

Creating a 3D Printed Model of a Watershed (suitable for an Augmented Reality Sandbox) using QGIS

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This tutorial describes how to convert a DEM file for 3D printing. For those who want their 3D printed model to be larger than the maximum dimensions of the 3D printer (such as for an Augmented Reality Sandbox), I've also included instructions about how to clip the DEM into equal-sized boxes that can later be stitched together after printing.

For this tutorial, you will need the following programs:

1. [QGIS](#)
2. DEMto3D plugin for QGIS (can be downloaded within QGIS under Plugins -> Manage and Install Plugins)
3. [Blender](#) (optional, if you want to double check your STL file in 3D before 3D printing)

Steps:

1. Open QGIS and add the DEM raster file to layers. If you only want to print a portion of the DEM (such as just printing a watershed), also add a shapefile that has the area you want to clip.
2. To clip your DEM to a specified extent, select: Raster - > Extraction -> Clip Raster by Extent. Your input layer is your DEM and your clipping extent is the layer extent of the shapefile you added above.
3. To subdivide the watershed for 3D printing to a large size, right click on the layer created in Step 2 and select Export -> Save As... Within the dialog box, keep everything the same, except:
 - i. Check Create VRT
 - ii. Select where you want to save under file name – this is where the program will create a folder of your clipped files.
 - iii. Extent: click Calculate from layer
 - iv. VRT Tiles: This determines how many tiles will be created. First check the total dimensions of the DEM tiff file. For example, the Ala Wai Watershed, located in Honolulu, Hawai'i has dimensions $x = 1052$, $y = 1056$ and I wanted to print 3×4 10 inch (254 mm) tiles for our augmented reality sandbox. I divided $1056/4 = 264$ and $1052/3 = 350$ (rounding down to the nearest integer). I entered max columns = 264 and max rows = 350. You may need to play with this one a bit depending on your application.
 - v. Make sure add saved file to map is selected and click OK.
4. After the tiles have been created, you'll want to change the band rendering in each layer so that they are the same as the initial file. To do this, right click on each tile one by one, go to Properties... and change the min and max values under color gradient in Symbolology to be the same for all tiles.
5. Next we want to convert the tiles to an STL file so it can be read by 3D printing software. To do this, go to

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arrows).

same layer (click the box with the

7. Select spacing. For Ala Wai watershed, I selected spacing = 2mm, width = 254 mm (= 10 inches, max printing dimension with the 3D printer), and then length was autofilled based off of the DEM's dimensions.
8. Then select exaggeration factor (this is your vertical exaggeration), I selected 3 for Ala Wai Watershed based off of the maximum vertical dimension of the 3D printer.
9. Under Height base, set height = 0. Then click Export to STL.
10. If you want to view your files in 3D before printing, you can download and install the free program Blender and import the STL files to the stage to see what they look like.

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