

Basic Work with the Point Cloud Program

Program: Point Cloud, Stratigraphy

Files: Demo_manual_50.gsg

Introduction

This engineering manual will explain the basic editing of point clouds and its subsequent use for terrain generation in the "Stratigraphy" program.

Two point clouds generated during terrain mapping using a drone are used as input data.

The data is freely available here: <https://data.fine.cz/manuals/EM50.zip>

The whole manual is divided into two parts – the first part deals with the alignment of two shifted point clouds. The second part shows other modifications – point reduction, vegetation removal, etc. Most users work with clouds that do not need to be aligned – these users can skip the first part and focus directly on the second part.

The first point cloud covers the upper part of the slope and was created using photogrammetry performed from a drone equipped with a so-called RTK system with a connection to the network provider of individual positioning stations (NTRIP). The use of this system ensures very high accuracy of all measured points with respect to global GPS coordinates.

The second point cloud covers the bottom part of the slope and was created using measurements taken by a lidar-equipped drone. The individual points in this point cloud have a bottom accuracy relative to global GPS coordinates because the RTK system was only connected to one mobile station. However, the local accuracy of all points (points relative to each other) is the same as in the first cloud.



Point cloud 1 – upper part of the slope focused by photogrammetry



Point cloud 2 – the bottom part of the slope focused by lidar

Assignment

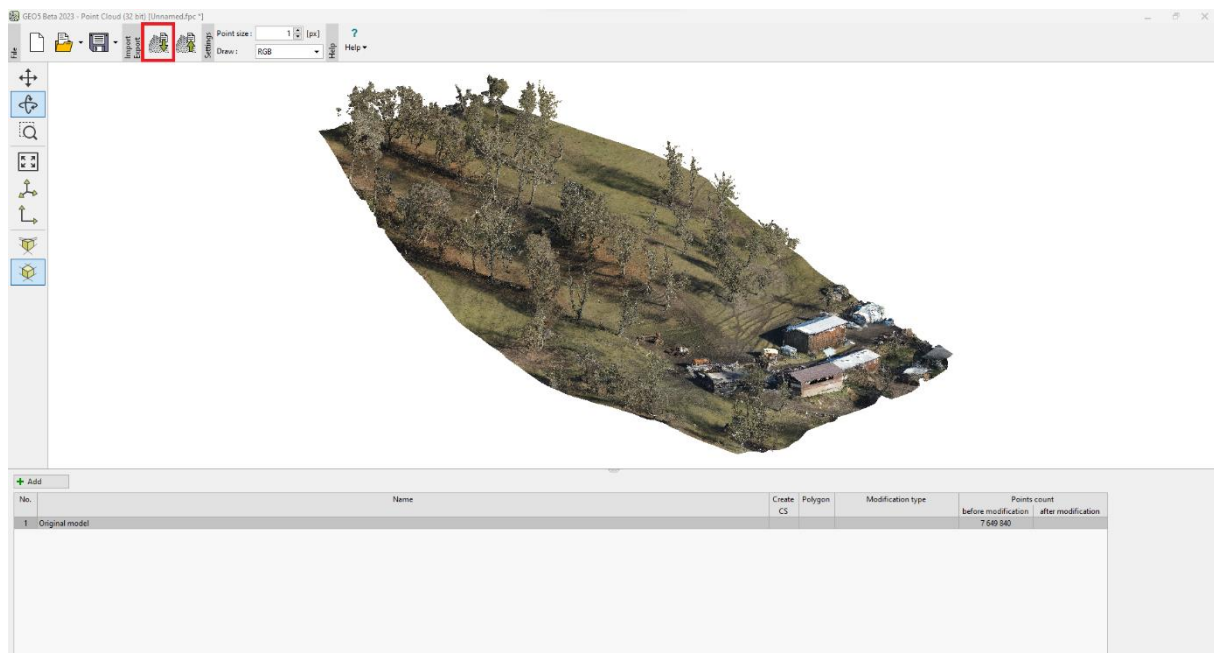
Create a digital terrain model (DMT) from the two point clouds for geological model processing.

Process

- 1) First, check the relative position of the two clouds – if the coordinates are offset from each other, align them. **(Part 1 – Aligning the clouds)**
- 2) Merge the aligned clouds and make other necessary modifications – point reduction, vegetation removal, etc. **(Part 2 – Cloud Modifications)**
- 3) Import the terrain into the "Stratigraphy" program

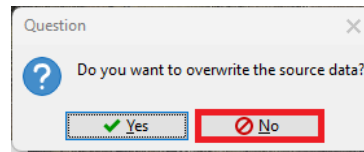
Part 1 – Cloud Alignment

Start by importing the first cloud (UpperSlope.las) into the "Point Cloud" program using the import button – see highlighted below.

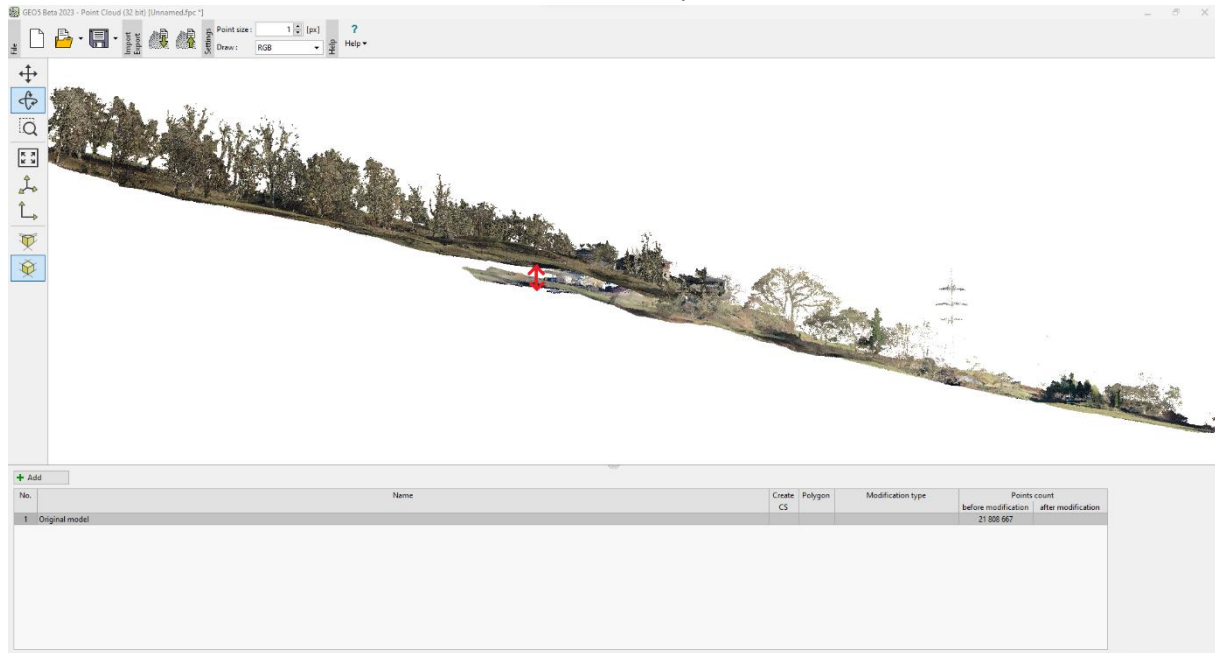


Import of the first point cloud – upper part of the slope

Then import the second point cloud (BottomSlope.las) into the same task using the same button. We will not overwrite the source data – so we will add the points of the second cloud to the points of the first cloud. We would achieve the same result if we selected and imported both clouds at the same time.



At first look, it is obvious that the clouds are shifted away from each other:

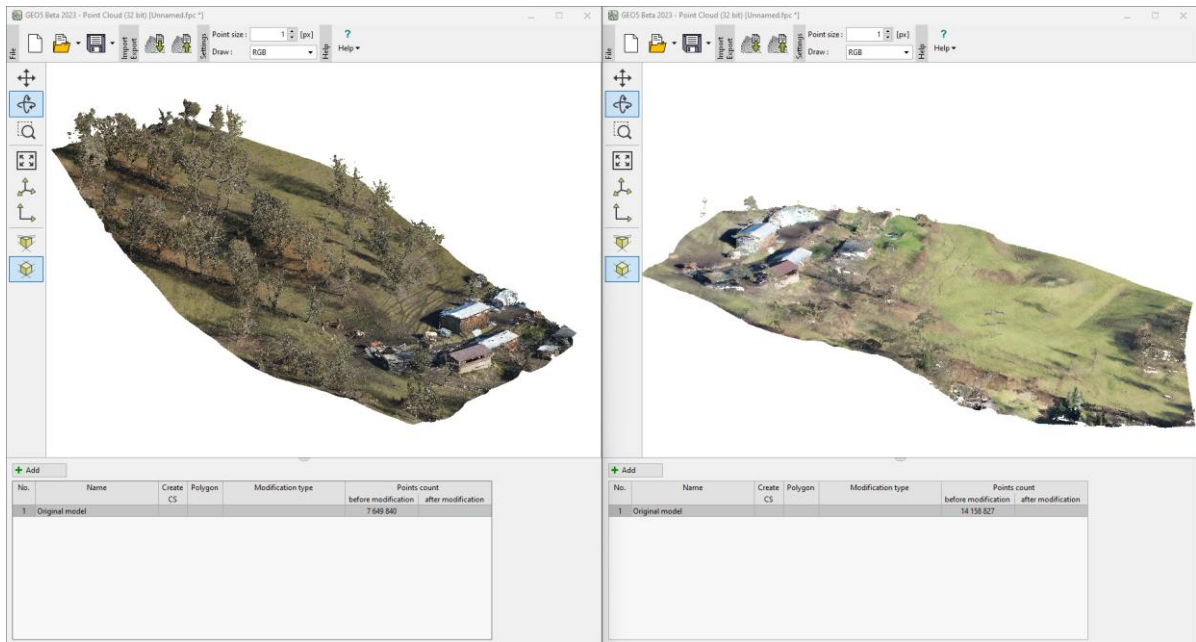


Both point clouds at the one view – visible shift

We said in the introduction that the upper cloud has more accurate global coordinates. Therefore, we will use the "Alignment of two point clouds" function, which allows us to align the coordinates of the bottom point cloud to match the coordinates of the upper point cloud.

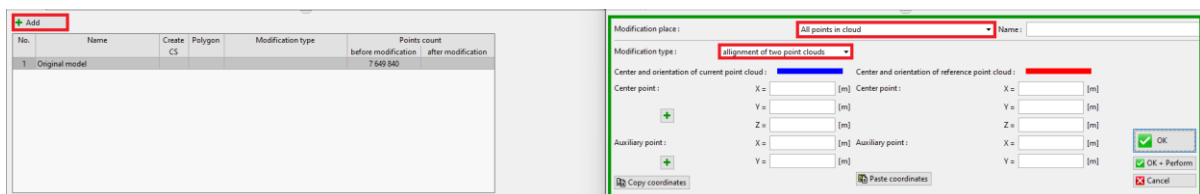
The point cloud alignment function consists of finding a pair of points that define a semi-line that should match in both point clouds – in our case, it will be the roof ridge of one of the buildings.

The simplest way to use it is to open the two point clouds in two separate tasks (windows) side by side. So close the original task and start two new "Point Cloud" programs – import the upper point cloud into the left task, and the bottom cloud into the right task.



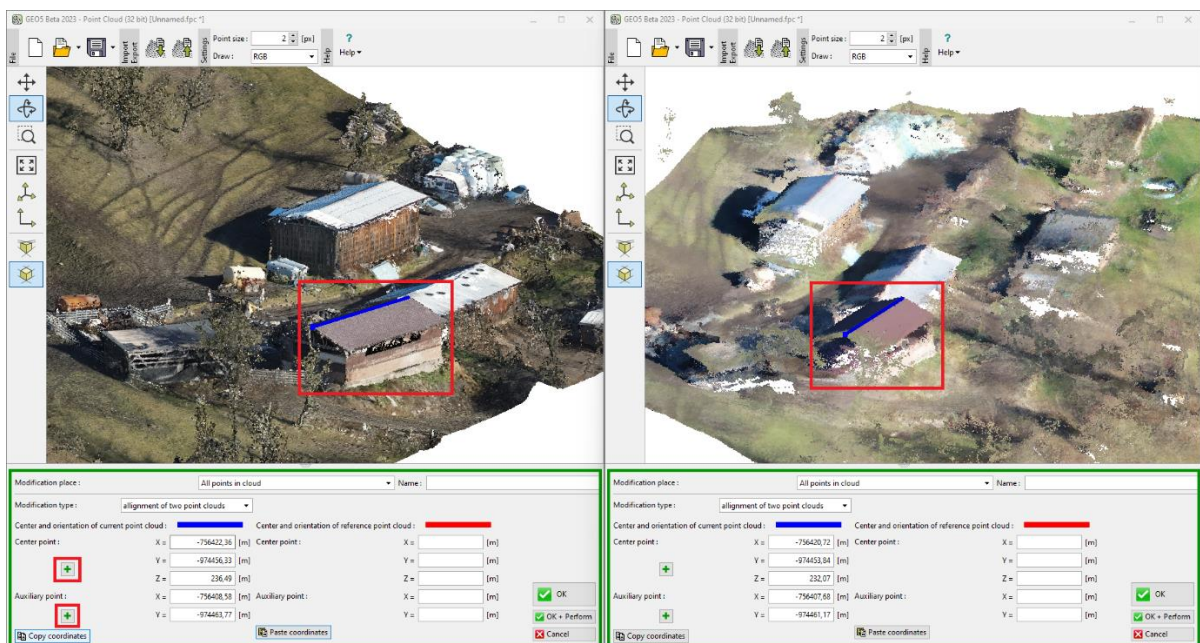
Both point clouds opened side by side in two separate tasks

In both tasks, add a new modification using the "Add" button and select the modification place "All points in cloud" and select "Alignment of two point clouds" as the type.



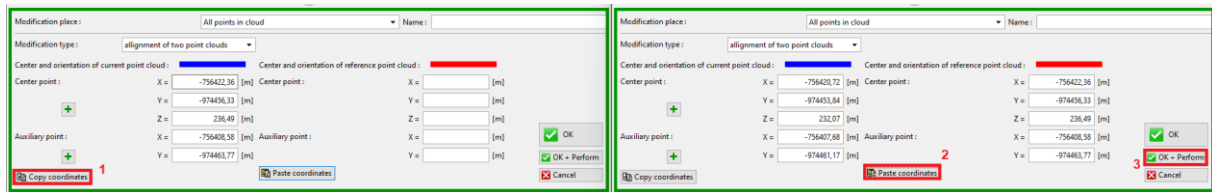
Selection of modification

Use the "plus" buttons to select the coordinates of the points you want to align.



Semi-line input – roof ridge

We placed the center point on the closer edge of the ridge, and the auxiliary point on the far edge. Now copy the coordinates from the left task (1) and paste them into the right task (2).



Copying coordinates from the left task to the right task

The left task with the upper cloud can be closed without saving (it was only used to get the coordinates), in the right task confirm the alignment of the cloud using the "OK + Perform" button (3).



Aligned point cloud

In the modification table, we can see that the alignment modification has been performed. We can also see the resulting shift – the original blue direction of the semi-line corresponds to the red direction in the new coordinates.

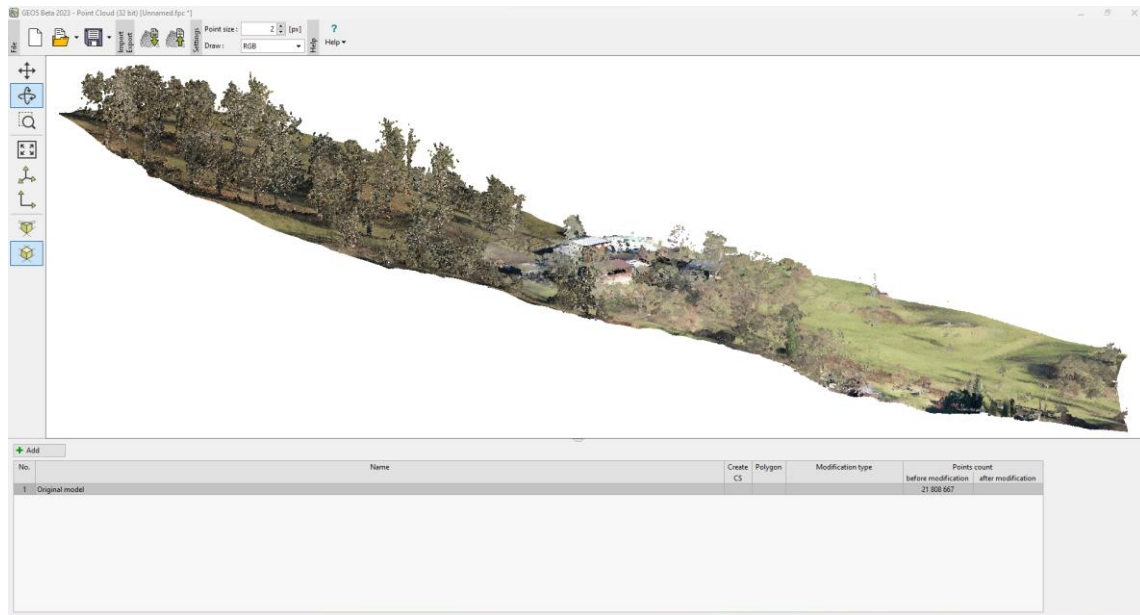
Export the aligned cloud as a new file using the export button and save it to disk under the name "BottomSlopeNew.las".



Export of .las file

Open a new task in the "Point Cloud" program.

Import the original upper and newly aligned bottom point cloud (*UpperSlope.las*, *BottomSlopeNew.las*).



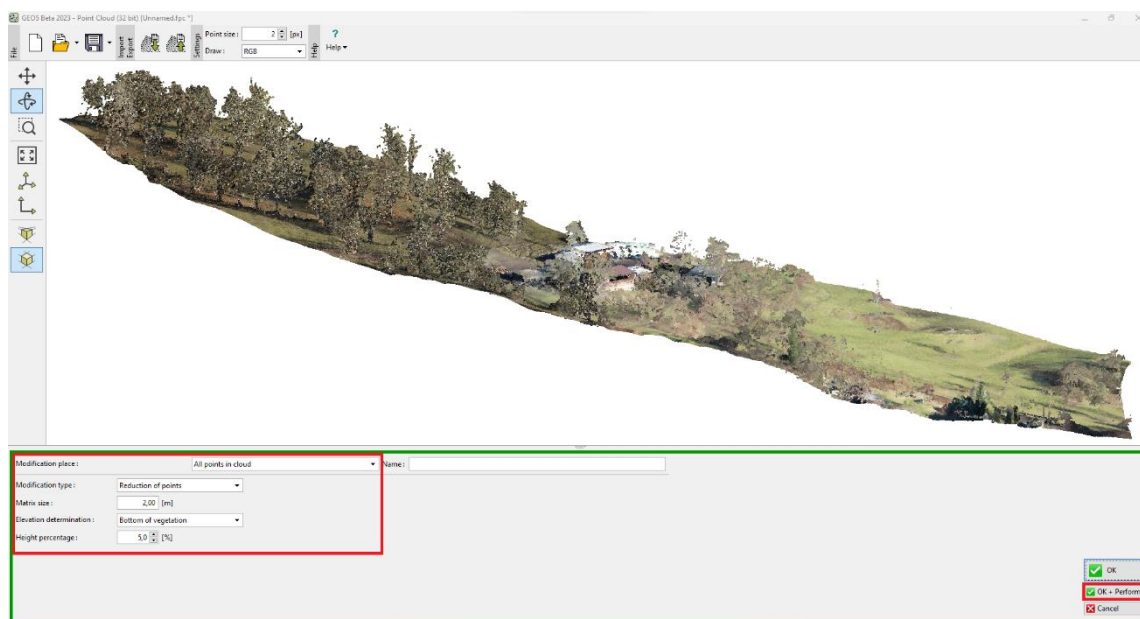
Merged point clouds after alignment

Both point clouds are already aligned properly. The alignment was successful.

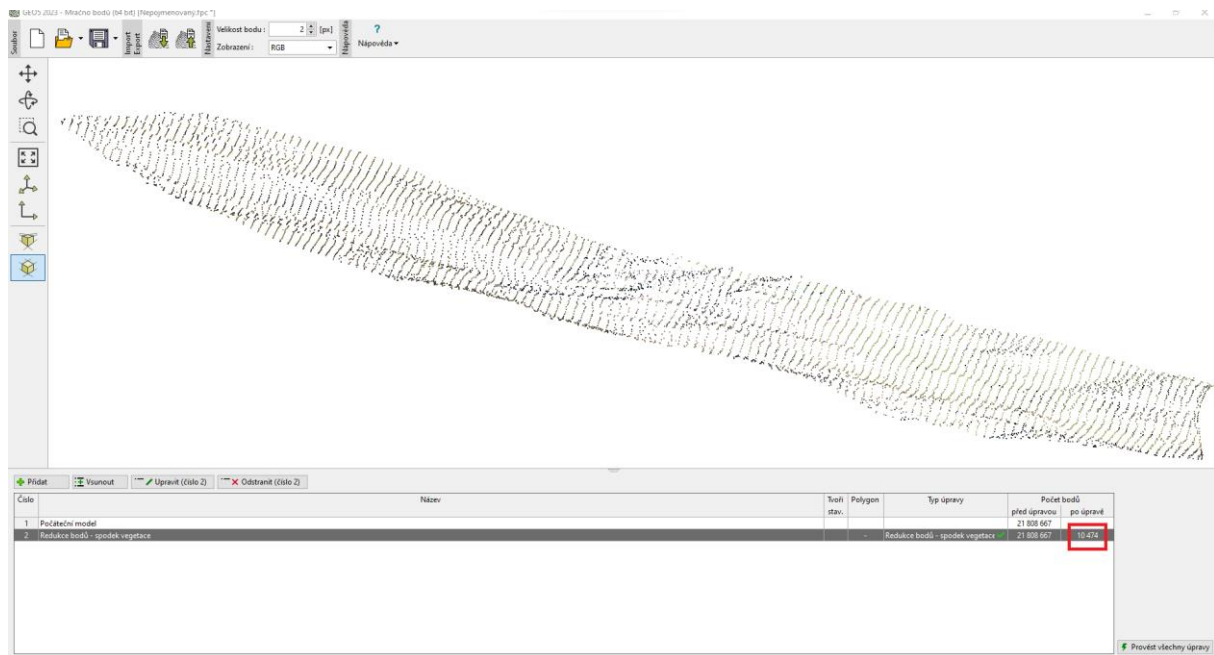
Part 2 – Point cloud modifications

We can see that the merged point cloud contains about 21.8 million points – such a high number of points is inappropriate for the creation of terrain in the "Stratigraphy" program – firstly, the cloud contains many points that do not represent the terrain (trees, buildings...) and at the same time, the focused terrain is unnecessarily detailed for the geological model – the processing would take an unreasonably long time. At most, lower tens of thousands of points are recommended for data transfer to the Stratigraphy program.

We start by trying to remove vegetation and reduce the number of points. For the whole point cloud, we add a new modification, which we set as "Reduction of points" for the "Bottom of vegetation" in the 2 m grid.



Vegetation removal – input of modification

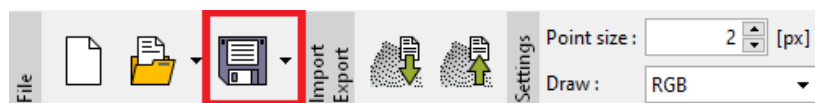


Vegetation removal – completed modification

Note: The [principle of vegetation removal](#) is to average a certain percentage of the lowest (or highest) points in a grid of a specified size. The setting parameters (grid size, percentage of height) depend on the type and scope of the task and it is usually a good idea to try several options. At the same time, it is important to note that the principle can only work well where there are enough points focused on the terrain in the grid step around the objects to be removed – typically around a tree trunk. For example, dense bushes or buildings can make removal problematic.

We have reduced the number of points from 21.8 million to 10,474. By editing, we removed most of the unwanted objects (trees, buildings...).

We could reduce the number of points even further, or use [other modifications](#). However, these will be done directly in the "Point Cloud" program, which we will launch from the "Stratigraphy" program. This will allow subsequent data transfer between the two programs. Save the file to disk under the name "FinalSlope.fpc" using the save button and exit the "Point Cloud" program.



Saving .fpc file in the "Point cloud" program

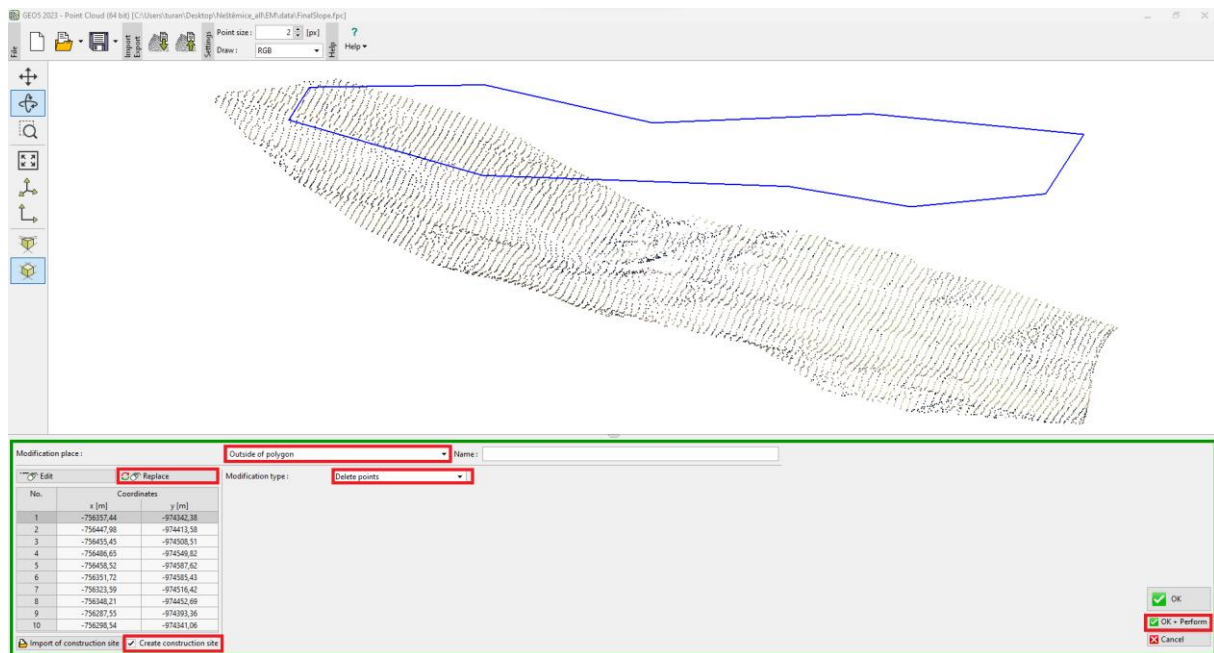
Terrain import into the Stratigraphy program

Open the "Stratigraphy" program, then launch the "Point Cloud" program from the top toolbar.



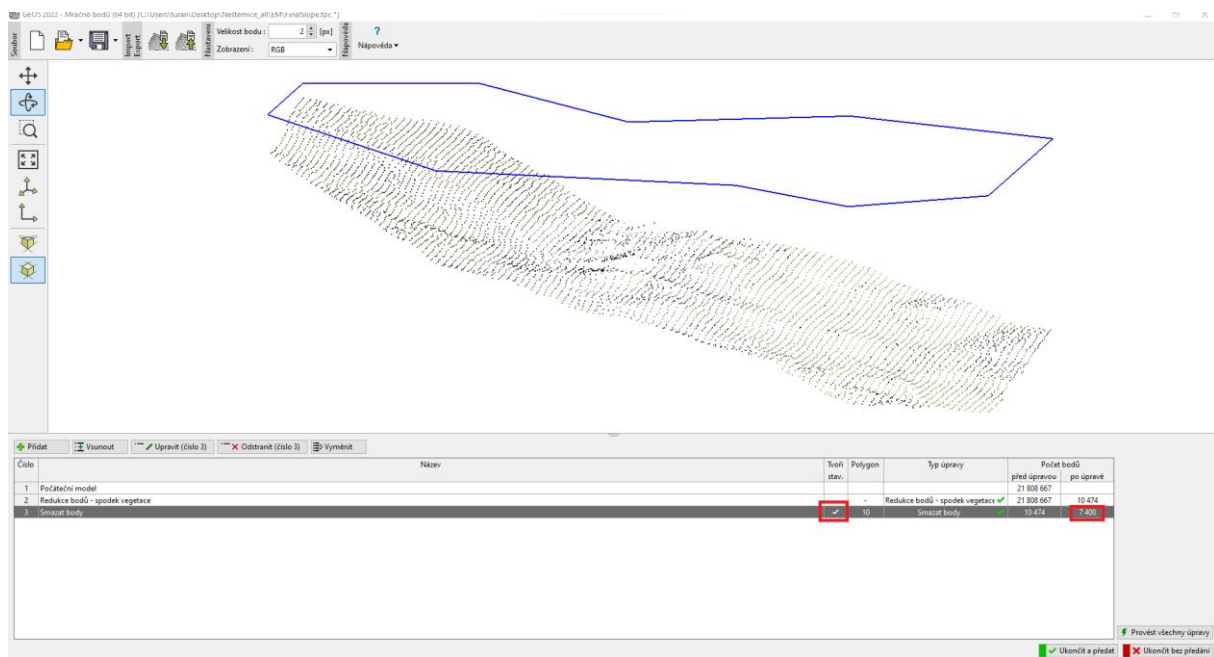
Launching the "Point Cloud" program from the "Stratigraphy" program

Open the "FinalSlope.fpc" file we saved earlier and make a new modification – create a polygon that will form our future construction site and delete the points outside this polygon. Don't forget to check that the polygon creates the construction site and confirm the modification.



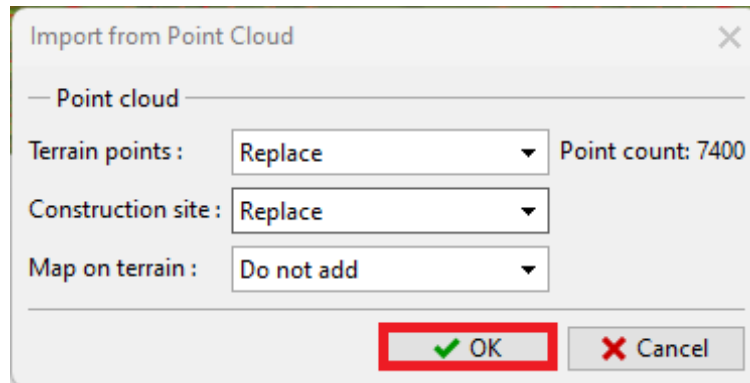
Construction site polygon input and points removal

Points outside the polygon were removed, and the total number decreased to 7400 points. We can also see in the table that the specified polygon will form a construction site in the "Stratigraphy" program.

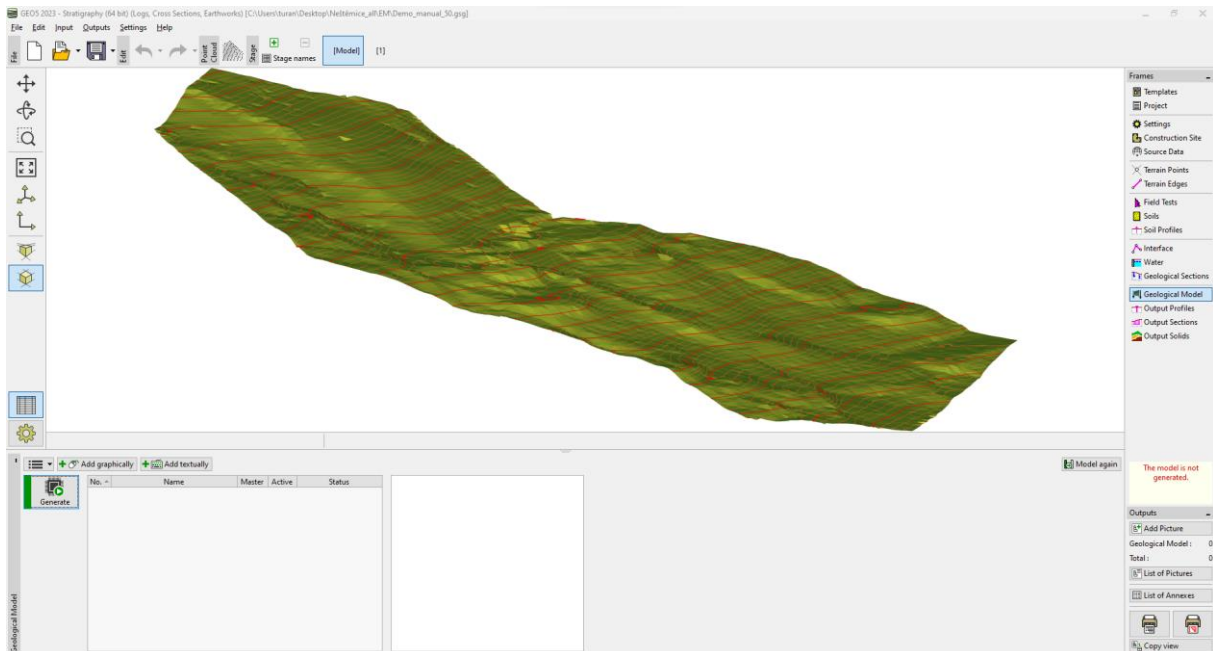


In the central part of the point cloud, we can see the remains of the roofs of buildings – see note on vegetation removal. We could remove some of this in the "Point Cloud" program using the "Noise Removal" feature on smaller polygons at approximately the locations of the building plans. However, in this case, it is easier to transfer all points directly to the Stratigraphy program and remove these few points graphically by hand.

Continue with the transfer – at the bottom, click on the " Exit and save" button, and in the "Import from Point Cloud" window that opens, select that you want to import all points and the construction site.



Data transfer from Point Cloud to Stratigraphy



Created digital terrain model in Stratigraphy software

Data transfer to the "Stratigraphy" program is completed.

Remember to set the [coordinate system](#) in the "Settings" frame correctly to match the coordinate system in which the original point cloud was created. In our case it is S-JTSK.

Coordinate System

Coordinate system type : from database

Search :

Coordinate System :
[Information on website](#)

S-JTSK / Krovak East North
EPSG:5514
Area : Czechia; Slovakia.

Modification


View

☐ Invert X
☐ Invert Y
☐ Interchange X and Y
☐ Invert Z

☐ User-defined orientation
Orientation : right-handed
☐ User-defined rotation
Axes rotation : 0°
North correction : 5,63 [°]

Coordinate ranges

x = -951499,37 .. -159365,31 [m]
y = -1353306,15 .. -911041,25 [m]



Construction site is within the ranges.

Default
OK
Cancel

Selection of coordinate system

The correct location can be checked in the "Construction site" frame using the "View on map" button.



View the construction site on Google Maps