Using Blender to Create Terrain From Digital Elevation Data

Terrain elevation data is produced by various government agencies and ranges from relatively small ASCII files (e.g., ASCII Arc Grid [.asc]) to large digital elevation models such as .dem files. Therefore, your computer could be a limiting factor in producing the more detailed terrains.

At a minimum, you will need the following software:

MicroDem (http://www.usna.edu/Users/oceano/pguth/website/microdem.htm). Note that free application was developed at the US Naval Academy, Annapolis, Maryland, USA. It also has a few odd characteristics. I highly recommend selecting the defaults when installing it, even though it installs at the C:\ root director. I've found installing it anywhere else causes occasionally errors that will prevent you from using it properly.

Additionally, there appear to be a couple of bugs in the dialog windows that allow you to open files. Some of them will not let you change from your C drive. Therefore, I recommend that when working with MicroDEM that you create a directory on your C:\ root to work on your elevation data. Once you are finished, you can move those files where you want.

Optionally, you may want the following software if you would like to create terrain worldwide using the Shuttle Radar Topography Mission (SRTM) elevation data. Typically, this data is large scale for creating regions. By using GoogleEarth and the srtm41.kmz overlay, you will be able to download and create terrain models from real elevation data from almost anywhere in the world.

Google Earth: http://earth.google.com. GoogleEarth is free. Install GoogleEarth before installing srtm41.kmz.

The GoogleEarth SRTM Overlay (srtm41.kmz): http://www.ambiotek.com/topoview. The srtm41.kmz file is free. Run the file from the dialog that gives you the option to "Run" or "Save" and it will install in GoogleEarth automatically.

A graphics program, such as GIMP, Photoshop, Paintshop Pro etc. This is not essential, but gives you flexibility to adjust contrast and to paint in your own elevation modifications such as roads, rivers, etc. on the heightmaps you create with MicroDEM.

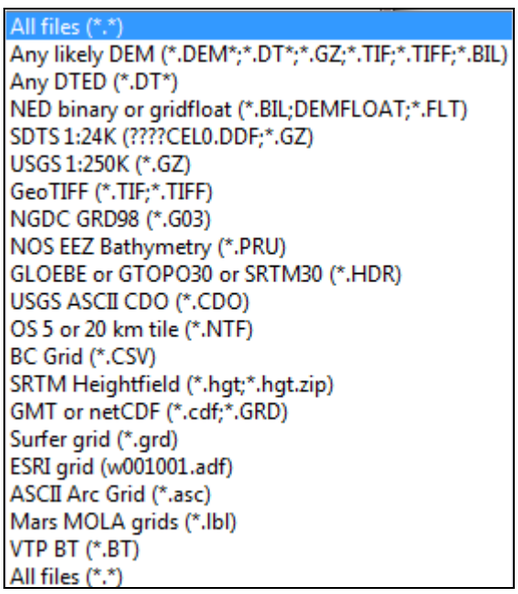
Before beginning, install MicroDEM. As noted, it is optional whether you want to install GoogleEarth and srtm41.kmz.

Overview for Using MicroDEM and Blender.

Conceptually, this is a simple four step process. Once you have located the elevation data you want to use, it should not take more than 5 to 10 minutes to create a detailed model of that terrain in Blender after two or three practice models.

The four steps are:

1. Locate the elevation data you want to use. MicroDEM can import the following digital elevation file formats:



However, some of these formats are old and have evolved over time with slightly different parameters. Therefore, MicroDEM will give you an error if it doesn't recognize older formats or proprietary formats that use the .dem extension such as the old VistaPro .dem files.

Also, some digital elevation files are easier to work with than others, and you will sometimes find errors in the elevation data that the government has not corrected. These are usually small errors (such as a spike or "hole" in the terrain) and can be easily fixed in Blender or ignored if not visible in the Blender camera angle used.

2. Process the digital elevation in MicroDEM (about a 3-5 minute process)

3. Export the data to a GeoTiff format which will be a gray scale height map.

4. Create a subdivided/subsurface plane in Blender and use the height map as the texture in the Displace Modifier.

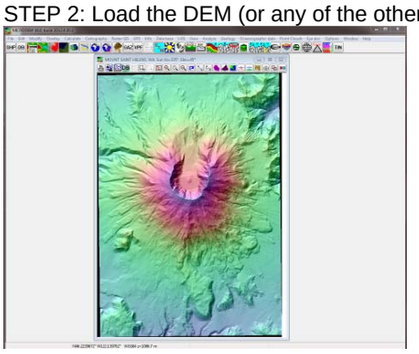
The rest of the process is tweaking the strength of the displacement, the subdivisions, and/or the subsurface levels to get the desired degree of resolution. But the higher the resolution, the more difficult it is to navigate and work with the terrain in Blender. I suggest making most of your adjustments at a fairly low resolution and then adding subdivisions and subsurfacing to meet your needs. Turning off the visibility of the subsurface modifier greatly improves your ability to navigate/manipulate the terrain model.

Creating the Mt. St. Helens Volcano in Blender.

Before I begin, let's take a quick look at what the process will look like visually:

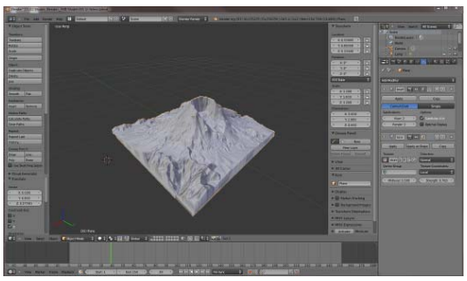
STEP 1: Download a digital elevation file. In this case for Mt. St. Helens the file will be: 10.2.1.1043901.dem

STEP 2: Load the DEM (or any of the other elevation formats) file into MicroDEM



STEP 3: Convert the file to a gray scale heightmap in MicroDEM

Use the heightmap for the Displace Modifier in Blender



OK, so now follow me through the details of how to do this.

STEP 1:

The first thing you need to do is locate the digital elevation data for Mt. St. Helens and download it.

You are probably thinking, “There are over two dozen elevation file formats, which one do I use, and where do I find it.”

Well, be warned that finding the precise digital elevation data you want on the Internet can be a challenge. I find it best to start with a simple generic query such as “Mt St Helens digital elevation.” In this case, you’ll see a search result that directs you to the historical digital elevation model (DEM) on an USGS sight for Mt. St. Helens. You’ll have the option of downloading the DEM files before or after the eruption. Because each of the Mt. St. Helens .dem files is nearly 9MB, I have not included them. But here is the URL where you can download the two files: http://ned.usgs.gov/Ned/historic.asp.

DEM is an older format that is no longer supported by the USGS or other government agencies. The standard format now is the National Elevation Dataset or NED. However, there are still a lot of DEM files from around the world that you can find on the Internet.

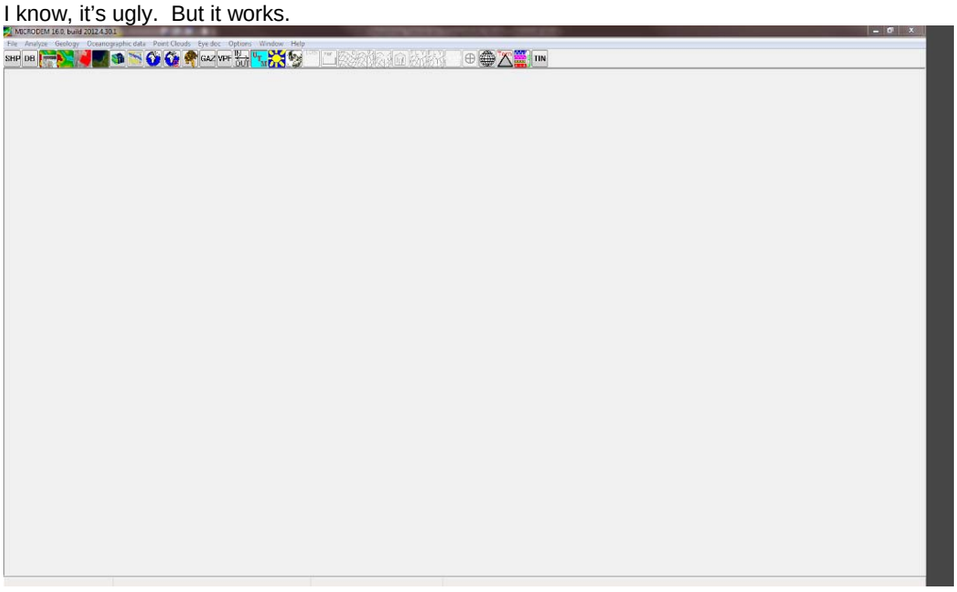
Also, there are USGS sites where you can select the area you want and download it either NED or other formats. Some options are preselected regions and others let you define the area you want.

The higher the resolution of the elevation data, the more detailed the Blender model will be.

STEP 2:

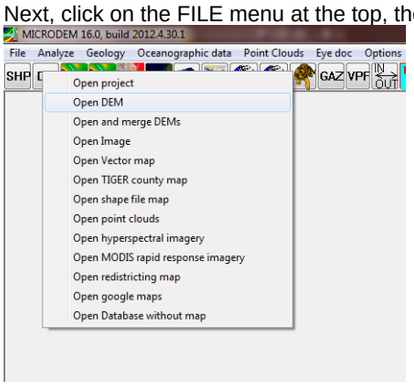
Now run MicroDEM. The UI should look like this:

I know, it’s ugly. But it works.

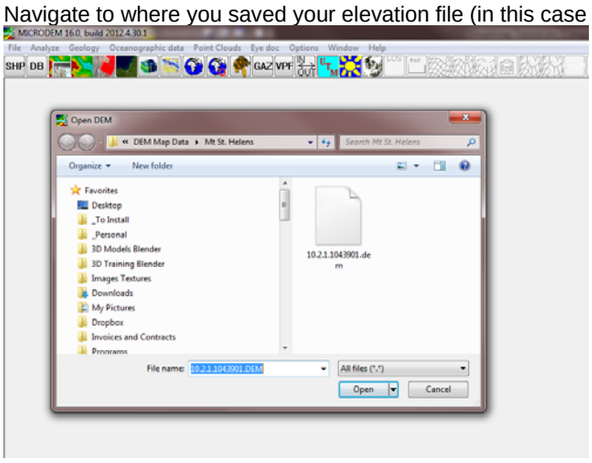


By the way, MicroDEM has an option under the FILE menu and the OPEN AND MERGE DEMs option to merge multiple elevation data files into one large terrain. It's easy and you won't have any difficulty finding out how it works.

Next, click on the FILE menu at the top, then click on the OPEN option and select OPEN DEM as shown below:



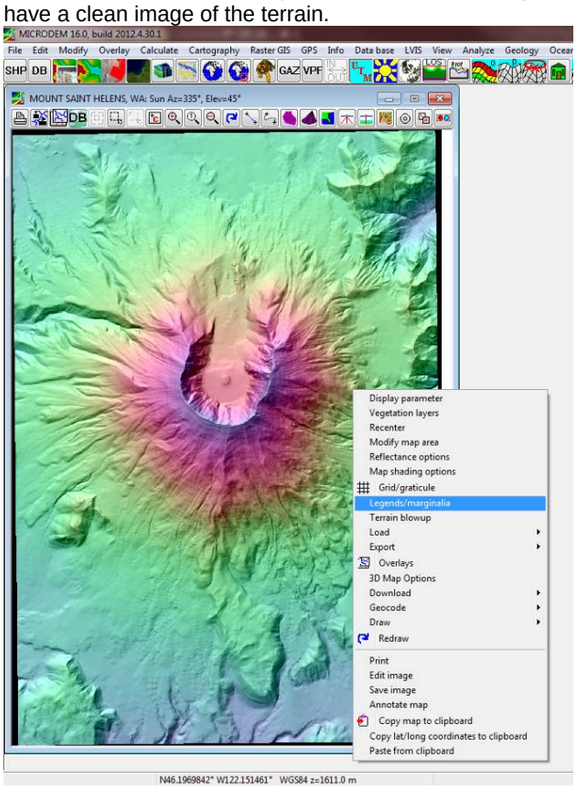
Navigate to where you saved your elevation file (in this case the Mt. St. Helens .dem file) and open it.



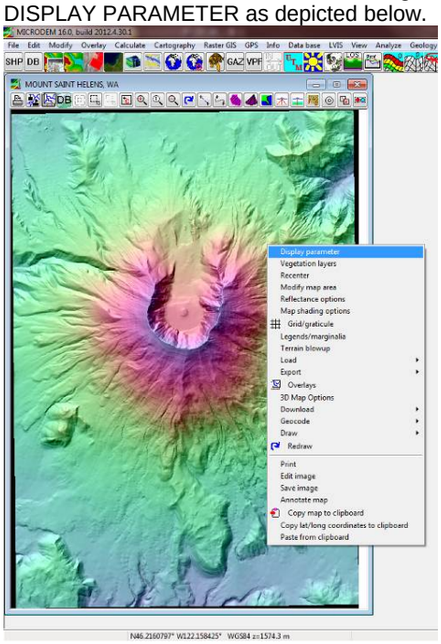
And voila, you have a color coded version of Mt. St. Helens after the eruption.

But that's not what we want. We want a gray scale heightmap we can use in Blender. So we will need to process this data to convert it.

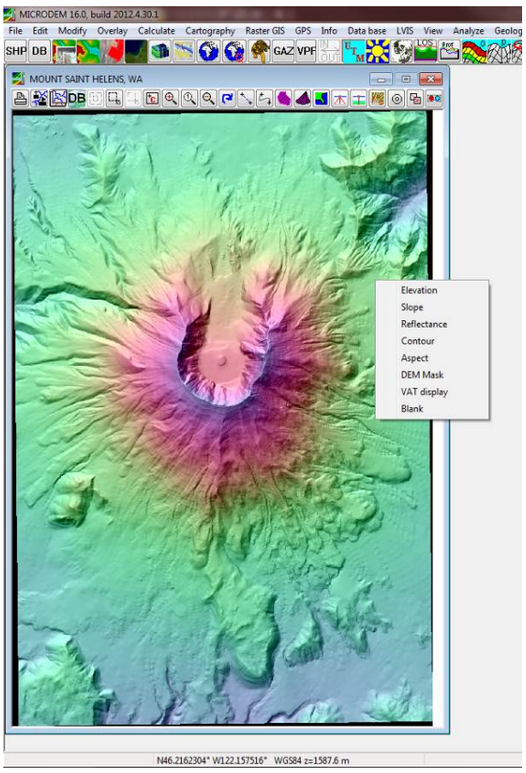
When you first import elevation data into MicroDEM, it may have legend information and display latitude and longitude lines. We will want to hide those before we save the gray scale image. To do that, right click directly on the image of Mt. St. Helens and select the LEGENDS / MARGINALIA option and uncheck the legend options in the resulting dialog window and click OK to exit. You should now have a clean image of the terrain.



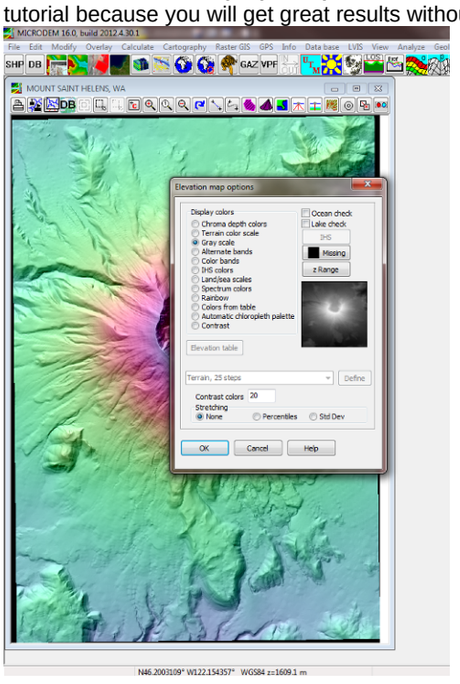
Next, we need to convert the current image into a gray scale heightmap. To do this, right click again directly on the image and select DISPLAY PARAMETER as depicted below.



Then select ELEVATION which is the first option at the top of the list.

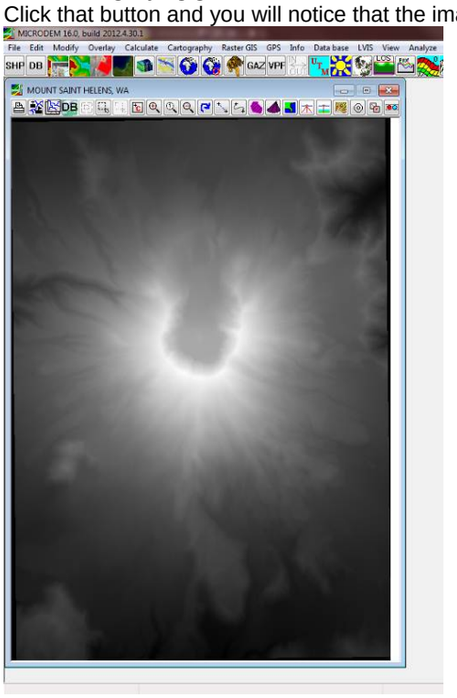


A dialog window will appear with a bunch of options. Click the GRAY SCALE button. You can leave the rest as defaults, but later you may want to experiment with the CONTRAST COLORS (which set to 20 in this case) and the “z Range” which allows you to modify the resolution. But it is truly a journey of trial and error until you get the feel of how the z Range parameters work (not the subject of this tutorial because you will get great results without messing with it). Now click OK.

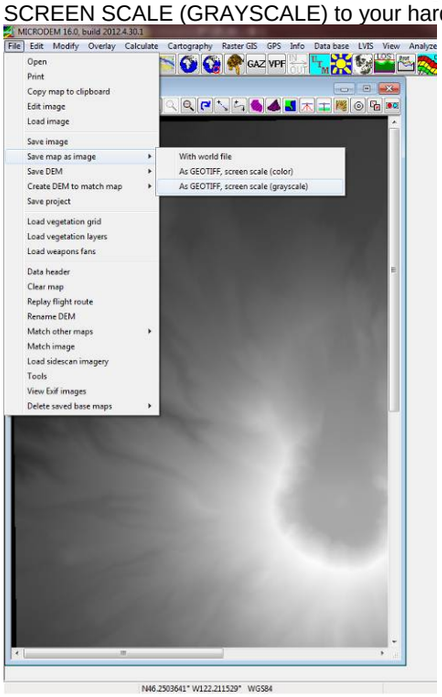


You have a nice heightmap, but there is one more thing you must do before exporting it to a GeoTiff file format. Notice the icons on the

window of the Mt. St. Helens image right under where it says “Mount Saint Helens, WA.” Count over 10 icons from the left to where you see the magnifying glass with the number “1” in the middle of it. This is the 1:1 Scale button that resets the image to its natural scale. Click that button and you will notice that the image gets much larger. We are now ready to export the heightmap to a GeoTiff file.



So all that’s left for the MicroDEM processing is to save the image. Go to FILE, SAVE MAP AS IMAGE, and select AS GEOTIFF, SCREEN SCALE (GRAYSCALE) to your hard drive with a name that makes sense to you.



If you familiar with Blender’s functions for creating a plane, subdividing it, creating a subsurface modifier, and then using the heightmap image for a displacement modifier, then you can do the rest of this blindfolded.

But in case you are new to Blender, I'll step you through it.

1. Open Blender and delete the default cube.

2. Press the Keypad "7" to switch to the top orthographic view

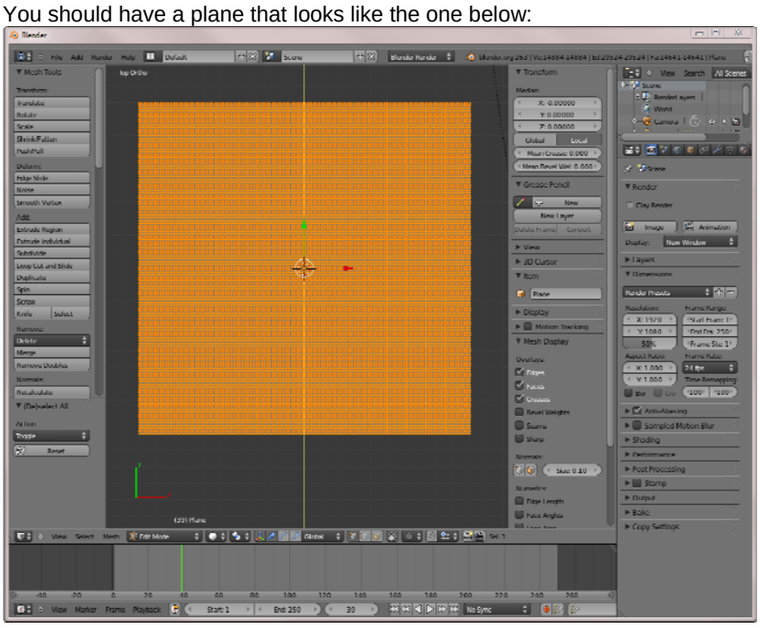
3. On the menu bar at the top, click on ADD, then MESH, and then PLANE. Don't scale the plane. Leave at the default size.

4. Click on the plane object to select it and then press TAB to switch to EDIT mode.

5. In the Tools Panel on left side of the main window (if you don't see it then press "T" to make it appear) click the SUBDIVIDE option.

6. That subdivides the plan into four sections, but we need a lot more than that. Look down at the bottom of the Tools Panel and you should see a new section called "SUBDIVIDE" with a data box labeled "NUMBER OF CUTS" and the default should be set to "1". Change the number of cuts to 10, which is the maximum allowed, and then repeat that step again. In other words, click the SUBDIVIDE button again and then change the NUMBER OF CUTS to 10 again for a total of 20 cuts.

You should have a plane that looks like the one below:



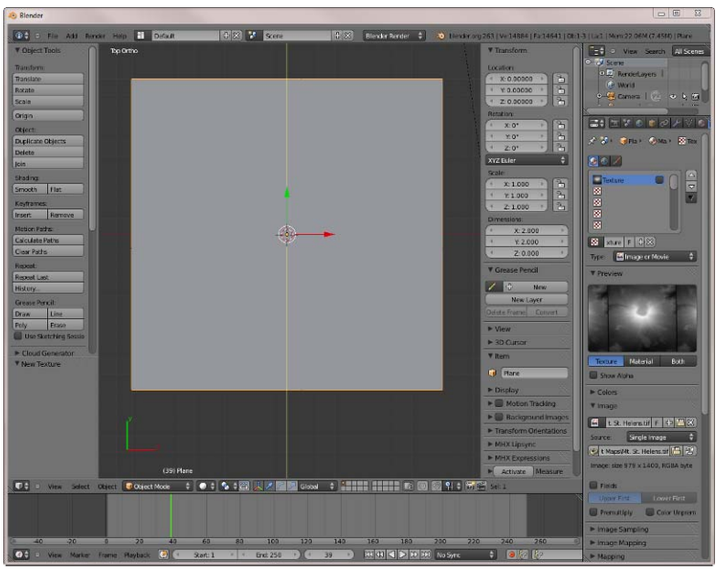
7. Switch to OBJECT mode by pressing the TAB key and then press CTL-2 (Control 2) to add a subsurface modifier with two levels.

Almost done.

8. With the plane selected in Object Mode, click on the MATERIALS button in the Properties Panel and add a default material and set the SPECULAR INTENSITY slider to zero.

9. Now click the TEXTURE button to add a new texture and for the TYPE select IMAGE OR MOVIE.

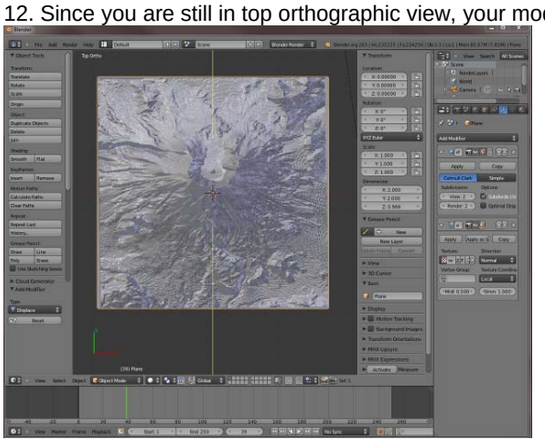
10. In the IMAGE pull down, click OPEN, navigate to your Mt. St. Helens heightmap and open it. Now uncheck the Texture because we are only going to use it as a heightmap for the displacement modifier and we don't need the colors. Blender should now look similar to this:



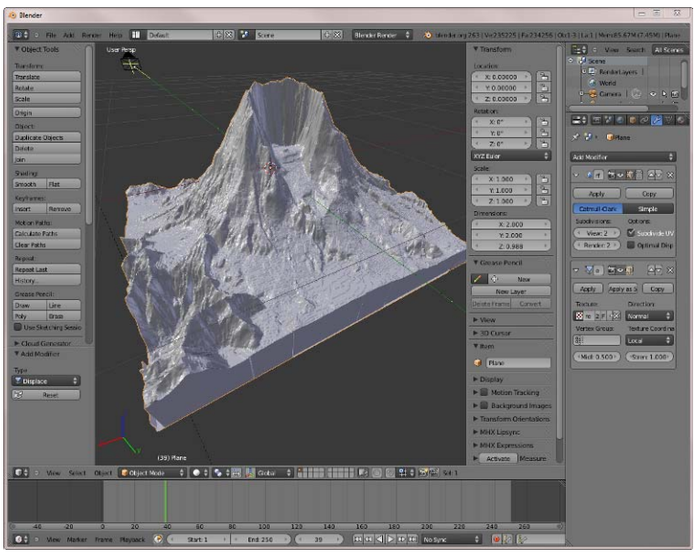
You can leave the rest of the settings at their defaults. Optionally, you can UV unwrap the plane and change the MAPPING pull down from GENERATED to UV, but to be honest, I only notice a slight improvement, so I don't think it's really necessary unless you perhaps have a very high resolution heightmap with precise details.

11. Next, click on the OBJECT MODIFIERS button in the Properties Panel and add a DISPLACEMENT modifier and in the TEXTURE option of the modifier, click on the red and white checkered icon and select the heightmap texture you added.

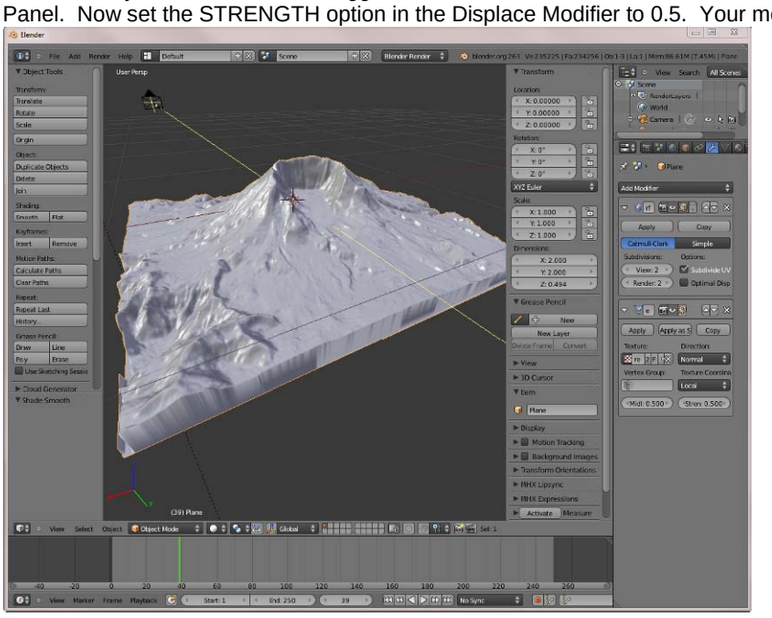
12. Since you are still in top orthographic view, your model of Mt. St. Helens will look like this:



And moving your camera to perspective your model should look like this:

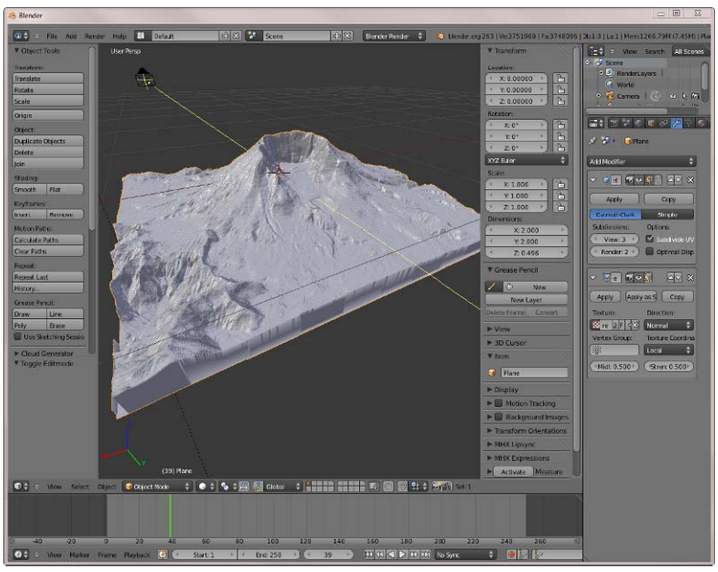


13. Obviously, the terrain is too exaggerated and needs to be toned down. In Object Mode, click on the SMOOTH option in the Tools Panel. Now set the STRENGTH option in the Displace Modifier to 0.5. Your model should look something like the one below:



From here, it's just a matter of tweaking by increasing the number of subdivisions, increasing the level of the subsurface, and/or adjusting the strength of the Displace Modifier. You can also increase and decrease resolution of the model somewhat by increasing/decreasing the Brightness and Contrast options in the COLORS pull down in the Textures.

Here is the same model where I increased subdivisions by 1 cut and increased the subsurface level from 2 to 3.



Notice there is more detail and it looks more realistic. But it also slows everything down, requires a lot of memory, and increases the render time. Older computers and those with limited memory may encounter problems, but you'll have to try it. If Blender crashes or the render times are too long, then reduce the resolution. Although you can always reduce the subsurface levels, you can't undo the subdivision cuts. So I would try increasing the subsurface levels first and if you think that you still need more detail in the terrain, then save your model before adding subdivisions to the plane so you can get back to your starting point.

This is not a texture tutorial. But if you are not comfortable texturing mountains and terrain, there are some good tutorials on the Internet and/or reverse engineer some of the great models on BlendSwap (www.blendswap.com).

Overview for Using GoogleEarth with srtm41.kmz, MicroDEM, and Blender.

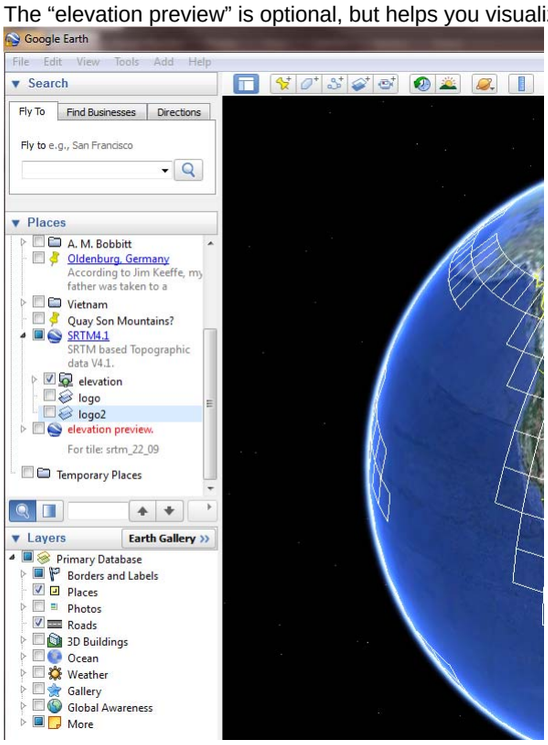
This is optional for creating real terrain in Blender. In other words, you can just download existing elevation data files and use MicroDEM to process them. However, if you want to create real terrain from around the world, I will demonstrate how to select and download the terrain from within GoogleEarth. Once the terrain file is saved to your hard drive, the process to create the terrain in Blender is exactly the same as described above.

At this point, I assume you have installed MicroDEM, installed GoogleEarth, and loaded the srtm41.kmz file into GoogleEarth as described at the beginning of the main tutorial.

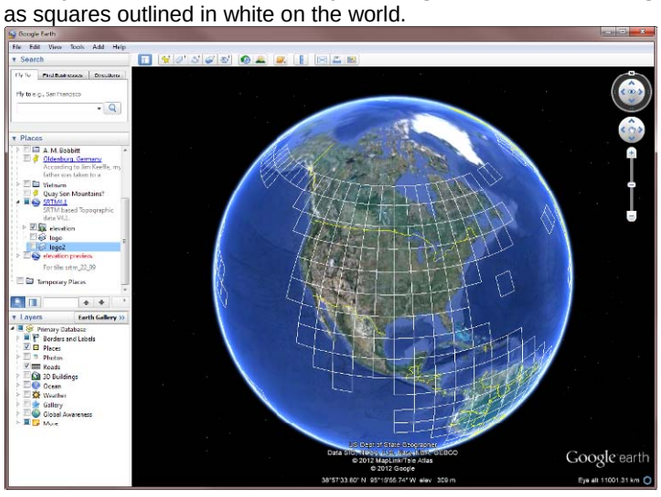
OK, this is going to be very easy.

STEP 1:
Run GoogleEarth and activate the SRTM4.1 option in the PLACES panel as shown below. When you click the checkbox for SRTM4.1, notice that Elevation, Logo, and Logo2 are automatically checked as well. Uncheck Logo and Logo2.

The “elevation preview” is optional, but helps you visualize the terrain you will be downloading.

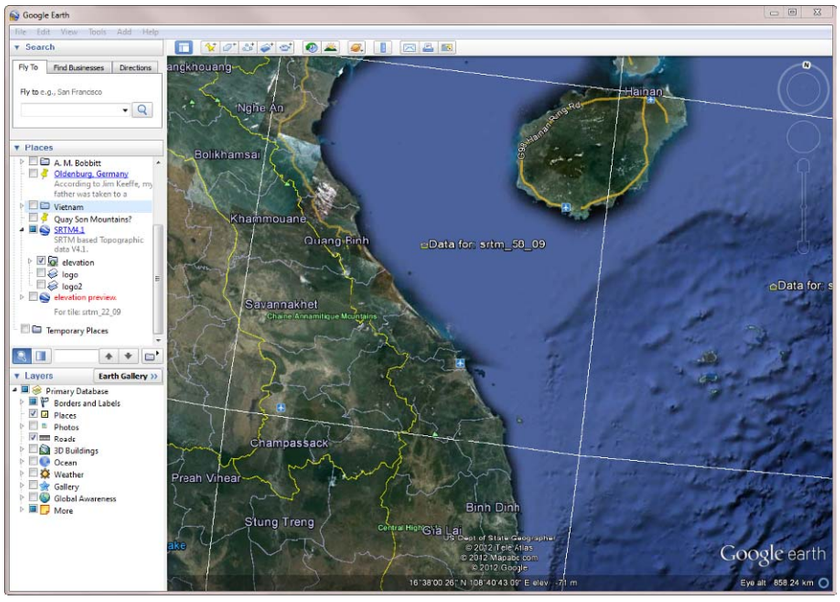


Once you’ve activated SRTM4.1, your GoogleEarth view will change so that all of the regions that have terrain elevation data are visable as squares outlined in white on the world.

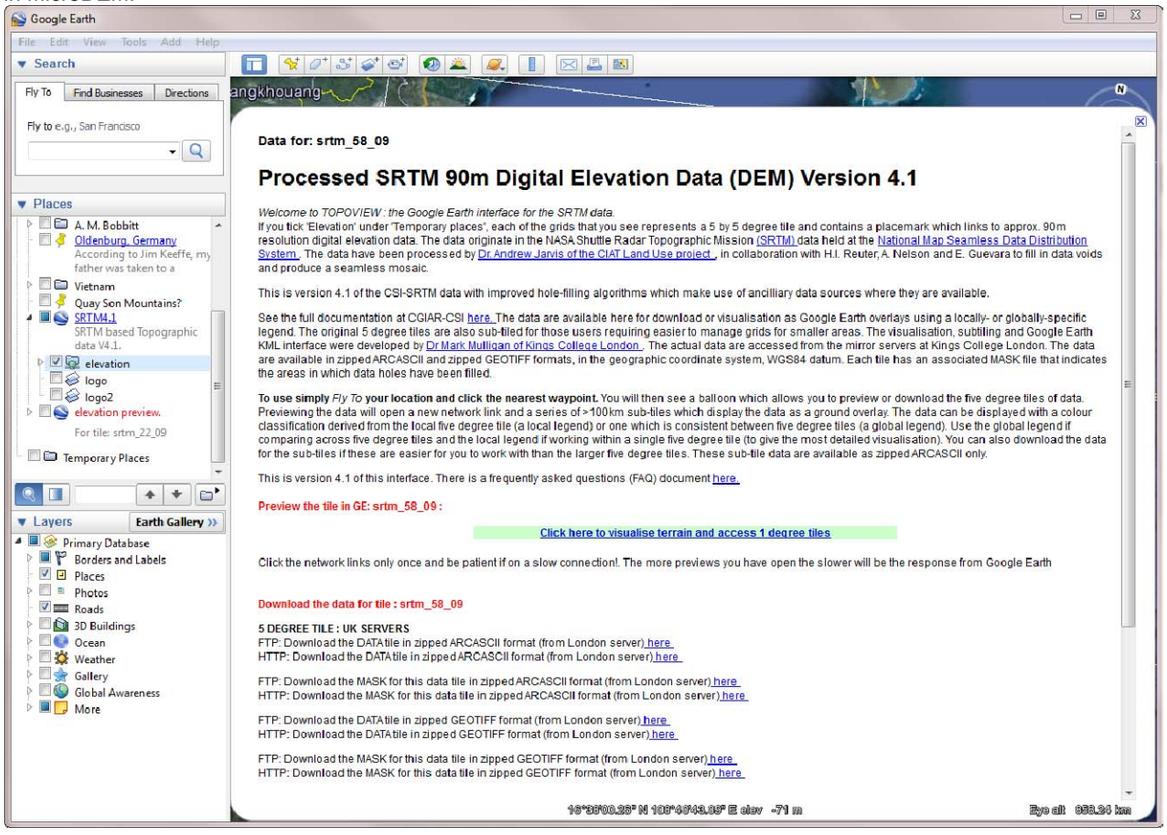


Next, simply navigate to a location on Earth that you want to convert into a terrain model. Realize that SRTM stands for Shuttle Radar Topography Mission and as such it is going to be low resolution. Still, it is very good for creating large scale complex terrains as you will see.

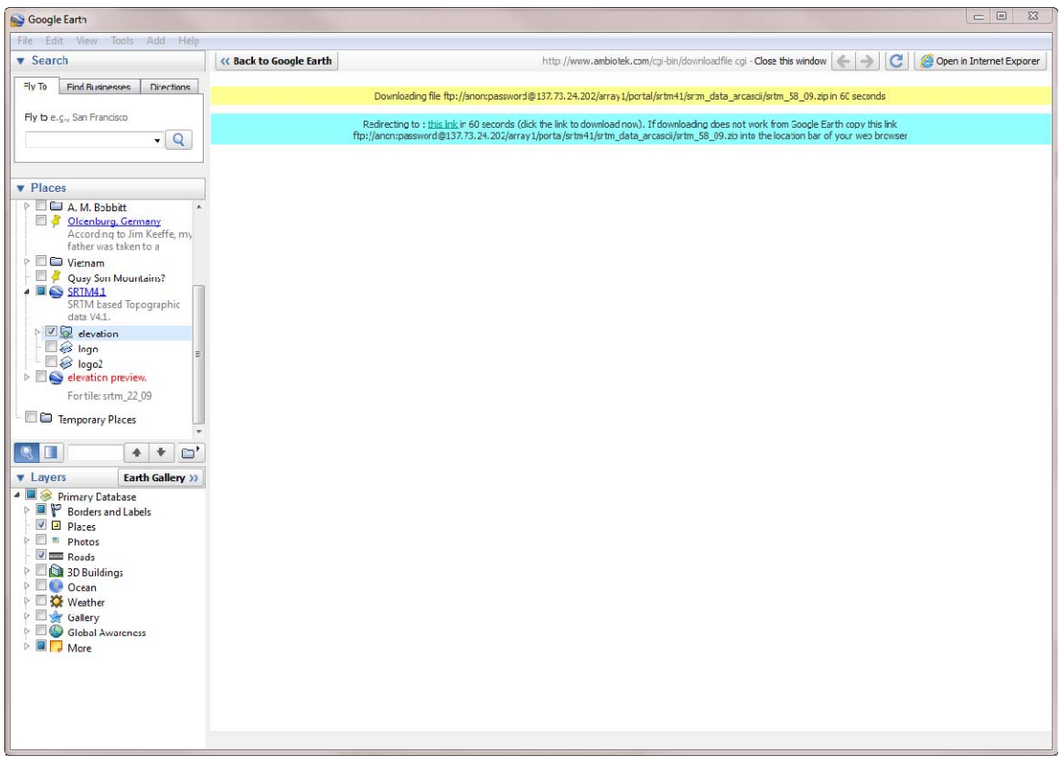
In the screen capture below, I’ve navigated to a coastal area of Vietnam with Hainan Island. Notice there is a small “house-like” icon in the center of the terrain square labeled “Data for: srtm_58_09”.



Click on the “house-like” icon. GoogleEarth will present a new screen that looks like the one below. The important part is at the bottom where you download the elevation files. Download the ARCASCII format. Or, download the GeoTiff version. Both will work equally well in MicroDEM.



Downloading the file will take you another GoogleEarth screen that looks like this:



You have the option of downloading from the ftp or http sites. On my computer, the ftp site doesn't work but the http site does. I don't wait for it to start automatically or to redirect. I just click on "this link" as soon as the page displays.

Save the ZIP file to your hard drive.

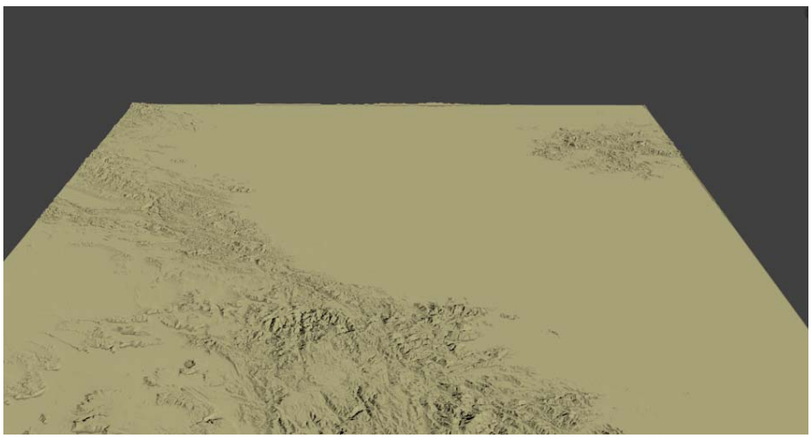
You are finished with GoogleEarth unless you want to download more terrain. Remember that MicroDEM allows you merge adjacent terrain files into one larger area. Theoretically, you could merge all of the files for a country into one terrain model, but you should have a very high end computer.

STEP 2:
Unzip the terrain file or files. These files have unfriendly names so I suggest that you rename them to something that makes sense to you. I create folders for the countries for which I have terrain data and the file names include the general regions.

When you unzip these SRTM files, there will be three files: a readme text file, a file with the .asc extention and a file with the .prj extention. You don't need the prj file so you can delete if you like.

STEP 3:
From here, creating the terrain in Blender is the same as in the main tutorial. The only difference is that instead of opening a .dem file in MicroDEM, you will be opening the .asc or GeoTiff file. If you don't see the .asc or GeoTiff file in the MicroDEM file open dialog window, make sure the file selection is set to "All Files" or "ARC ASCII Grid (.asc)" or "GeoTiff". You will then see the file you downloaded. The image in MicroDEM will look just like the image you did for Mt. St. Helens and the steps to create a heightmap are exactly the same.

Here is a screen capture of the Vietnam elevation data as I described in this tutorial.



Additional Notes:

The terrain doesn't seem to be scalable in Blender. It's probably something I doing wrong, but when I try to scale the terrain to make it larger, the plane gets larger but the terrain doesn't. If I change the mapping to repeat or extend, I get unexpected results.

So what do I use these terrains for? As part of my business, I create scenarios that require 3D visualization of large areas. I'm also a student of history and I create the low and high resolution 3D terrains for places with historical significance. Additionally, I create these models for educational props and to study geology.

Here are some basic sites where you can download elevation data.

National Elevation Dataset (NED): http://seamless.usgs.gov/about_elevation.php

Obtaining free USGS digital terrain formats: http://vterrain.org/Misc/usgs_data.html

USGS Earth Explorer: http://earthexplorer.usgs.gov/

USGS National Map Viewer: http://nationalmap.gov/viewer.html

Canada Terrain Data: http://www.geobase.ca/geobase/en/index.html

California Areas: http://cluster3.lib.berkeley.edu/EART/dem/dem.html

Shuttle Radar: http://www2.jpl.nasa.gov/srtm/

USGS Elevation Products: http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/Elevation_Products

But there are many more resources for digital terrain, but it can be a challenge to find the high resolution data for exact locations. High resolution data doesn't exist for much of the world, and there isn't an index that tells you what areas have high resolution coverage. You just have to some research.

I hope you found this tutorial helpful.