

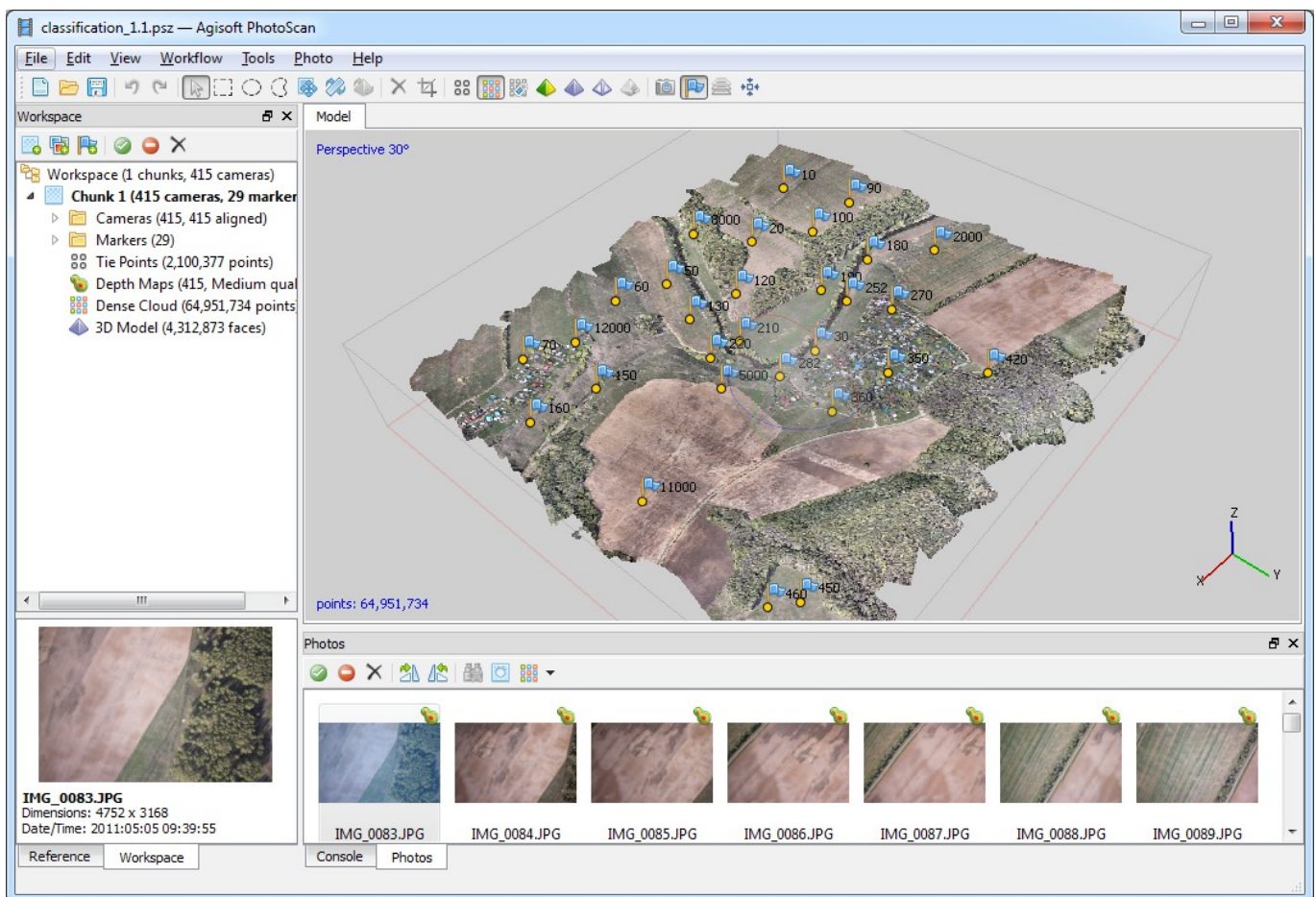
*Tutorial (Intermediate level):*  
*Dense Cloud Classification and DTM generation*  
*with Agisoft PhotoScan Pro 1.1*

This tutorial illustrates how to perform dense point cloud classification in manual and automatic mode and how to produce Digital Terrain Model (DTM).

There are two options of dense point cloud classification: automatic division of all the points into two classes – ground points and the rest, and manual selection of a group of points to be placed in a certain class from the standard list known for LIDAR data. Dense cloud points classification opens way to customize *Build Model* step: you can choose what type of objects within the scene you would like to be reconstructed and indicate the corresponding point class as a source data for mesh generation. For example, mesh reconstruction based on ground points only, allows to export DTM (as opposed to DSM – Digital Surface Model, based on the complete dense point cloud).

**Note:** If you need guidance on how to build a dense point cloud with PhotoScan refer to *Tutorial (Intermediate level): Orthophoto and DEM Generation with Agisoft PhotoScan* and follow all steps up to *Build Model*.

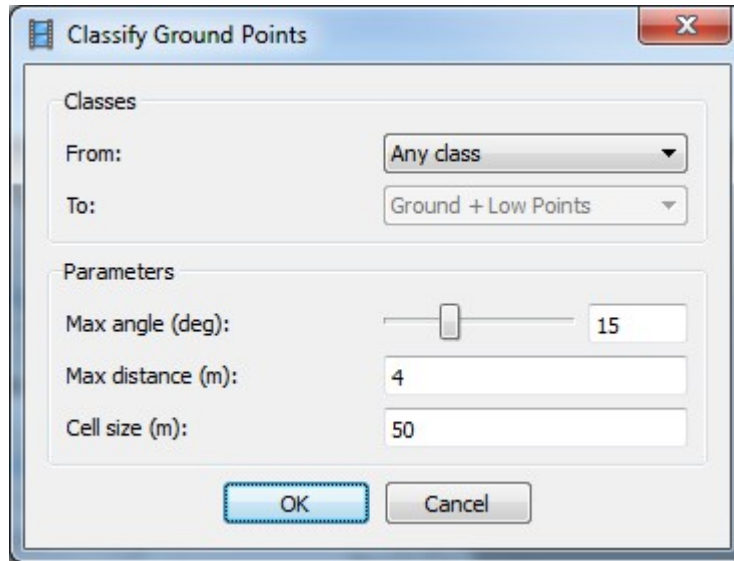
It is also important to georeference your model prior to proceeding to the steps mentioned below.



# Classify Ground Points

PhotoScan Professional provides instrument for automatic ground point classification tool.

Select *Classify Ground Points...* command from the *Tools* → *Dense Cloud* menu:



Generally automatic classification procedure consists of two steps. At the first step the dense cloud is divided into cells of a certain size. In each cell the lowest point is detected. Triangulation of these points gives the first approximation of the terrain model.

At the second step new point is added to the ground class, providing that it satisfies two conditions: it lays within a certain distance from the terrain model and that the angle between terrain model and the line to connect this new point with a point from a ground class is less than a certain angle. The second step is repeated while there still are points to be checked.

The following parameters control automatic ground points classification procedure:

## Max angle (deg)

Determines one of the conditions to be checked while testing a point as a ground one, i.e. sets limitation for an angle between terrain model and the line to connect the point in question with a point from a ground class. In fact, this parameter determines the assumption for the maximum slope of the ground within the scene.

## Max distance (m)

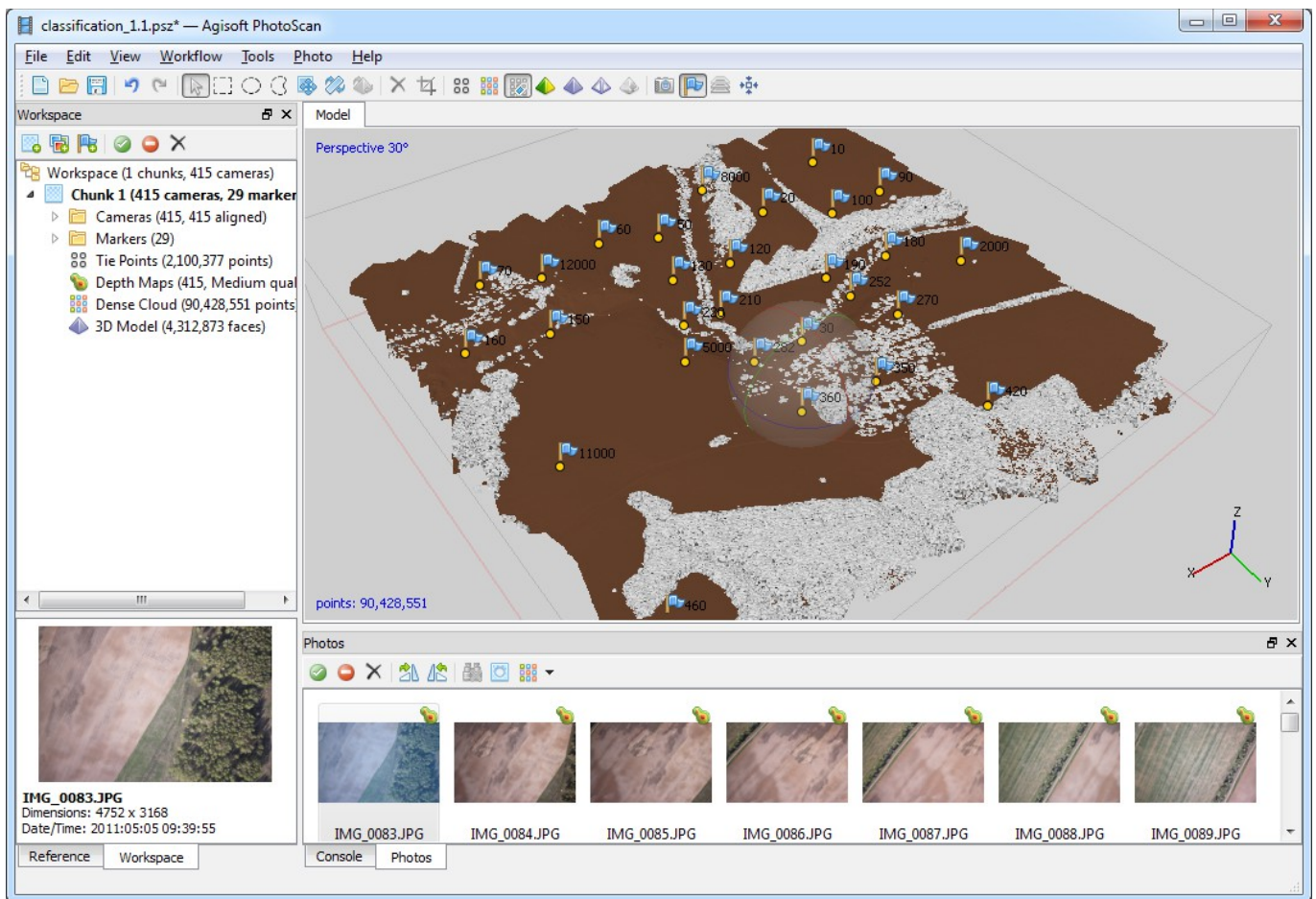
Determines one of the conditions to be checked while testing a point as a ground one, i.e. sets limitation for a distance between the point in question and terrain model. In fact, this parameter determines the assumption for the maximum variation of the ground elevation at a time.

## Cell size (m)

Determines the size of the cells for point cloud to be divided into as a preparatory step in ground points classification procedure. *Cell size* should be indicated with respect to the size of the largest area within the scene that does not contain any ground points, e. g. building or close forest.

In case the result of automatic dense cloud classification is not acceptable the procedure can be re-run using adjusted parameters (for example, if some on-ground objects like stones and small bushes were classified as ground points it is reasonable to reduce *Max angle* and *Max distance* parameter values).






**Note:** It is important to reset the assigned classes for the dense cloud prior to starting the procedure again with the new set of parameters. To reset classification results choose *Reset Classification* option in *Tools* → *Dense Cloud* menu and then select point classes you wish to be discarded.



Ground points will be colored with brown color, low-points (noise) class points will be colored by pink and unclassified points will remain white.

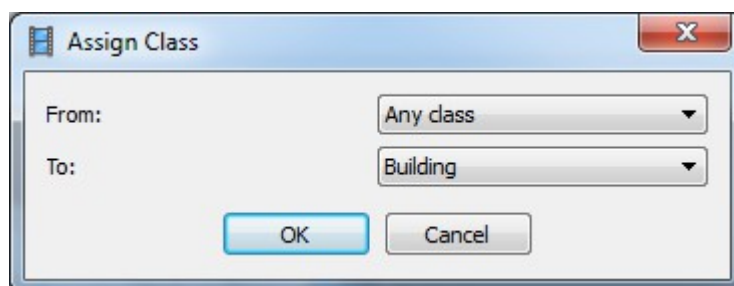
## Classify Points Manually

Dense cloud points may be classified manually, also the same workflow allows to reset the classification results for the dense cloud points of the certain areas.

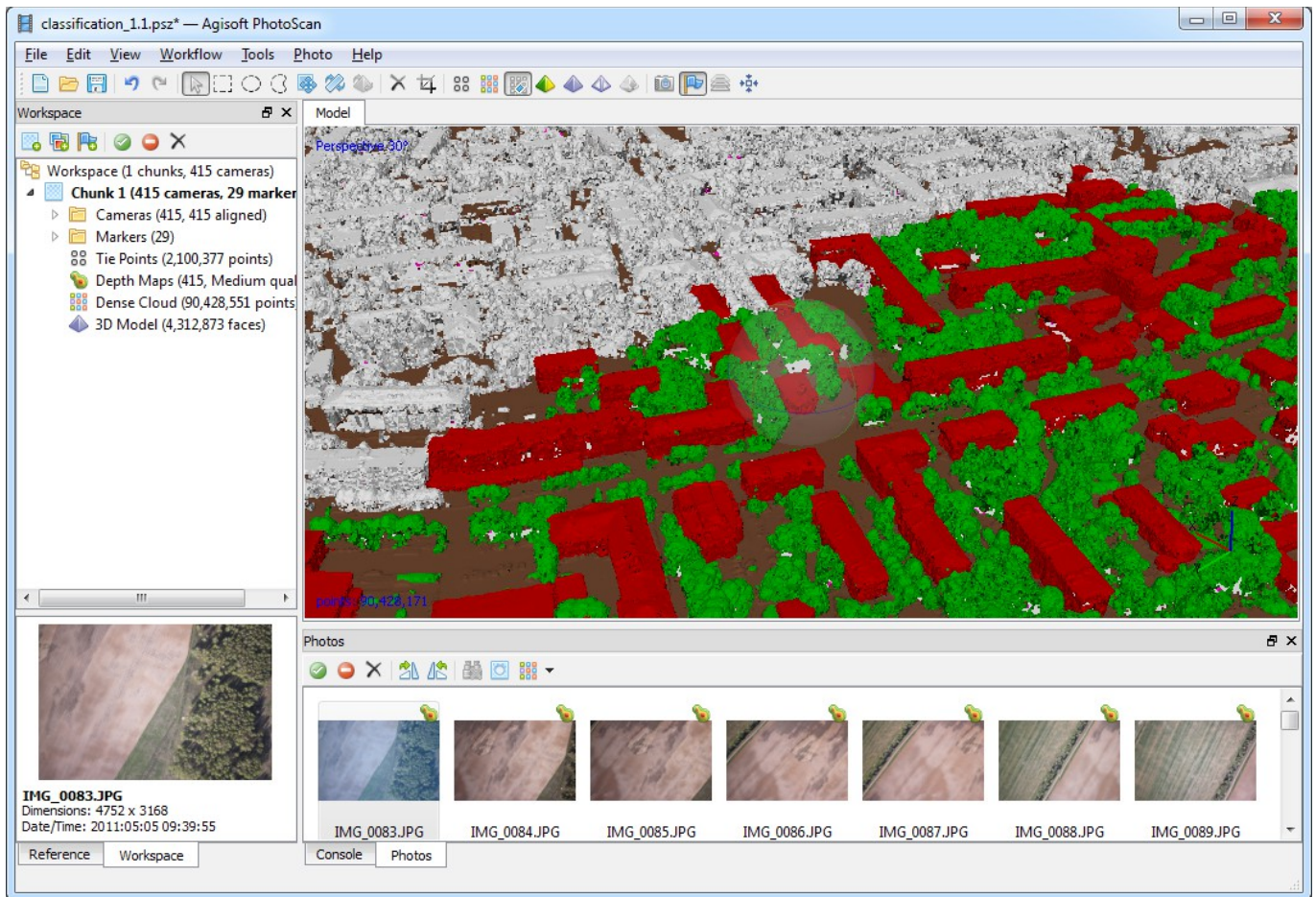
Switch to the  *Dense Cloud* or  *Dense Cloud Classes* view mode using the corresponding buttons located on the Toolbar. Then select points in the *Model* view to be placed to a certain class using  *Rectangle Selection*,  *Circle Selection* or  *Free-Form Selection* tools.

To add new points to the current selection hold the Ctrl key during selection of additional points. To remove some points from the current selection hold the Shift key during selection of points to be removed.

When all the points to be assigned to any class are in selection, choose *Assign Class...* command from the *Tools* menu:



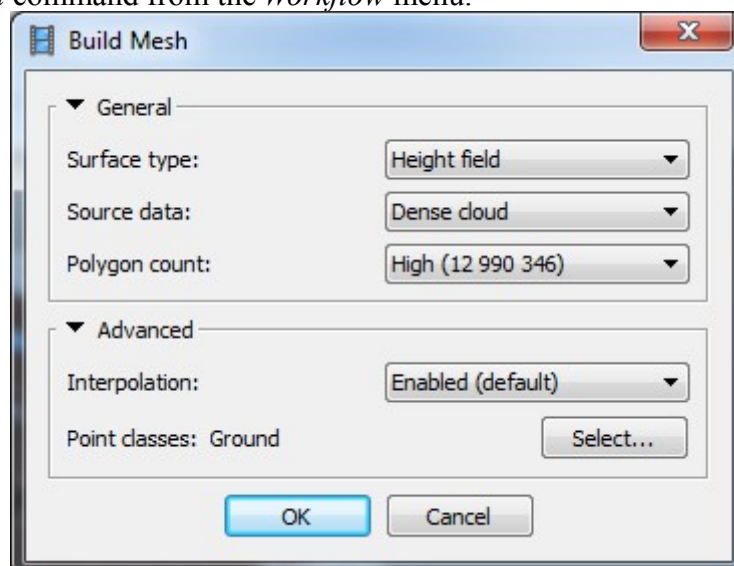
In the *Assign Class* dialog specify source and destination class points. If you need to reset the classification results for selected points, choose *Any Class* in *From* field and *Created (never classified)* in *To* field.



## Build Mesh

New when the dense point cloud has been generated it is possible to generate polygonal mesh model based on the certain point classes. To produce Digital Terrain Model (DTM) on ground point class should be used for mesh reconstruction.

Select *Build Mesh* command from the *Workflow* menu.



Set the following recommended values for the parameters in the *Build Mesh* dialog:

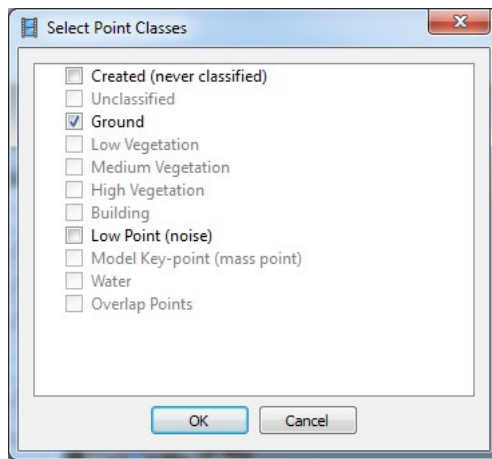
**Surface type:** *Height Field*

**Source data:** *Dense cloud*

**Polygon count:** *High* (maximum number of faces in the resulting model)

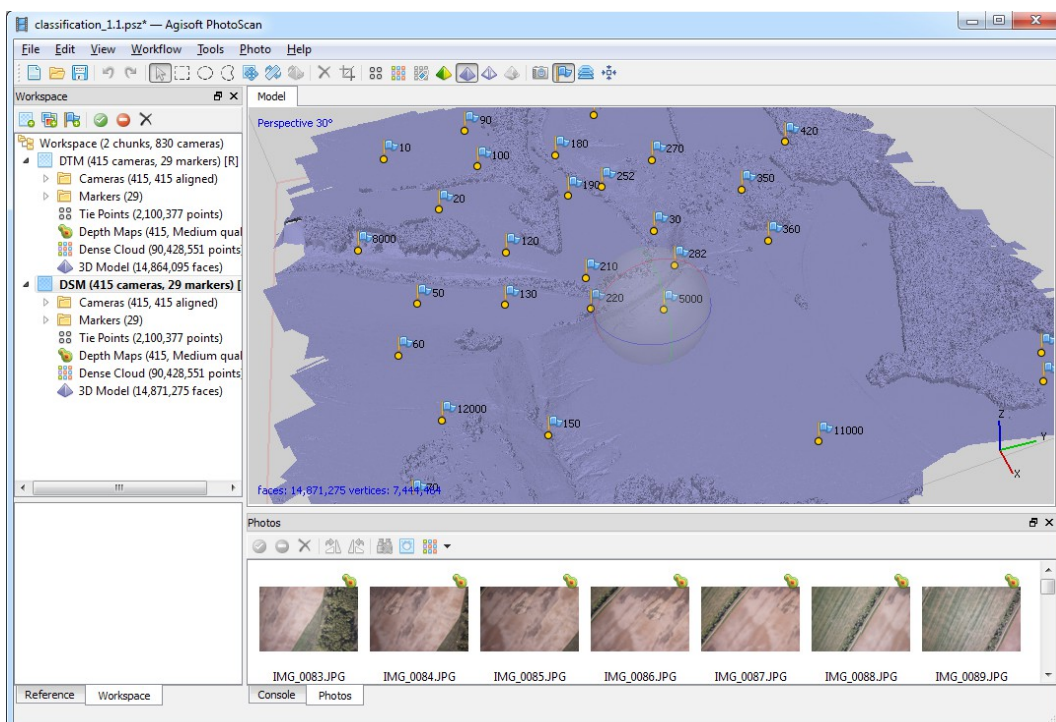
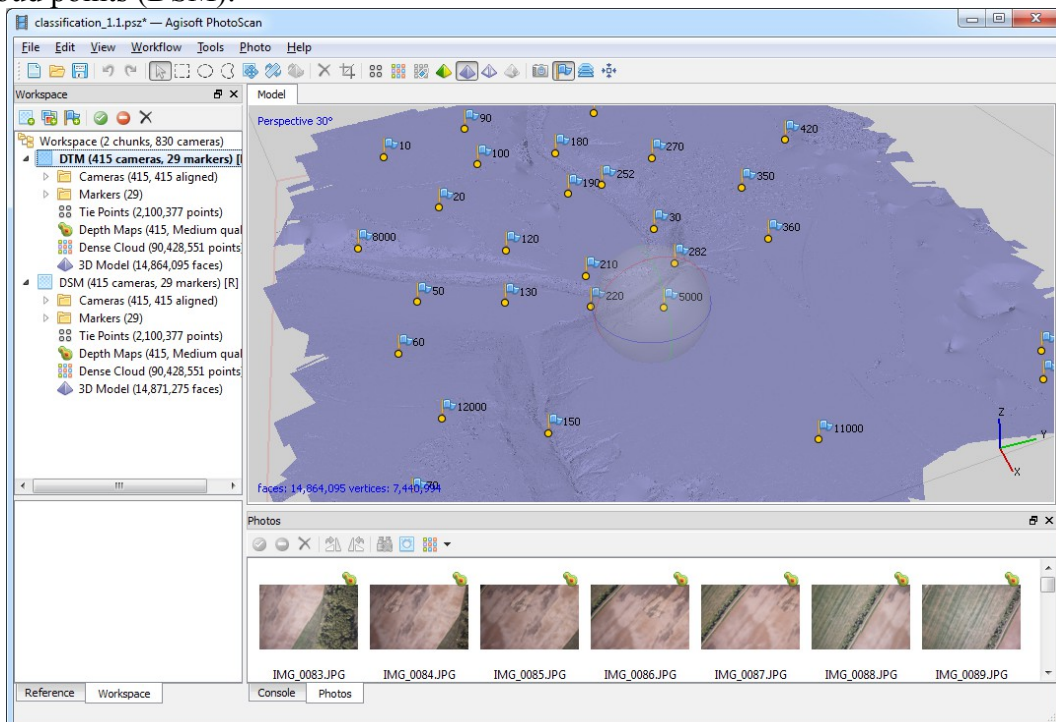
**Interpolation:** *Enabled*

**Point classes:** *Ground* (use *Select...* button to choose the point classes to be used for mesh generation):



Uncheck all classes except *Ground* class only and click *OK* button to start building geometry.

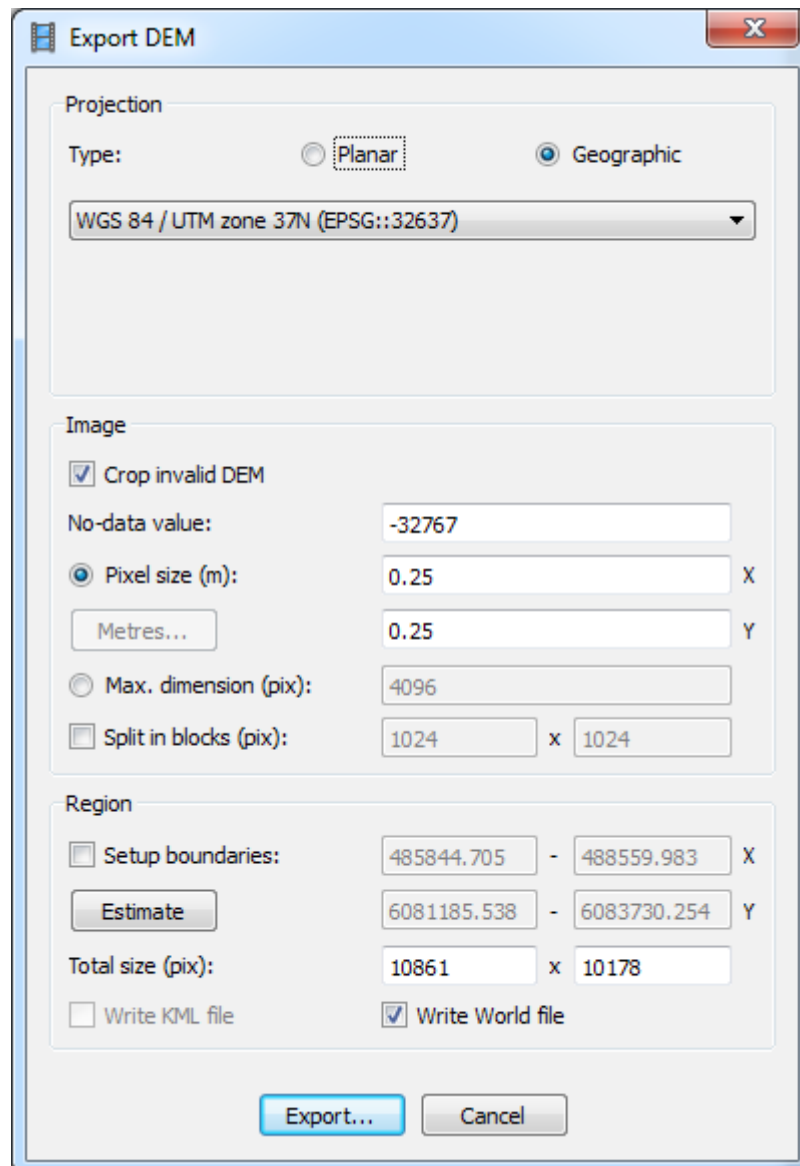
Here are results of mesh generation based on *Ground* point class only (DTM) and based on all the dense cloud points (DSM):



# Export DEM

After the polygonal model reconstruction to export DTM use the standard export instruments.

Select *Export DEM* → Export GeoTIFF/BIL/XYZ command from *File* menu.



Set the following recommended values for the parameters in the *Export DEM* dialog:

**Projection type:** *Geographic*,

**Projection:** by default the projection specified in the *Reference* pane settings dialog is used,

**Crop invalid DEM:** check this option to crop the regions with unreliable elevation data, since they are visible on less than two source photos,

**Pixel size:** you can increase the effective resolution compared to the default value,

**Split in blocks:** *10000 x 10000* (if the exported area is large it is recommended to enable *Split in blocks* feature, since the memory consumption is rather high at exporting stage),

**Region:** set the boundaries of the model's part that should be presented as DEM.

Click *Export...* button and then specify target file name and select type of the exported file (e.g. GeoTIFF). Click *Save* button to start DEM generation.