TreeSoft BigTopo

BigTopo was written by Paul Rowntree, who retains all copyright control over the program and its sources. Although Rowntree believes it works well, no guarantees are given for its use in any application.

Change Log

Feb 8 2013	- Added internet downloads of SRTM-1, SRTM-3 files - Added unzipping of downloaded files with 7za.exe - Improved handling of edges to prevent (?) missing stripes and discontinuities - Confirmation required if STL file will be >100 MB - Allow blocking of different file types, Special cases
Feb 4 2013	- Repaired file finder bug
Feb 2 2013	- First distributed version written

Disclaimer

By downloading, installing and using this program you are accepting full responsibility for any and all consequences. CNC machinery is potentially dangerous, and the user is 100% responsible for ensuring that the output of **BigTopo** is safe to use on any CNC equipment, and that it will have the desired effects.

As always with CNC equipment, think many times before running code, and doing air cuts is often a good idea with new files. In Mach3, verify the Z limits of the loaded files before cutting to ensure that you are not going to destroy your table top, spindle, or both.

Play safely.

What is BigTopo ?

BigTopo is a program that reads binary elevation data and outputs a standard STL file for use in CNC applications. The data was measured by the SRTM shuttle mission STS-99 in 2000. Most of the data is for the N60-S60 latitudes. The US government provides high resolution SRTM-1 data for the US territories (~30 m per pixel), and lower resolution SRTM-3 and SRTM-30 data (~100 m and ~1000 m, respectively) for the entire world (Thank you!). The elevation resolution is 1m in all files. These data files are available for free download from **http://dds.cr.usgs.gov/srtm/version2_1/**

BigTopo is a more sophisticated program than **Topo**. **Topo** gives a visual map in false colours, and lets the user select a rectangular region for output in STL format, using a mouse or numerical entry field. This is not useful for large areas that span more than one SRTM file (outside of 1 degree x 1 degree regions). **BigTopo** only accepts numerical fields to choose the region of interest, so there is not much eye-candy here, but it will seamlessly stitch together maps (if the data can be found) to make a single STL file. It also allows you to choose the STL pixel spacing, which is important for small and large scale

regions. When working with land surrounded by water **BigTopo** can put the land up on a slight pedestal, which improves the contrast.

BigTopo can read SRTM-1 and SRTM-3 files (like **Topo**), but it can also read files created by the program **DEM_2_SRTM**, which are lower resolution (1 km data spacing) but can be downloaded much easier in large blocks via DEM files. Each DEM file contains the equivalent area of 2000 SRTM-1 (or SRTM-3) files. Downloading standard SRTM files one-at-a-time gets tiresome very quickly. **DEM_2_SRTM** and its manual are included in the download package with **Topo** and **BigTopo**. DEM files are freely available at the above mentioned web site.

BigTopo is able to download SRTM-1 and SRTM-3 files directly from the NASA storage sites, and unzip them into the correct directories for immediate use. It is not very smart in this regard, and you may have to repeat the operation if internet issues break the transfer. It works 99% of the time.

BigTopo is available for free download from PaulRowntree.weebly.com, and may be used for any personal and commercial applications. If you feel that the program is worthy of your support, contributions at the web site will be gratefully accepted. These contributions also demonstrate community interest, and encourage further developments and updates. Donations of $25 or more will remove the NagScreen, and you will be informed directly of updates.

Using BigTopo

The **BigTopo** download package includes the Windows executable file (**BigTopo**.exe), this manual, and some raw data files to get started with the Christian Island example. There is also a shareware program **7za.exe**, which is used to unzip downloaded SRTM-1 and SRTM-3 files. All files are contained in a standard ZIP file, which can be extracted into the directory of your choice using **7-ZIP**, a free decompression program. Please do a virus scan on the downloaded ZIP file and the unzipped contents before running **BigTopo**. There is no installation per se, and when you are done with the program you can simply delete the files. There are no Windows registry entries to worry about.

I suggest that you create directories SRTM_1, SRTM_3, SRTM_30 and DEM within the directory that you use for **Topo and BigTopo**. The directory containing the 4 executables and the sub-data directories is called the default DataRoot directory by **BigTopo** and **DEM_2_SRTM** (**Topo** doesn't care**)**. A good structure would be as shown in this table, showing c:\TreeSoft\ as the parent of DataRoot; use whatever you want. Even if you do not plan to use some of these data files, please create the directories because **BigTopo** will search for files in them.

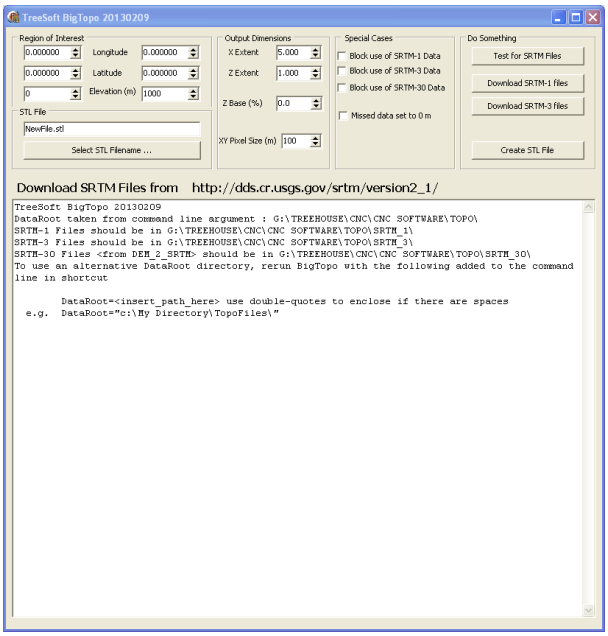
Windows Path	Function and Contents
C:\TreeSoft\Topo\	this is the DataRoot, The **Topo Package** is easiest to use if **Topo**.**exe**, **BigTopo**.**exe**, **DEM_2_SRTM**.**exe** and **7za.exe** are installed here
C:\TreeSoft\Topo\DEM\	this is where the ~56MB DEM files go e.g., e140s10.DEM for New Zealand
C:\TreeSoft\Topo\SRTM_1\	this is for the ~25MB SRTM-1 files (continental US only) e.g., N46W123.hgt for Mount St. Helens (Washington State)
C:\TreeSoft\Topo\SRTM_3\	this is for the ~2.9 MB SRTM-3 files (available for most land areas) e.g., N44W081.hgt for Christian Island (Georgian Bay, Ontario)
C:\TreeSoft\Topo\SRTM_30\	this is for the ~29 KB SRTM-30 files (created from DEM files by **DEM_2_SRTM**)

	e.g., N19W156.hgt for part of Hawaii

While the **BigTopo** and **DEM_2_SRTM** don't *have* to be installed in the DataRoot directory, it is easier if they are. If they aren't there, you will need to use command-line arguments and Desktop shortcuts to tell the codes where to find the data. For example, if you have the above structure for the data files, but have installed the executable files (**Topo**.exe, **BigTopo**.exe and **DEM_2_SRTM**.exe) into c:\exe, then run **BigTopo** using the command line or shortcut

C:\exe\BigTopo.exe DataRoot="C:\TreeSoft\Topo\"

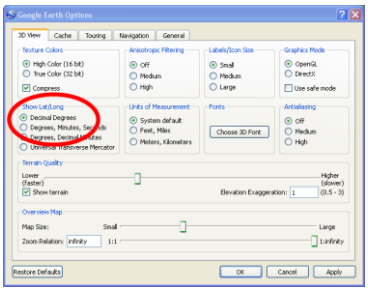
When ready to go, run **BigTopo**.exe, and after the nag screen you should see a screen that looks something like this.



BigTopo does not ask you to load up the SRTM .hgt files the way that **Topo** does, because it tries to find what it needs in the SRTM_1, SRTM_3 or SRTM_30 subdirectories. In this example, the region of interest is in the Georgian Bay area of Ontario. The SRTM maps that **Topo** and **BigTopo** uses are labeled by the Latitude and Longitude of the South-West corner of the map region, and they are always in 1 degree increments. The zone of interest for this example is ~N44.8 degrees, W80.2 degrees, so the file is N44W81.hgt (included in the Topo package). Since it is outside of the USA, only SRTM-3 and SRTM-30 data are available, and **BigTopo** presumes that they are in the appropriate sub-directory. Move the provided N44W81.hgt file to the SRTM_3 directory before continuing.

You may want to run Google Earth at this point, because it may help you identify the region of interest; you need the longitude and latitude coordinates for the rectangular bounds of the region. **Topo** and **BigTopo** use decimal degree formats (i.e. 50.5075 degrees, instead of 50 degrees 30 minutes 27

seconds), so you may have to change Google Earth's preferences. Go to Tools → Options, and select it from the dialog box.



For this example, enter the Longitude limits to be W80.275 to W80.141, and the Latitude limits to be N44.925 to N44.750. West and South values are entered as negative values. This is Google Earth's view of this area.

Choose the X and Z dimensions of the STL file, usually in inches or mm. This information changes the values saved to the file, but STL files do not contain scaling information or units, so these numbers are a bit arbitrary. **BigTopo** will calculate the correct Y dimension to maintain the correct proportions of the output file, taking into account the latitude of the region. Most CNC programs need to be told what units to apply to STL files, or allow you to stretch them. Select the XY Resolution, in meters, for the output STL. The STL file size increases by a factor of 4 when you reduce the XY Resolution by a factor of 2. Choose according to how you want to compromise size vs accuracy. **BigTopo** will interpolate as required, regardless of the resolution of the source files.

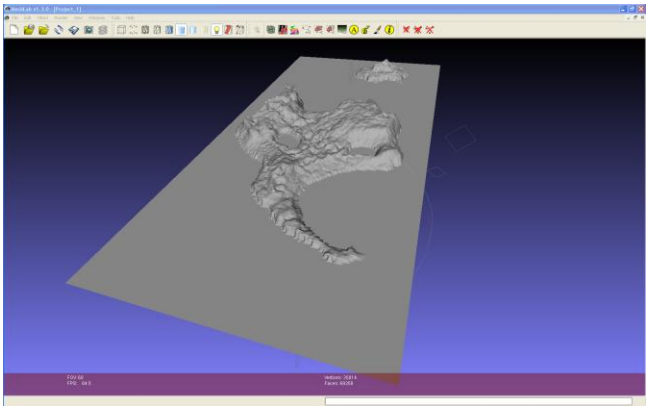
The output STL will have Z values that range from 0 to Z Extent, in whatever units you want (inches, mm, furlongs). Elevations below the low elevation limit entered on **BigTopo's** front panel will map to Z=0 in the STL file. Elevations between the low and high limits map to Z between 0 and the Z extent. If ZBase>0, then this value will serve as a pedestal below the elevation; this is good for making shorelines more visible.

To check if there are data files available that cover the region chosen, press the 'Test for SRTM Files' button. It will scan your machine for the necessary files, and tell you what it found (if anything) in the text box. The last lines of this output will tell you how many files are missing (if any), and will give some

measure of how big the STL file will be. I try to keep STL files below 50 MB because larger files take longer to load in **MeshLab**. If files are missing, that portion of the STL will be empty, which is probably not what you want. In most cases you will want to download the required data. In the present example, all of the area of interest is within a single SRTM-3 file. **BigTopo** will start searching for data in the SRTM_1 directory, and move to the lower resolution data if it can't find what it needs; it does this for each file, so you may end up using files of different resolution. **BigTopo** takes care of the details as much as possible. The text box will tell you what it found and where. Using different resolutions on the same STL file sometimes causes border errors because the Z values at the edges don't match exactly. Even worse, the SRTM-1 files do not show anything outside of USA jurisdictions, so they seem to fade off as if neighbouring land masses (Canada, for example) don't exist. That is why the front panel check boxes allow you to prevent some files from being used, and what to do if no data is found.

You can add notes to the text box, clear it, and copy it to the clipboard, then paste the text into Notepad or similar editors. This is a good way to document your STL creation so you can reproduce it later on.

If everything looks reasonable, it is time to generate the STL file. Press 'Select STL Filename …' to set the destination of the file (or just type it in directly), and then press 'Create STL File' to actually make a file. I load up the STL file in **MeshLab** to see that it covers the desired range, the vertical contrast is good, etc. Once you have **MeshLab** running, you can tweak the parameters in **BigTopo**, regenerate a modified STL file, then reload into **MeshLab** very quickly. **MeshLab** can also filter, smooth, manipulate and convert the STL files into obj, ply (and many other) formats if you wish. The Christian Island file loaded into **MeshLab** looks something like this. It can be rotated, zoomed and inspected in detail.



Downloading SRTM Files

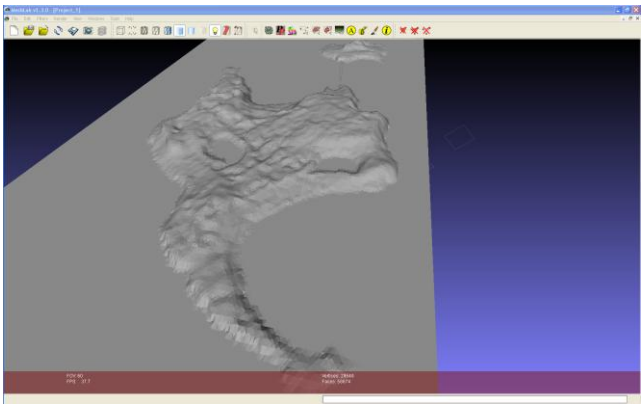
You can go directly to the SRTM data site to find and download SRTM-1, SRTM-3 and DEM files (all zipped), and then use an unzip program of your choice (like the command-line program **7za.exe that is** included in the Topo package) to produce the working data files and stuff them in the appropriate directories. Alternatively, **BigTopo** can directly download missing SRTM-1 and SRTM-3 files if you have a working Internet connection. It will not download DEM files. It uses the rectangular region selected on the Longitude/Latitude controls, and the data that it can find in the DataRoot's subdirectories to decide which files to look for on the 'net. The process usually takes a few minutes.

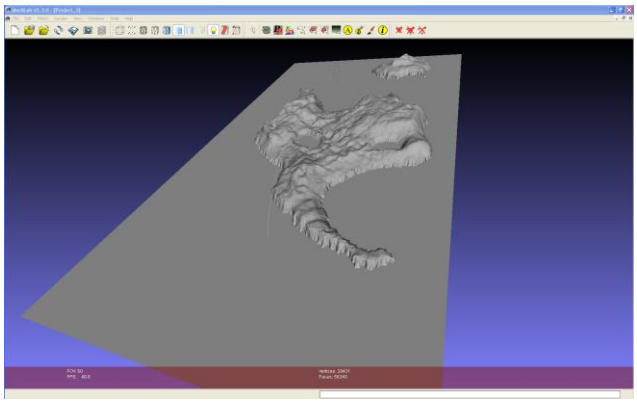
1) Run a Files Test to see which files are not available, and decide if you want SRTM-1 or SRTM-3 data.

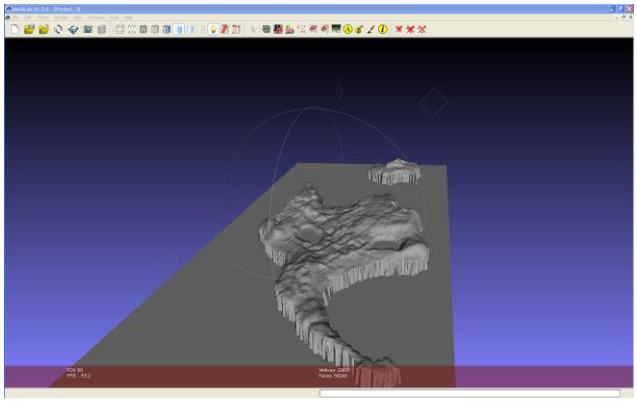
2) Press the appropriate 'Download … Zipped Files', and the text display will show the progress. You will see many reports of unsuccessful downloads, because **BigTopo** has to search to find the necessary data, and (for **BigTopo**) the easiest way to search the internet is to try and fail. **BigTopo** learns from its failures to speed up subsequent downloads.
3) When **BigTopo** finds and downloads a file correctly, it will use **7za.exe** to unzip the data file and put the contents in the right directory. This causes some screen flashing.
4) Occasionally you may get a message showing an internet error. Just accept it, and the program will continue as best it can. I occasionally get timeouts, especially if the lad's PS3 is running on the network.
5) Once the downloading has finished, re-test to see what files are now available. Some may still be missing if you have asked for a region that covers a lot of open water (pure water zones like mid-Atlantic do not have SRTM-1 or SRTM-3 files). If you think it has missed some data because of an internet error, just press 'Download…' again. **BigTopo** will only try to fetch data that it cannot find in the data directories.

Tips for Using BigTopo

1) Noise in the elevation data may be distracting when converted to the 3D format of the STL file especially for large scale images. Consider using the smoothing functions of **MeshLab**. 'Normals Smoothing' is a good first step, and then 1-3 steps of Laplacian Smoothing if required. I have no idea what Laplacian Smoothing is.
2) **MeshLab** can fix holes in the STL file, which would probably cause problems in CNC use. Gaps arise because the SRTM data sets contain flaws, especially in mountainous areas. With **MeshLab's** default blue background, gaps are obvious if you cruise around the model, or look at the underside of the STL surface.
3) Large scale STLs look bizarre if the Z range is too large, since it distorts the expected vertical and horizontal dimensions. Reduce Z Extent if necessary. Your CNC machine will thank you too.
4) Google Earth's push-pin location markers are great for picking the corners of your region of interest, and by keeping them on your machine, you can easily pick and revise them. Plus, when you pick a point, GE opens a box that gives the exact coordinates, and tracks the push-pin movements as you move it on the map.
5) There can be an aesthetic value of using a STL spacing that is much finer than the raw data spacing : it improves the look of shorelines quite a bit, and smooths out the surfaces. For small areas, I have used 15 m spacings on SRTM-3 data to good effect. Since small areas make small STL files, there is not much of a penalty to this trick.
6) The contrast between land and water may not be very visible at shorelines such as in the Christian Island example. To put the land onto a slight pedestal, choose the Low elevation limit to be 1-2 m above the water level (Lake Huron is 175 m, so try 177 m in the Christian Island example), and then use a Z Base of 5% to 10%. **BigTopo** will give Z=0 in the STL file for all elevations below 177m, then elevations of 177m and higher will be up on a step that is 5-10% of the Z Extent of the STL file. Here is Christian Island with Z Base=0% (no pedestal) and 5% and 25% pedestals. 5-10% makes a pedestal that enhances contrast without being too obvious. Laplacian Smoothing in **Meshlab** smooths the edges of the pedestal. (Making and imaging this series of models took ~5 minutes, total).







If you use **BigTopo** to produce something interesting, please consider posting photos on the appropriate Forums, giving appropriate credit. If you have any questions, I am frequently on the Vectric and CNCZone forums as PaulRowntree, or you can reach me via the PaulRowntree.weebly.com website that you downloaded the **BigTopo** package from. And of course, if you really like this or if it has helped you in a significant manner, please consider supporting **BigTopo's** continued development.

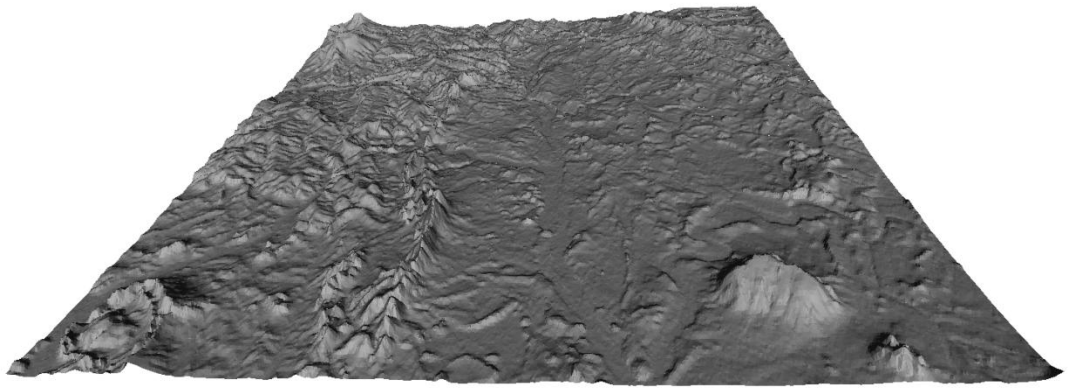
Cheers!

PR

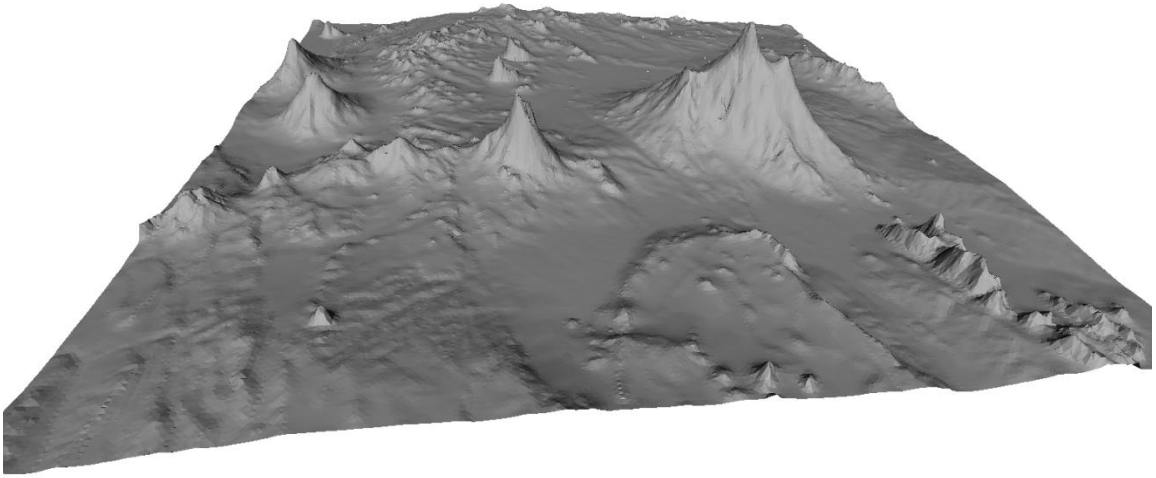
There are some images on following pages …

Here are some **MeshLab** screenshots images of STL files.

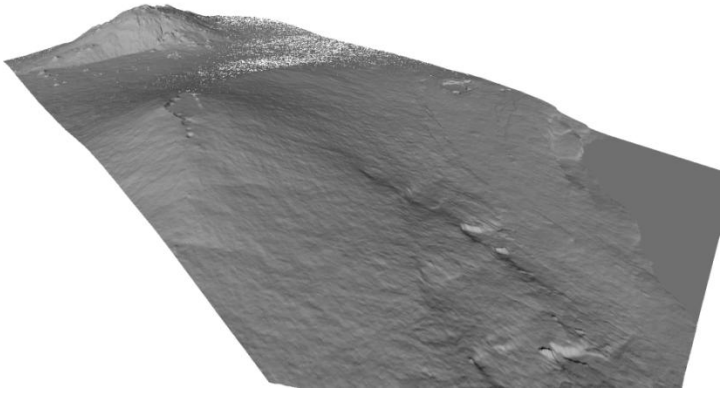
Vectric's County (?) of Worcestershire, UK. Redditch is near the right side of the region, about 2/3 to the top of the image.



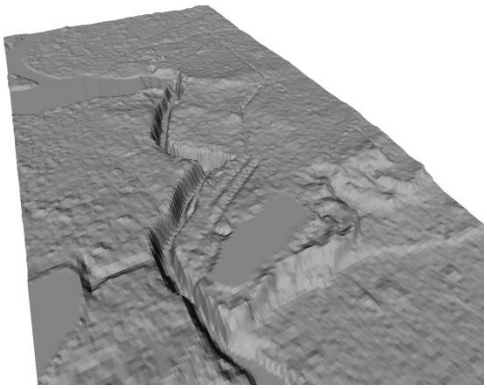
Mount Kilimanjero



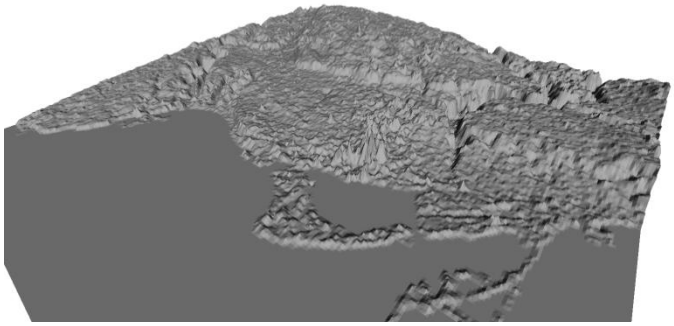
A small chunk of Hawaii (N19W156)



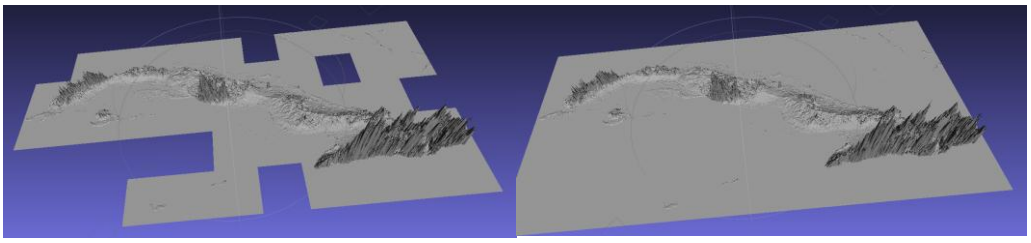
Niagara River Gorge and Falls, seen from the Lake Ontario side



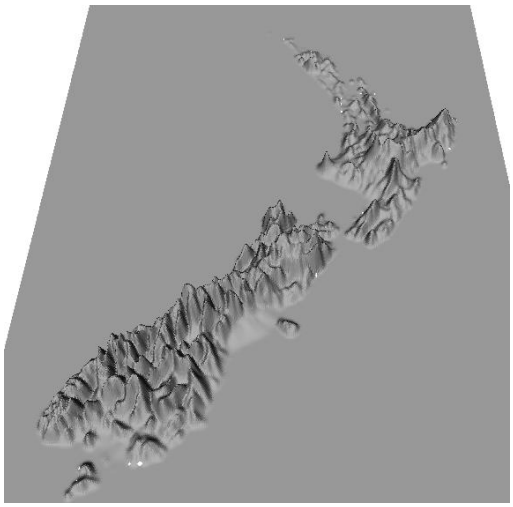
Toronto Island and City, Ontario : The waterfront ‘mountains’ are the tall buildings.



Cuba (Left side is with Blocking SRTM-30 data, no MissingData provisions; right side is allowing SRTM-30, identical to Blocking SRTM-30 and using MissingData filling option instead).



New Zealand (This covers MANY 1x1 degree tiles; **DEM_2_SRTM** was important here). You gotta love the beautifully symmetric Mount Taranaki on the SW edge of the North island!



Main Hawaiian Islands, 1 km resolution (circles are **MeshLab's** 'trackball' marks). Shoreline emphasis added using Z Base.