

Other Forms of Representation: The 3rd Dimension



Lesson Objectives

- Review the different techniques used to visualize relief
- Explain how to create a 3D model

After this lesson you should be able to

- Create a 3D model from a digital terrain model
- Use the Qgis2threejs plugin in QGIS

Geographic Information Systems

Hello and welcome to this lesson, dedicated to the representation of geographic information in three dimensions. So far, we have exploited the two dimensions of the plan and now we propose to you to acquire some basic notions useful for the manipulation and rendering of the data which are characterized by a triplet of coordinates X, Y and Z. We will first briefly recall the techniques available to graphically represent the relief then you will learn what the steps of the construction of models in 3 dimensions are before seeing 2 examples of application in QGIS, one in the Seychelles and the other in Geneva. The goals of this lesson are to remind you of different techniques available and allowing to visualize the relief and to explain how to build a 3D model from a digital land model. After this lesson, you will be able to build a 3D model from a digital land model and to use the Qgis2threejs plugin available in QGIS.

Notes

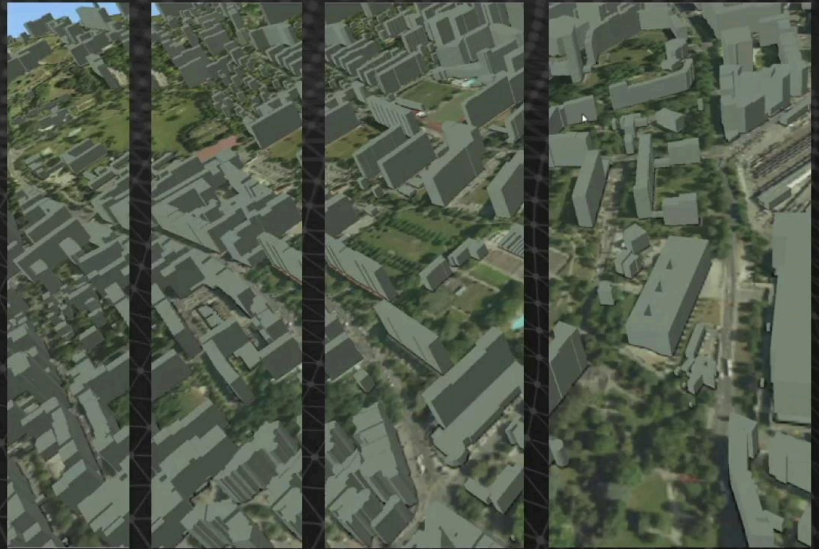
Summary



0m 30s

Representing Relief

- Why use 3D to represent relief?
- More concrete and realistic representation
- Allows for the best understanding of the spatial relationships between objects being represented
- Simultaneous visualization: the spatial component (X,Y,Z) + a thematic variable



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But why should we be interested in the third spatial dimension? We can indeed ask ourselves what relevant information is a geographical representation which includes the rendering of an altitude variable susceptible to produce. It is mainly a representation of the environment which is more concrete and realistic than the reduced model of geographical space in 2 dimensions. This makes the map or the view more attractive to the user. And this is why this category of images is often used in the context of impact studies as already mentioned or in the investigation of new works. The visual rendering of the volume of geographical objects on this type of view can promote a better perception and a better understanding of the space and relations between the objects that make up the landscape. Besides, this type of representation enables to make the point of view vary, to visualize the objects of interest from several angles. And finally, the construction of representations including the third dimension, allows to simultaneously visualize the relief plus a thematic attribute.

Notes

Summary



1m 38s

Representing Relief

- 2.5D or pseudo 3D
- Modifying hue of DTM pixels
- Contour lines
- Hillshade model
- Combination



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There are several ways of representing the relief and we discussed them in module 3, as part of the lessons dedicated to digital land models. This type of representation is sometimes called 2.5D or 2D $\frac{1}{2}$ or even pseudo 3D because its purpose is to simulate the appearance of 3D. The method consists in projecting the information of the third dimension on a 2-dimensional plan. A first technique is to make the value vary of a shade of pixels of a digital land model according to the altitude, here on the Island of Mahé in the Seychelles. In this first example, the grid levels vary, the whiter the pixel, the higher the altitude. It is also possible to determine and draw contour lines or to calculate a shaded model. Finally, we should note that several of these representations can be combined and that it is possible to superimpose a satellite image or a vectorial layer to a shaded model to produce a pseudo 3D view of this type.

Notes

Summary



2m 47s

Building a 3D model

- DTM, raster format
- Elevation of pixel given by its altitude (Z)
- Creates a surface
- Re-sampling
- Vector or raster draped on top

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But there is a form of relief representation in 3 dimensions and this form goes through the construction of a 3D model on which the image or a vectorial layer will be wedged, it is called draping. In three-dimensional computer graphics there are several types of modeling including the curve modeling or "NURBS" for Non Uniform Rational Basic Spline that is often implemented. The steps necessary to build this type of model are the following. From a digital land model in raster format, each pixel is characterized by its X and Y coordinates as well as its altitude in Z. Then each pixel is raised to its altitude Z after what, to avoid large drops on the edges of the pixels we construct a surface with the help of Bézier curves connecting the centers of each pixel. Some 3D models allow to resample the information, in order to adjust the resolution of the digital land model. Here, for example, the resampling allows to increase the spatial resolution but it is also possible to degrade the resolution in order to avoid handling a model that is too heavy. Finally, as a last step, we will drape a raster layer most often and which may be vectorial. This step consists of placing an image over the model. This superimposition operation causes the distortion of the pixels of the image to be draped located where there are significant differences in altitude.

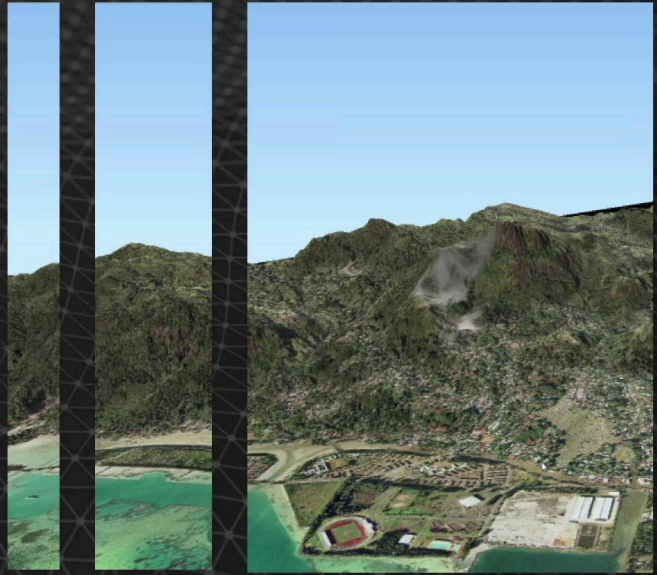
Notes

Summary



Qgis2threejs: Seychelles

- QGIS plugin "Qgis2threejs"
- Uses the **three.js** JavaScript library
- Creates and displays 3D landscapes in a web browser using **WebGL** interface
- 3D visualization



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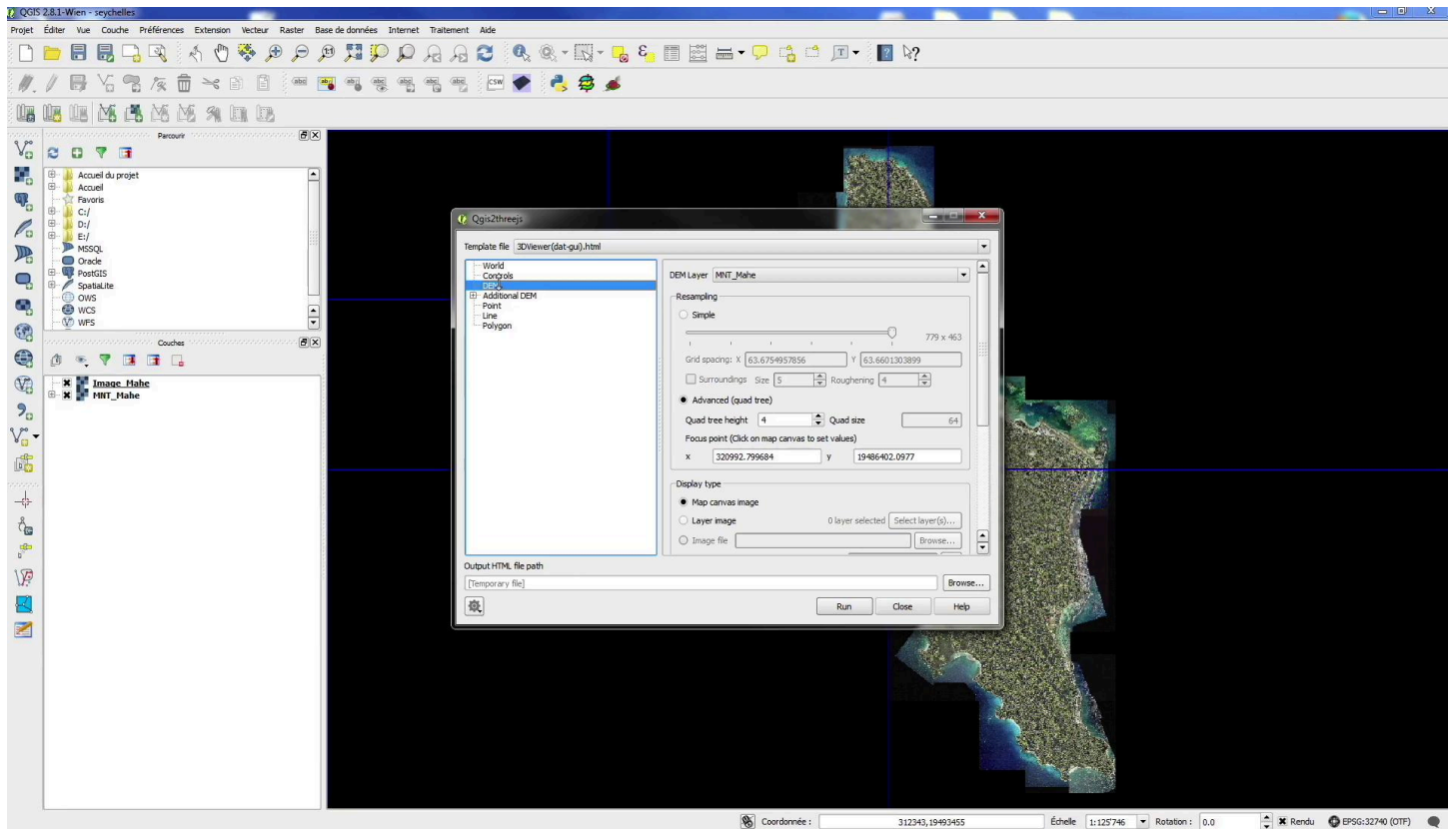
We will now use an extension of QGIS called Qgis2threejs. This plugin uses a JavaScript library called Threejs, hence its name. This program allows to create and display 3D landscapes in a web browser thanks to WebGL technology which is a specification of dynamic 3D programming interface for pages and application in HTML5. Qgis2threejs only allows the visualization of the 3D elements, it is not possible to create them, nor to apply treatments.

Notes

Summary



5m 37s



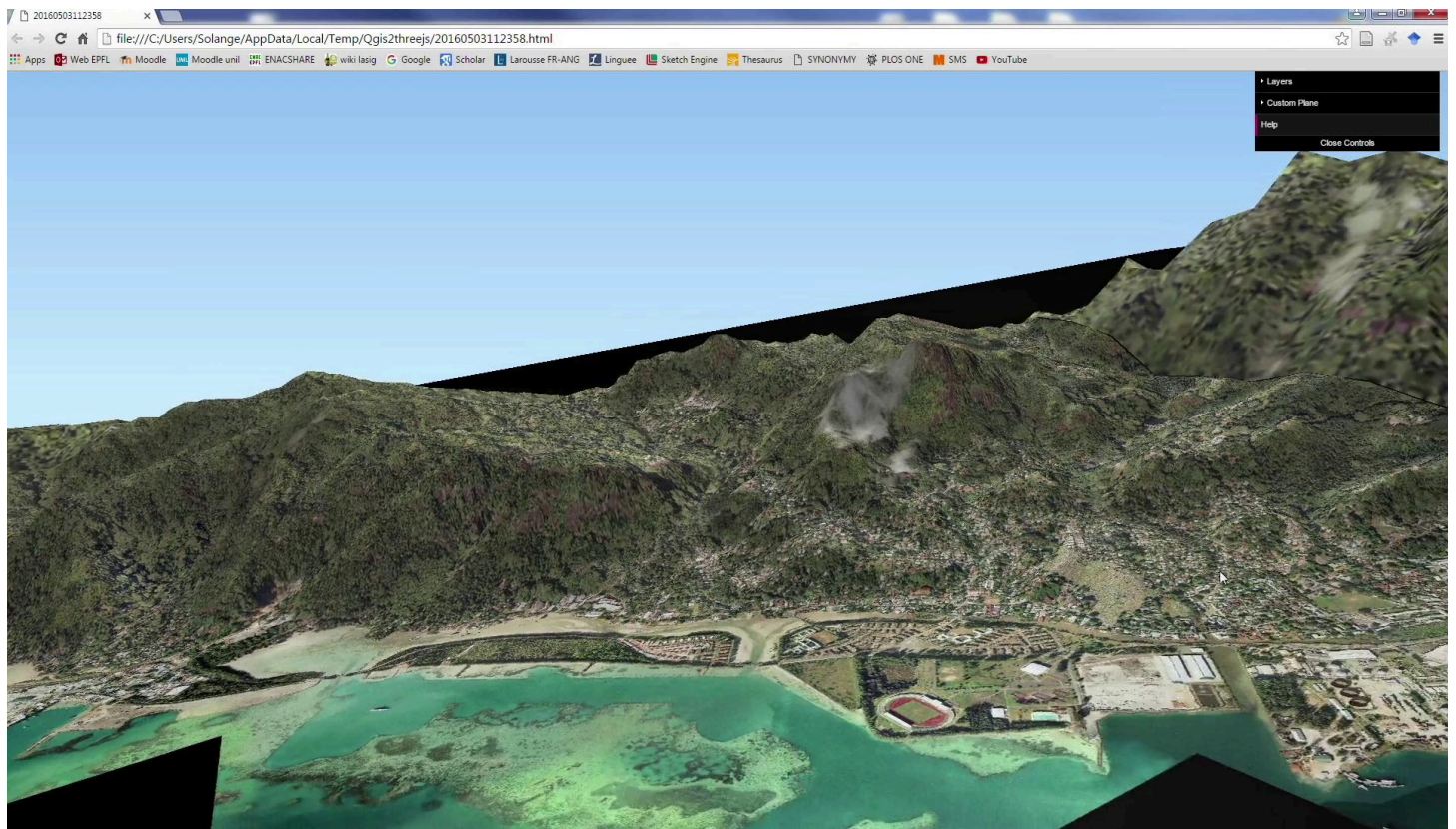
Let's go into QGIS, in which we have a digital land model of the Island of Mahé as well as an aerial image in three colors, red, green, blue. Please note that some data are missing at three locations in this file, which explains the three small white areas on the views obtained. We will first install the plugin in question, via the extension manager. In the "extension" menu, "install", "manage extensions", write the first letters Qgis2... and then select the desired plugin before clicking on "install the extension". Once done, click on "close" and the corresponding icon appears on the interface. Click on it to display the plugin settings window. You will find several tabs that allow you to define the desired options. The "world" tab is mainly used to define the grip of our model. We choose to conserve the total surface of the island. The "controls" tab lets you define keyboard combinations and the use of the mouse to navigate in the image once the model is generated. Here we leave the default settings. The DEM tab, for Digital Elevation Model, allows to designate the layer that contains the digital land model that we want to use.

Notes

Summary



6m 12s



Here we select the digital land model of the island and then it is possible to choose the resolution of this digital land model. And if the resolution is too high, the graphic map will not be powerful enough to process the information in a sufficiently fluid way. On the contrary, if the resolution is too weak, the details of the DLM and the draped image will be lost. A good solution is to use the advanced Quadtree function that adjusts the resolution of the image according to the zoom level. We can define the number of levels to create, here four, and choose on the screen the area for which we want to get the most details. In the last section of this tab, we can still select the image to drape on the digital land model, in this case it is the image available in the QGIS layer manager. The following tabs give the possibility to manage multiple digital land models or add vectorial objects such as lines or polygons, which is what we will do in the next example. We can now start the process. Once the calculation is finished, the plugin opens a window in a web browser and gives us the possibility to navigate in the 3D model thus generated. You can see that the resolution of the image is not the same everywhere, which corresponds to the setting of the Quadtree option with an optimal spatial resolution in a designated area and less optimal elsewhere.

Notes

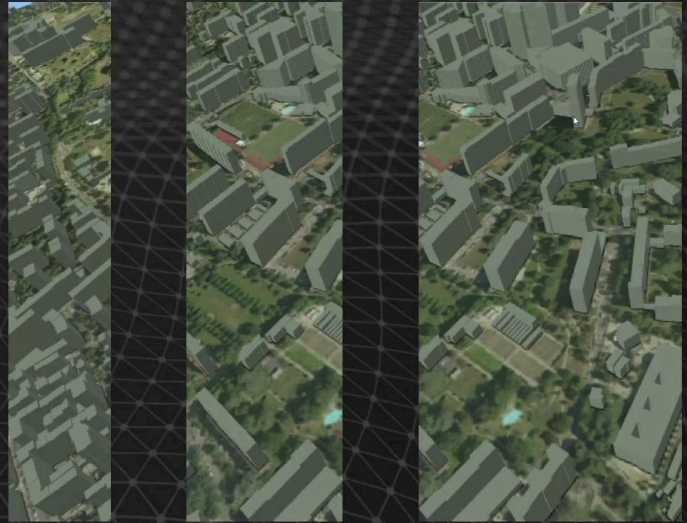
Summary



7m 35s

Qgis2threejs: Geneva

- QGIS plugin "Qgis2threejs"
- Uses the **three.js** JavaScript library
- Creates and displays 3D landscapes in a web browser using **WebGL** interface
- 3D visualization



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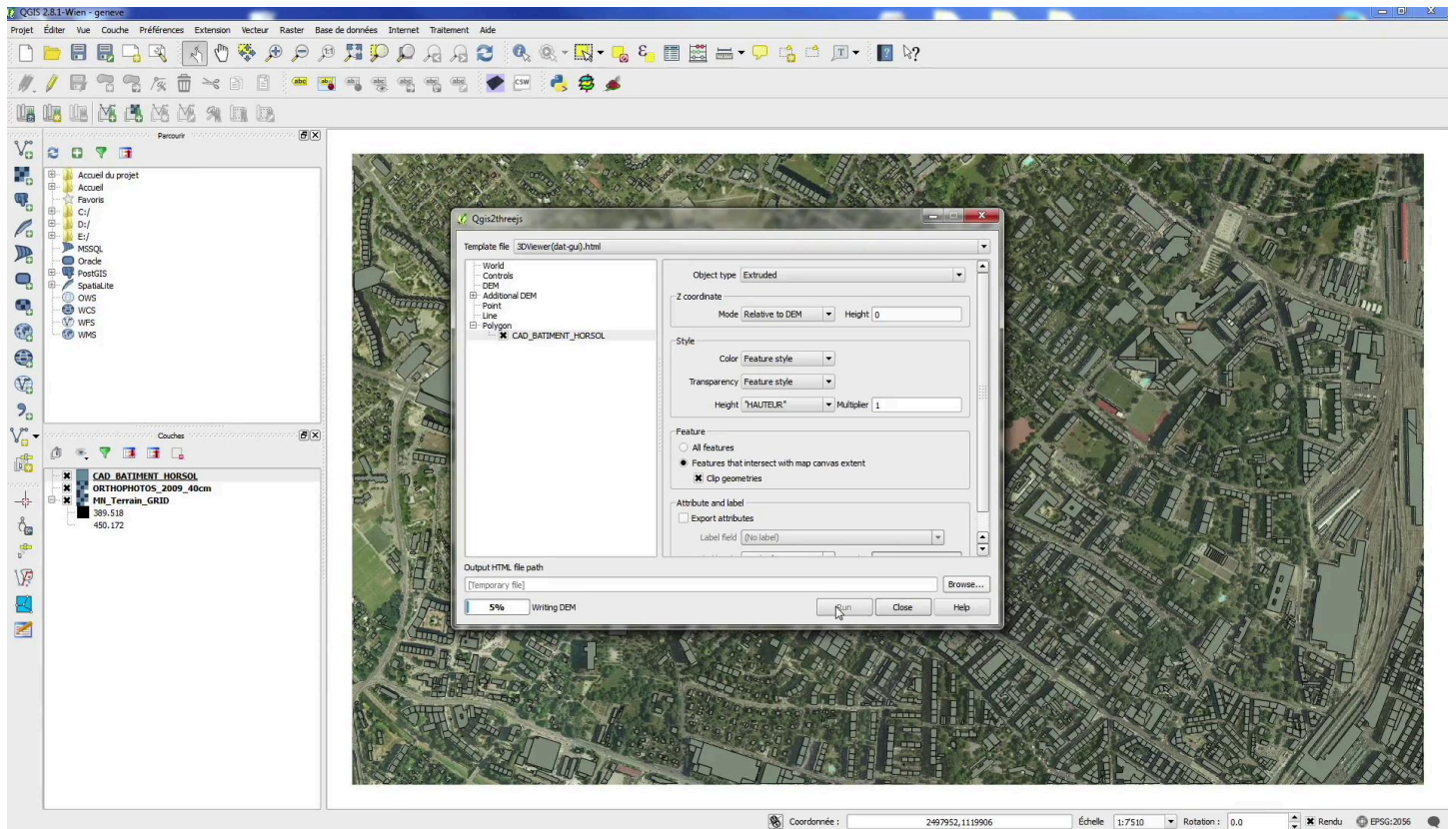
Here is a second example to illustrate the use of the extension Qgis2threejs, in urban environment this time with the contribution of a vectorial layer. The chosen area is a district of the city of Geneva.

Notes

Summary



9m 12s



In QGIS, we have a high-resolution digital land model, an aerial image with a spatial resolution of 40 centimeters in red, green, blue and the footprint of the city's buildings from the land register. An attribute table describes the latter, including a height variable that we will use. In the plugin setting window, we select the digital land model and then choose a simple resampling. The study area here is not too large indeed and the calculations will not be long. Compared to the example of the Seychelles, we have to complete the parameterization since the idea is to insert the volumes of buildings on the territory. In the "polygon" tab, we must select the layer containing the buildings we want to extrude at the altitude shown in the "height" field. You will notice that an additional parameter would allow to exaggerate the height of the buildings of a factor of our choice.

Notes

Summary





Finally, after launching the calculation, we obtain a 3D model of a neighborhood of Geneva with its buildings. The navigation tools allow to move in the landscape with more or less fluidity.

Notes

Summary

