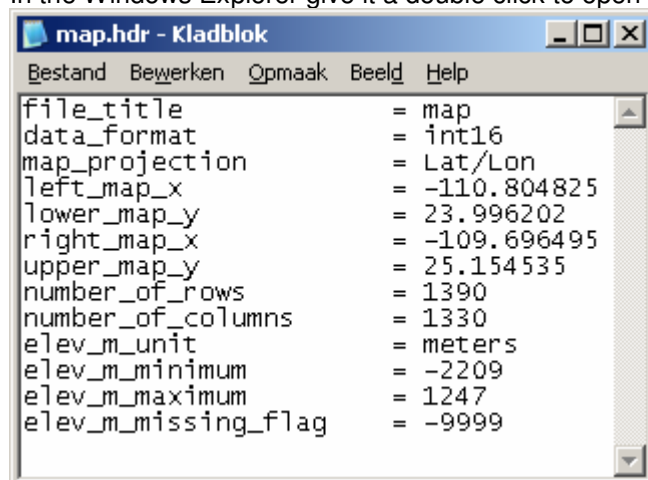
---



and save it as map.bin

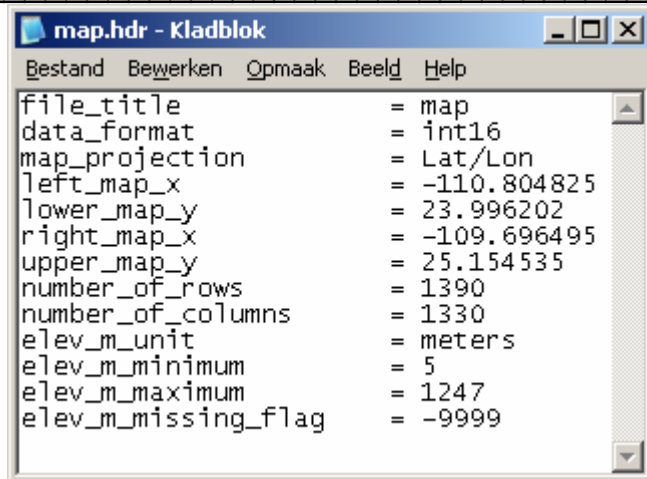
We are done but for one little edit on the map.hdr

In the Windows Explorer give it a double click to open the file:



Notice the value elev\_m\_minimum, it is -2209, change that to 5 and save the file.

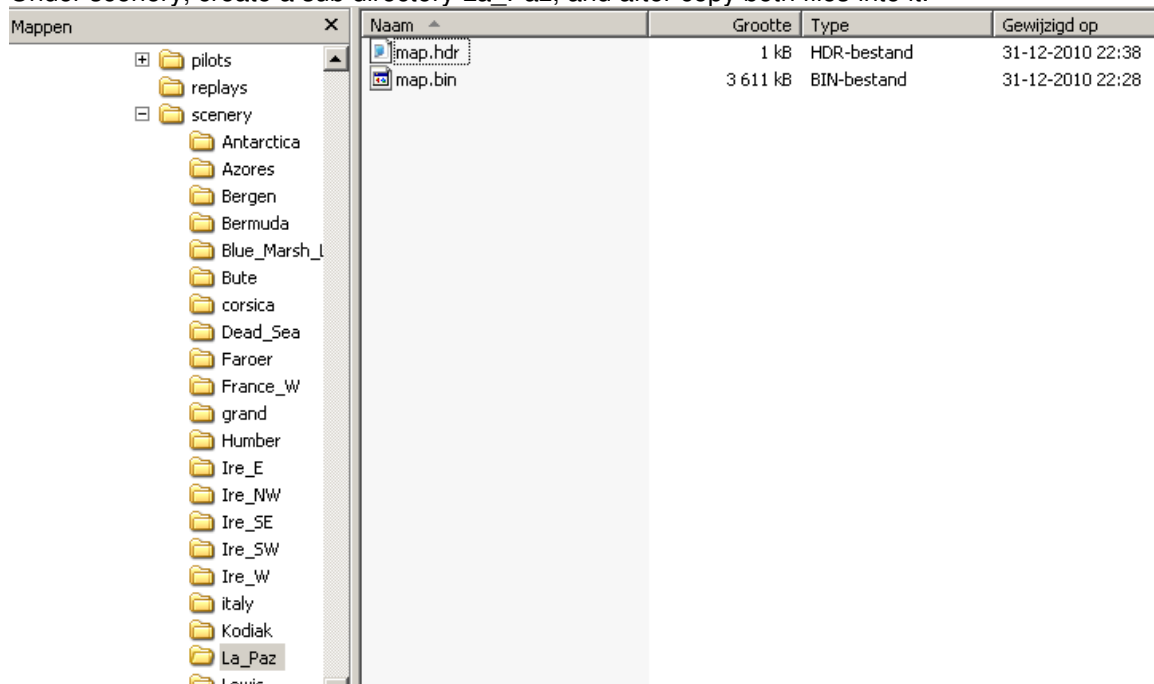
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```
file_title = map
data_format = int16
map_projection = Lat/Lon
left_map_x = -110.804825
lower_map_y = 23.996202
right_map_x = -109.696495
upper_map_y = 25.154535
number_of_rows = 1390
number_of_columns = 1330
elev_m_unit = meters
elev_m_minimum = 5
elev_m_maximum = 1247
elev_m_missing_flag = -9999
```

The only thing left to do now is to get the 2 files (map.bin and map.hdr) in the sim.

Under scenery, create a sub directory La\_Paz, and after copy both files into it.



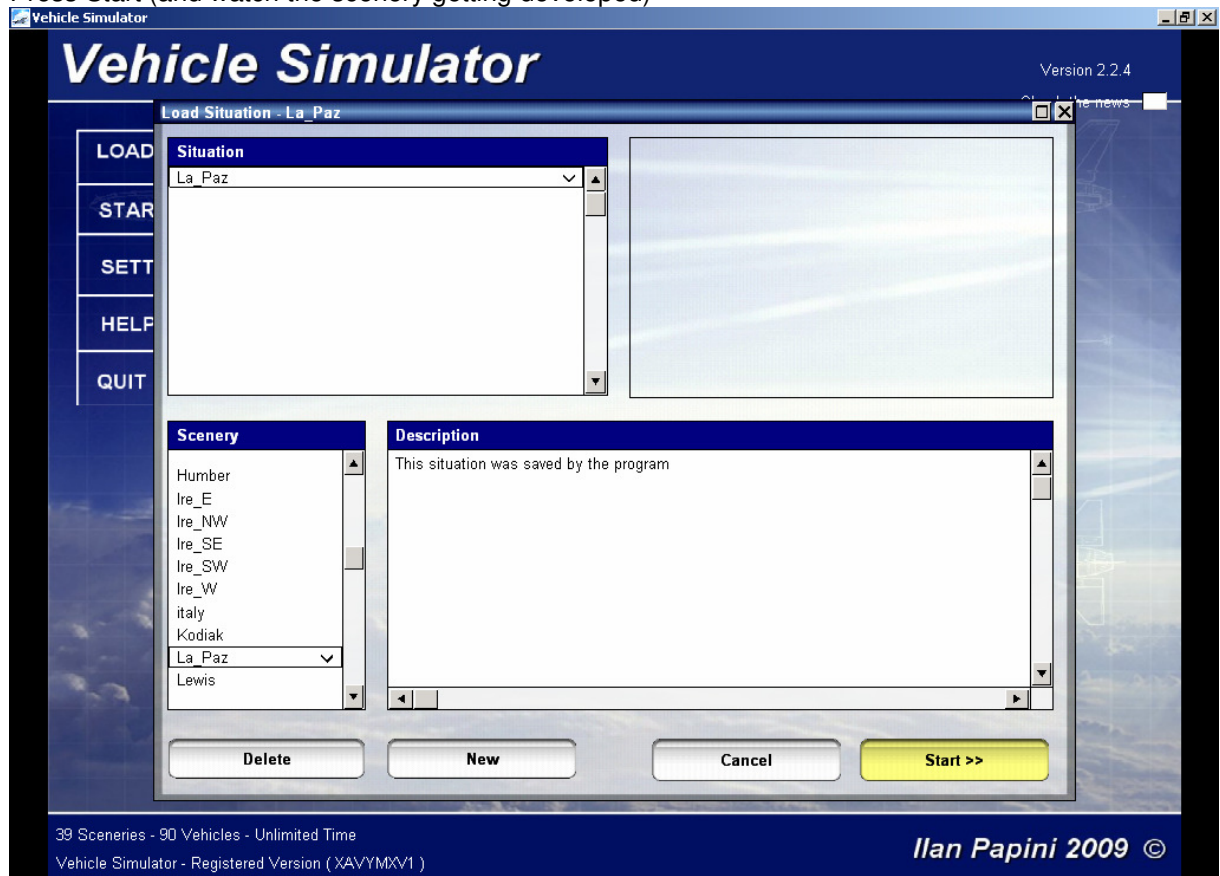
Now, start Vehicle Simulator.

Click "LOAD"

Select Scenery La\_Paz

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Press Start (and watch the scenery getting developed)



You will join the scenery somewhere up there.....  
Choose a boat like Cruiser.

Have a look at the map (M)  
and when you tick the Marine map box:

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Glorious and accurate depth!

In retrospect you might ask yourself why we had to use 2 applications (MicroDEM and Landserf) to accomplish this? The answer is simply that I haven't found a way to get the SRTM (depth) data into MicroDEM, data not recognized, hence.....

Next is to show you how to perfect this data to accomplish a match with what you know is "local detail". We will use the Matrix Editor for that purpose.

See the Matrix Editor tutor for that purpose.