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

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 stiched 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, Hawaiʻi has dimensions x = 1052, y = 1056 and I wanted to print 3 x 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 `Symbology` 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 `Raster -> DEMto3D`.

6. Select the layer to print as one of the tiles and set the print extent to the same layer (click the box with the arrows).

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.

Questions? Comments? Feel free to contact me:

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