



Menci Software - APS - Copyright © 2016

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# INDICE

Automatic photogrammetric processing station.....	3
Main features.....	3
Main view.....	4
Main Buttons.....	4
<b>TOOLBAR</b> .....	6
Main Toolbar.....	6
CAD Toolbar.....	7
Orthophoto Toolbar.....	8
<b>CREATE A NEW PROJECT</b> .....	9
<b>GCP</b> .....	14
<b>AOI - Area Of Interest</b> .....	17
<b>RADIOMETRIC BALANCING</b> .....	18
<b>DSM &amp; Point Cloud</b> .....	19
<b>MESH</b> .....	22
<b>DTM</b> .....	23
<b>CONTOUR LINES</b> .....	24
<b>SEAMLINES</b> .....	25
<b>ORTHOPHOTO</b> .....	28
<b>TRUE ORTHOPHOTO</b> .....	30
<b>GLOSSARY</b> .....	31
<b>APS WORKFLOW</b> .....	32



## **Automatic photogrammetric processing station**

APS is the powerful and widely tested photogrammetry software suite for massive and accurate UAV data processing.

APS meets all skill-level users by several interaction steps up to the full automatic process. It runs on your desktop computer or laptop and processes small and medium format aerial imagery to 2D maps and 3D models with centimetric accuracy.

## **Main features**

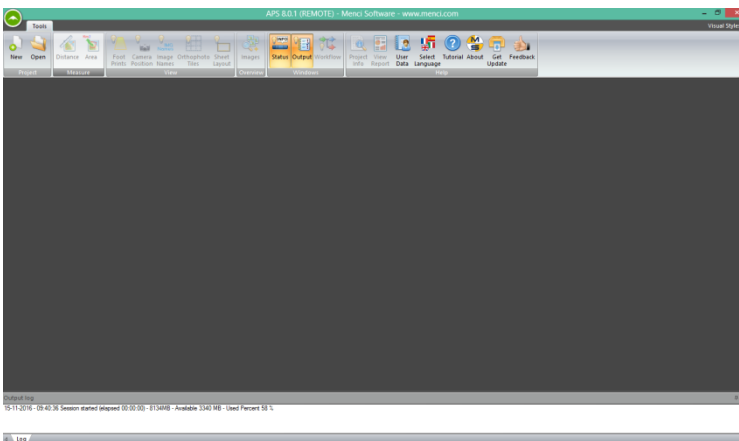
- Import images from any Drone/UAV (TIF, JPG)
- Import of GPS data expressed in different formats
- Selectable camera mounting
- Different Bundle strategies
- GCP Import, collimation and visualization
- Radiometric color balancing
- Automatic DSM generation
- Contour lines generation
- Textured Mesh automatic generation
- DTM ground automatic filtering on preset scenario
- Seamlines generation and editing
- Orthomosaic generation
- 3D point cloud generation and view
- All common CAD edit commands
- Orthophoto & True Orthophoto generation
- Lever Arm Management
- Graphical Report

## Main View

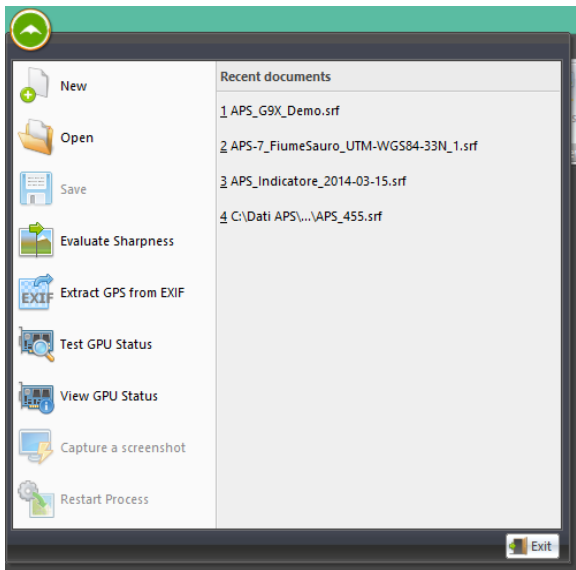
When the software starts the following bar will be opened.

The main view is divided in three part:

1. Toolbar, from which you can access some features classified into some tabs ("Tools", "CAD", etc).;
2. Main window;
3. Log output, where status messages are displayed while processes get developed.



## Main Buttons



APS main button gives you access to some extra features and shows you recently opened projects

At this level you can press "New" or "Open" an existing project.

Evaluate Sharpness is a tool that automatically highlights images with poor sharpness. It is useful to check huge datasets and to find blurred or "windy" images.

Sharpness tool returns a numeric value related to image sharpness in a 0-255 range. That rating is objective, so it could be assigned to each image and doesn't depend by current image set.

The poor/good cut-off point isn't absolute, because every image dataset has its own features, coming from light, wind and subject conditions.

This tool help you to easily find inside a big number of images which are more blurred than others, but you still need to evaluate if they can be excluded from next process.

For example you can exclude a blurred image one if the overlap allows you to cover its area with other shaper images.

Or you may choice to keep it in the process if the global sharpness is poor.

Test GPU status applies the GPU test to your graphic card. If your adapter support GPU for APS computation, GPU options will be enabled. The test is automatically done at APS first start.

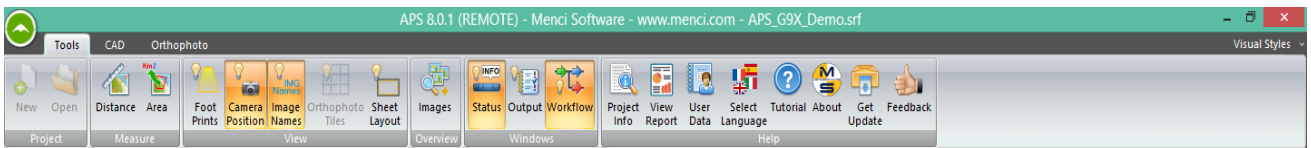
View GPU Status shows the latest GPU test results.

Capture screenshot takes a screenshot of your current view and put it in a project subfolder called "screenshots".

Restart process is usefull when the Bundle orientation process was interrupted for any reason. In that case you can restart the aerial triangulation bundle process recovering from last valid step.

# Toolbar

This is the main toolbar:

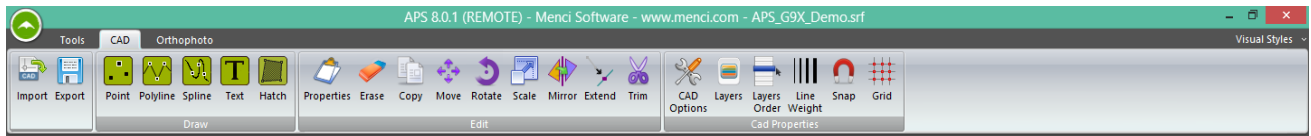


Through this bar you can open and create a new project, display or hide some generic layers and windows or get information about APS.

TIP: please fill the "User Data" form with your data: it will be useful to identify the reports you send to Menci Software if a problem occurs.

A screenshot of the 'Dati Utente' (User Data) form. The window title is 'Dati Utente - www.menci.com'. The form contains a message: 'Per favore completa questa scheda. Questi dati saranno salvati nel tuo PC e verranno usati per completare qualunque report invierai a Menci Software.' Below the message are five input fields: 'Nome (\*)', 'Cognome (\*)', 'Email (\*)', 'Azienda', and 'Telefono'. The 'Nome' field contains 'b', 'Cognome' contains 'c', and 'Email' contains 'c'. There is a small icon of a person next to the 'Nome' field. At the bottom of the form, there is a 'Storico Crash' button, a green checkmark icon, and 'OK' and 'Cancel' buttons. A note '(\*) necessari' is located below the 'Telefono' field.

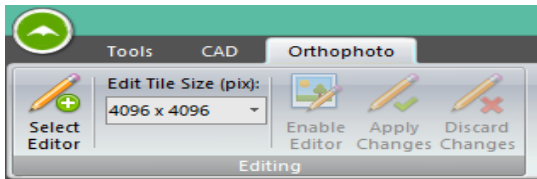
# CAD Toolbar



In the CAD section there are following commands:

- Import (import a DWG CAD drawing)
- Export (export current drawing to DWG / DXF)
- Draw a Point
- Draw a Polyline
- Draw a Spline
- Insert a Text
- Fill a closed polygon with Hatch
- Call current entity Properties
- Erase selected entities
- Copy selected entities
- Move selected entities
- Rotate selected entities
- Scale selected entities
- Mirror selected entities
- Extend current line up to entity
- Trim current line
- Select CAD Options
- Manage layers
- Select layers order
- Line Weight
- Toggle Object Snap
- Toggle CAD Grid

## ORTHOPHOTO Toolbar



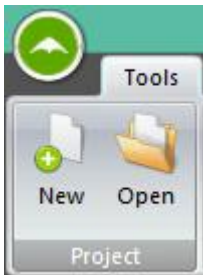
In the Orthophoto section there are the following commands:

- Select Editor: select your favorite external raster editor (e.g. Photoshop or GIMP). Here you need to select the executable path.
- Edit Tile Size (pixel): the size in pixel of edited tile.
- Enable Editor: enable or disable the editor opening when you click on orthophoto.
- Apply or Discard changes

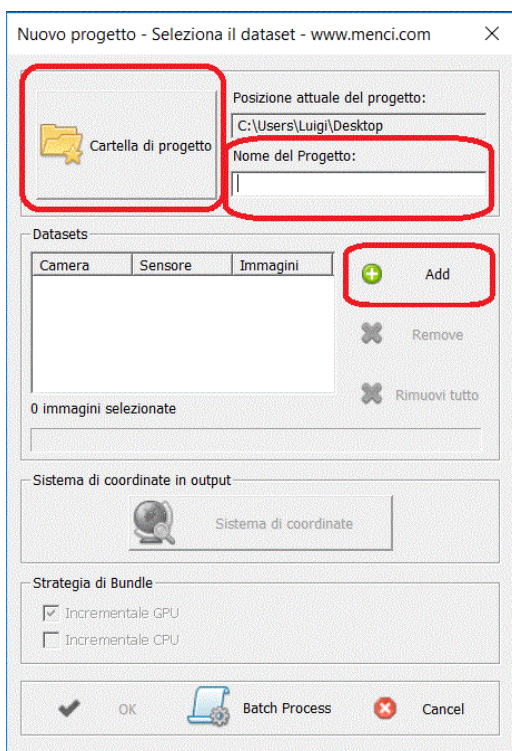


## CREATE A NEW PROJECT

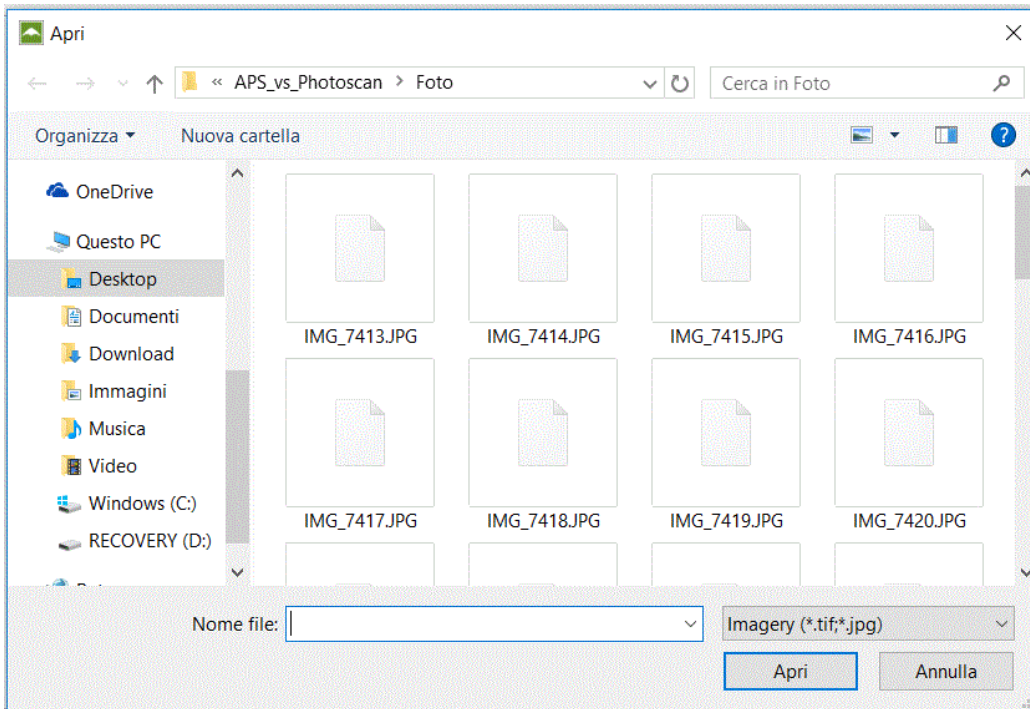
To create a new project , select "New" in the drop-down menu.



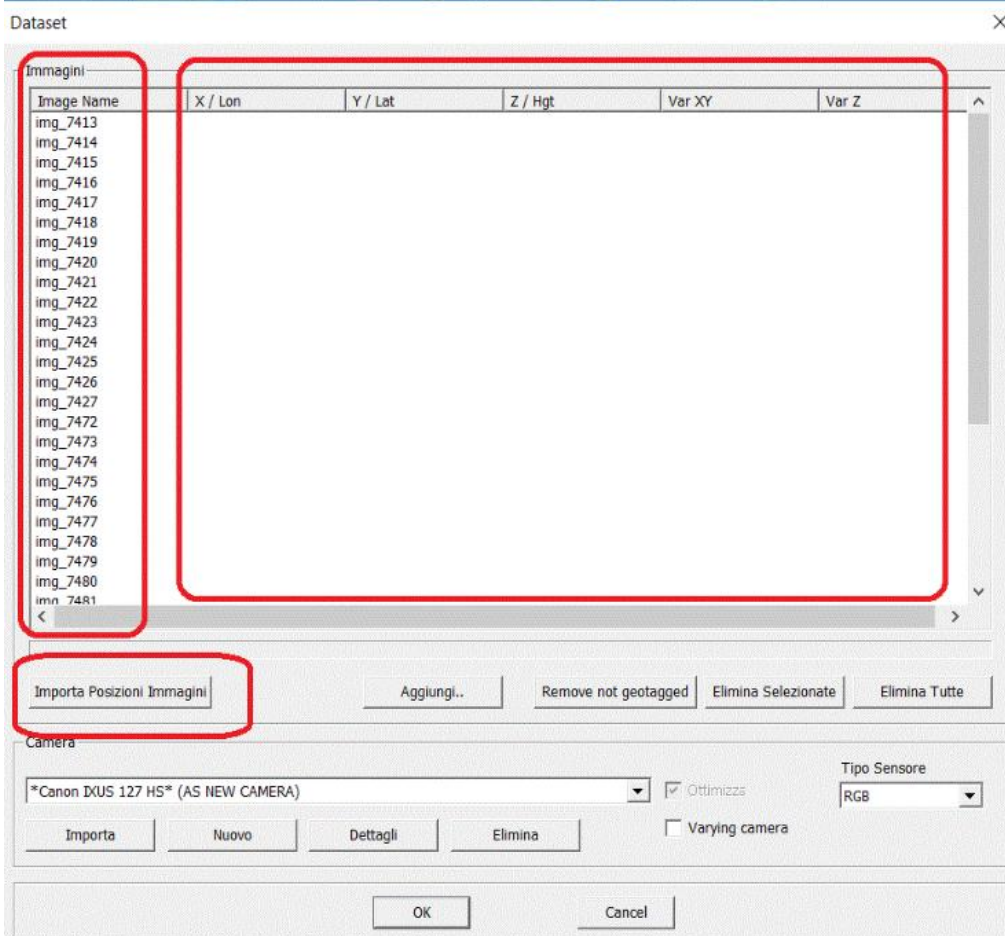
The following window opens:



Select the project name and add images.  
Browse your files and select correct ones.



Once added, images are listed in the left side of the window.



If the images aren't already geotagged, import camera positions file.

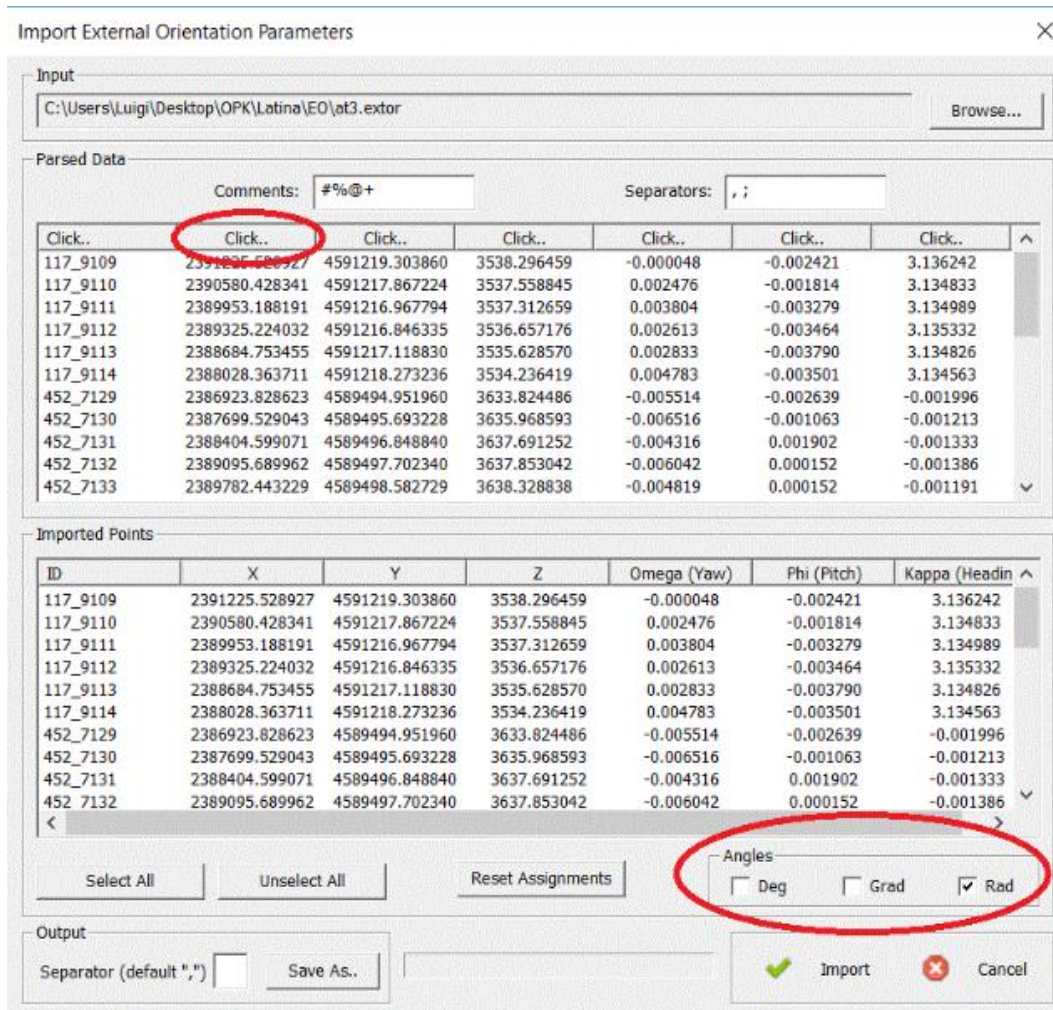
Here you can change the comments and separators to specify the format of your file.

Moreover you can assign the table headers values by clicking on a specific column.

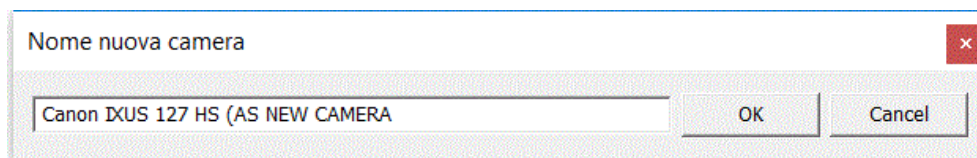
You can also select the units of measurement of angles.

The standard format is:

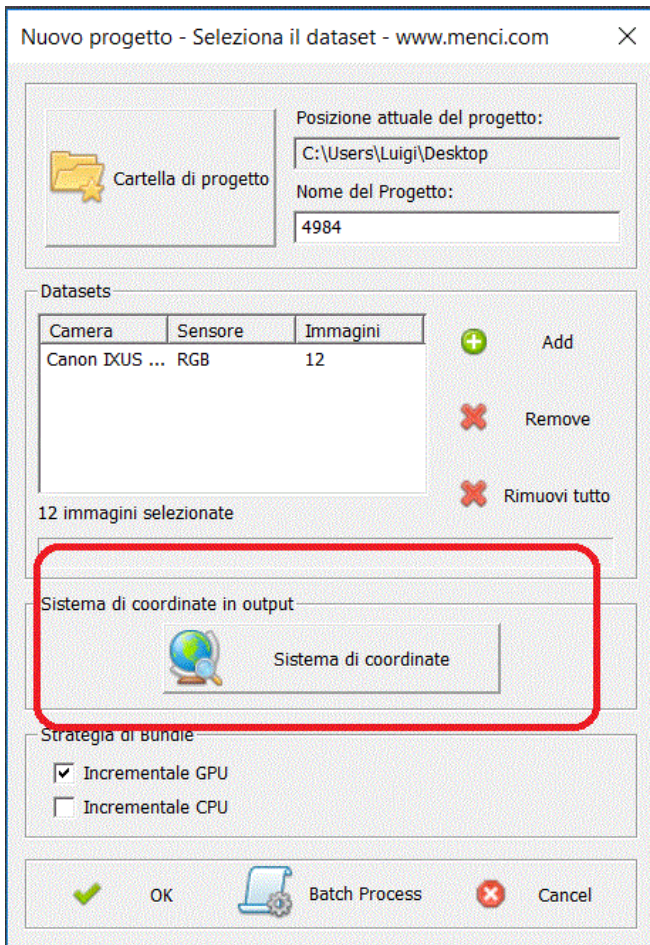
*ID | Latitude | Longitude | Height (amsl and wgs84) | Yaw | Pitch | Roll.*



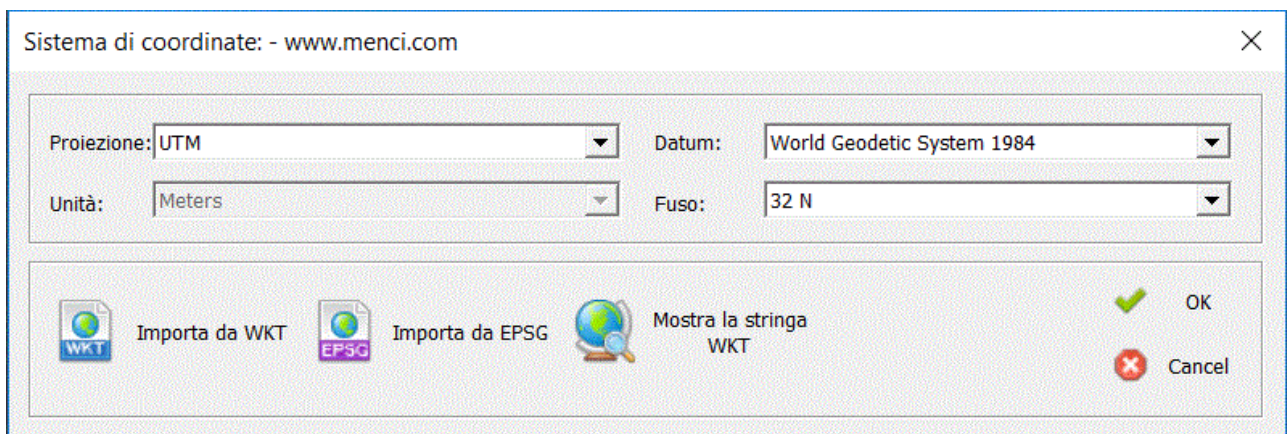
After you can name the camera and click "Ok".



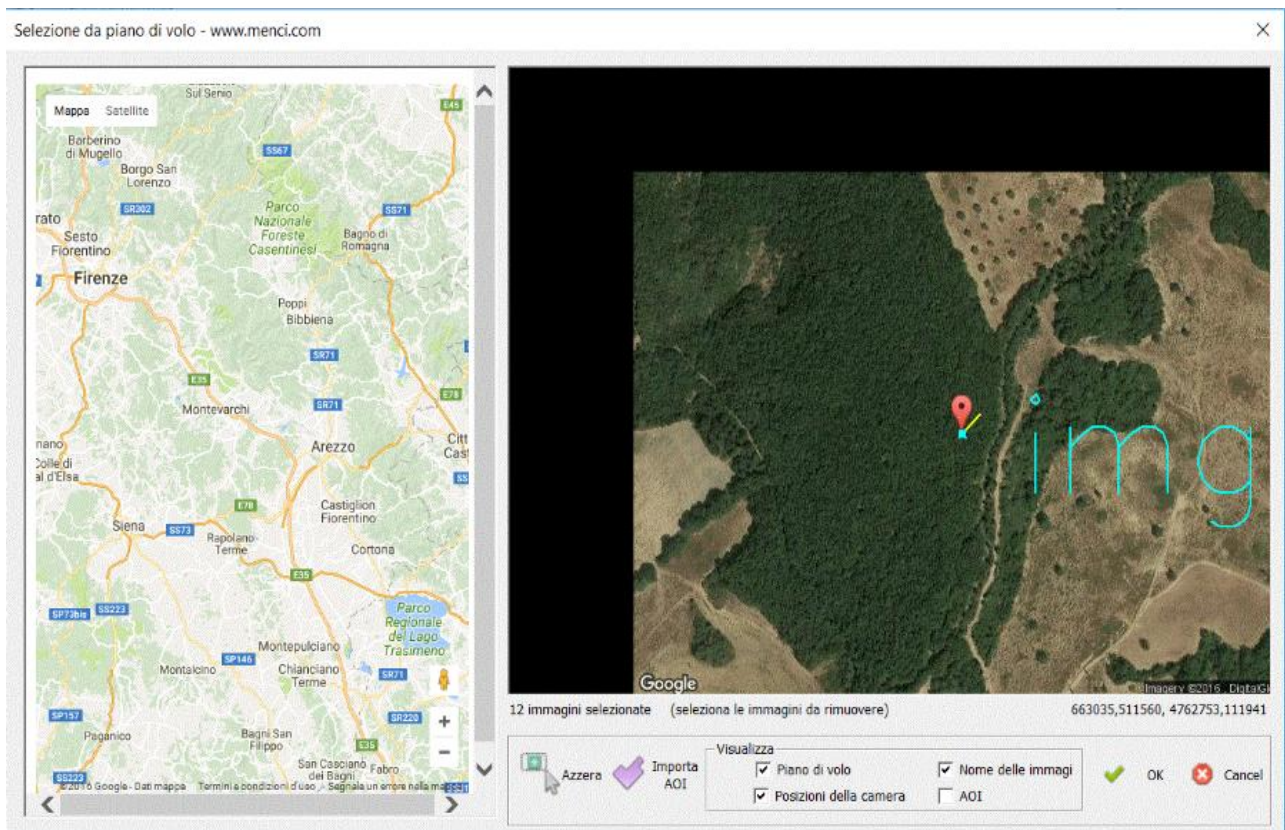
The following window automatically opens.



Now you can set coordinates system and then click OK.



The following window shows an overview of the area.



Click Ok.

The bundle automatically runs.

# GCP

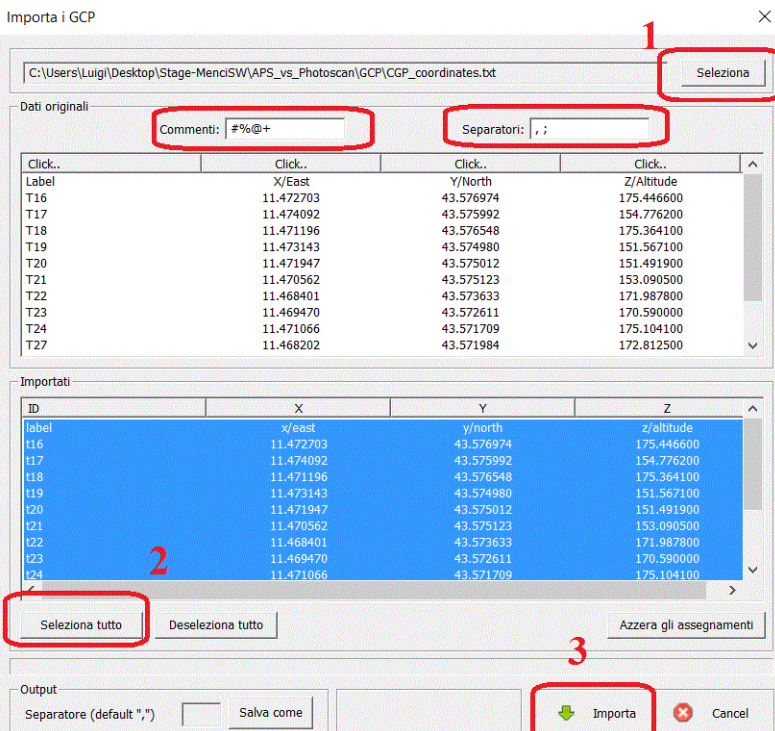
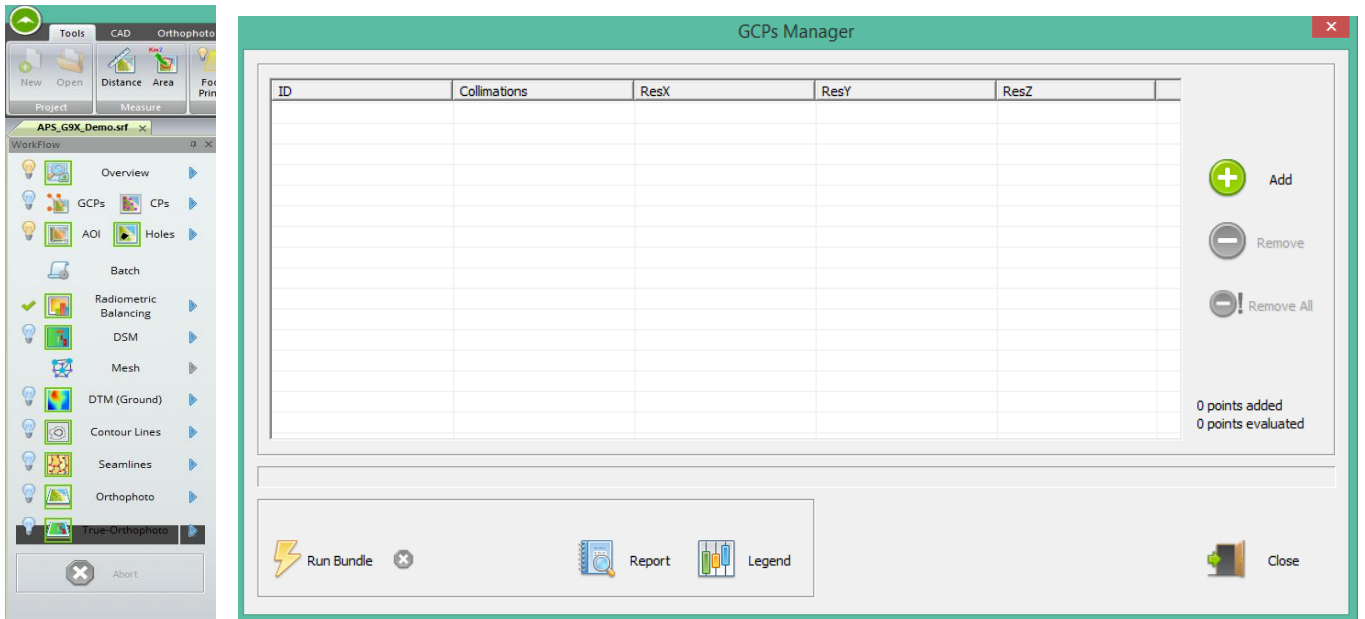
Optionally you can insert and collimate Ground Control Points and Check Points. Points must be on the **same coordinate system** of GPS data.

GCPs are used to refine the bundle orientation and CPs to verify results.

Their management (import, collimation and use) is the same.

Any modify to GCPs should be done before any next data extraction because their contribution affects the whole project development.

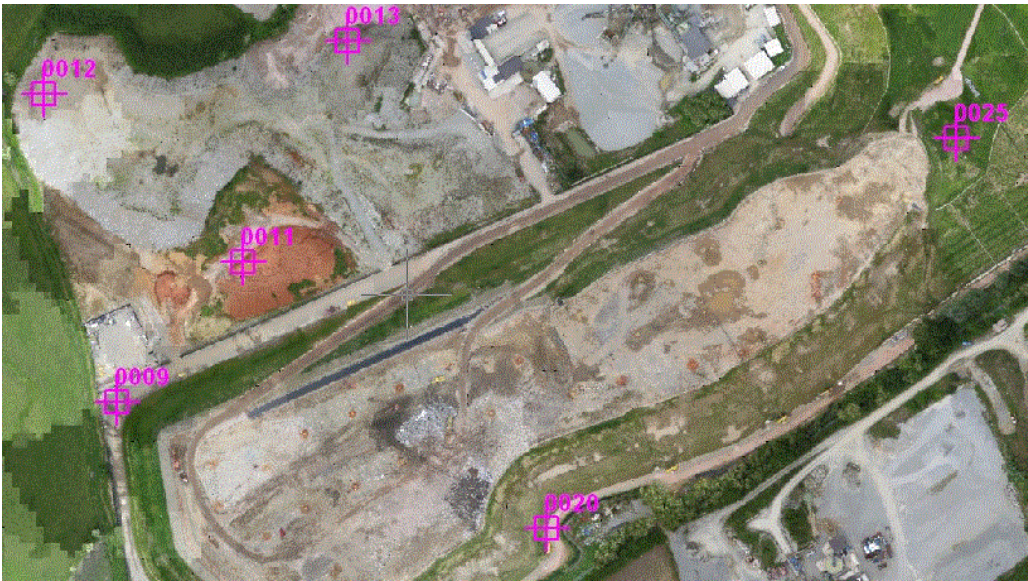
By clicking the GCP button you will open the GCPs manager window.



To add a new list of points click on the add button then through the browse command you can upload the list of your GCPs.

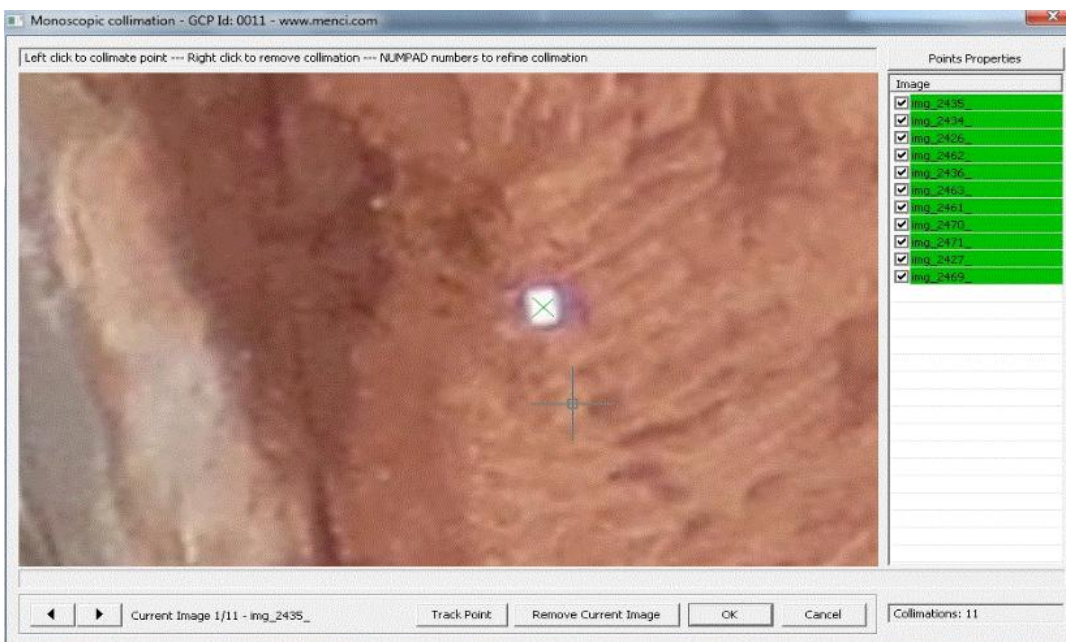
This list will be shown in the GCPs manager window. Every point must have its informations listed in the following format: id/longitude/latitude/height.

Once you have imported the final list of your points, close the dialog to view the GCPs overlaying the raster overview.



By clicking on each target you will be able to open the monoscopic collimation window. It shows all the images related to the selected point.

You have to collimate the point on each image it overlaps.



To collimate a point press left click (green cross), to remove collimation right click (yellow cross). Once you have collimated the point on the first image the software will track automatically it on each image where is overlapped.

The point is going to need a further check since it could not be well located. If you have collimated the first point erroneously the software will track that point.

To fix this mistake select again the correct point and then click on Track point button.

Verify this automatic transportation on each image in order to refine or exclude incorrect collimations.

Left-right arrows at the bottom of the window allow you to change current image.

To exclude an image from the collimation set remove the check from the related box, or click on "Remove current image" (it is a temporary exclusion only).

After all the points are collimated, click on "Evaluate" to start the external orientation refining.

The computation result will show for each point its residuals. Different colors highlight the point accuracy:

- Green: the accuracy point is high.
- Yellow: the accuracy point is medium
- Red: the accuracy point is low

ID	Collimations	ResX	ResY	ResZ	XY var	Z var
<input type="checkbox"/> 0014	13	0.000000	0.000000	0.000000	0.000000	0.000000
<input checked="" type="checkbox"/> 0025	8	-0.056650	0.010253	-0.168865	0.000000	0.000000
<input checked="" type="checkbox"/> 0009	15	0.011393	0.042593	-0.019928	0.000000	0.000000
<input checked="" type="checkbox"/> 0012	9	0.010748	0.051466	-0.204506	0.000000	0.000000
<input checked="" type="checkbox"/> 0013	8	-0.053928	0.039027	0.323007	0.000000	0.000000
<input checked="" type="checkbox"/> 0020	10	0.085800	-0.115898	0.088836	0.000000	0.000000
<input type="checkbox"/> 0011	11	0.000000	0.000000	0.000000	0.000000	0.000000

The accuracy depends on the flight altitude and it is usually related to the dimension of 2 pixels.

You can check these values through the "Legend" button.

Through the Legend button you can change the value related to the accuracy by typing new ones.

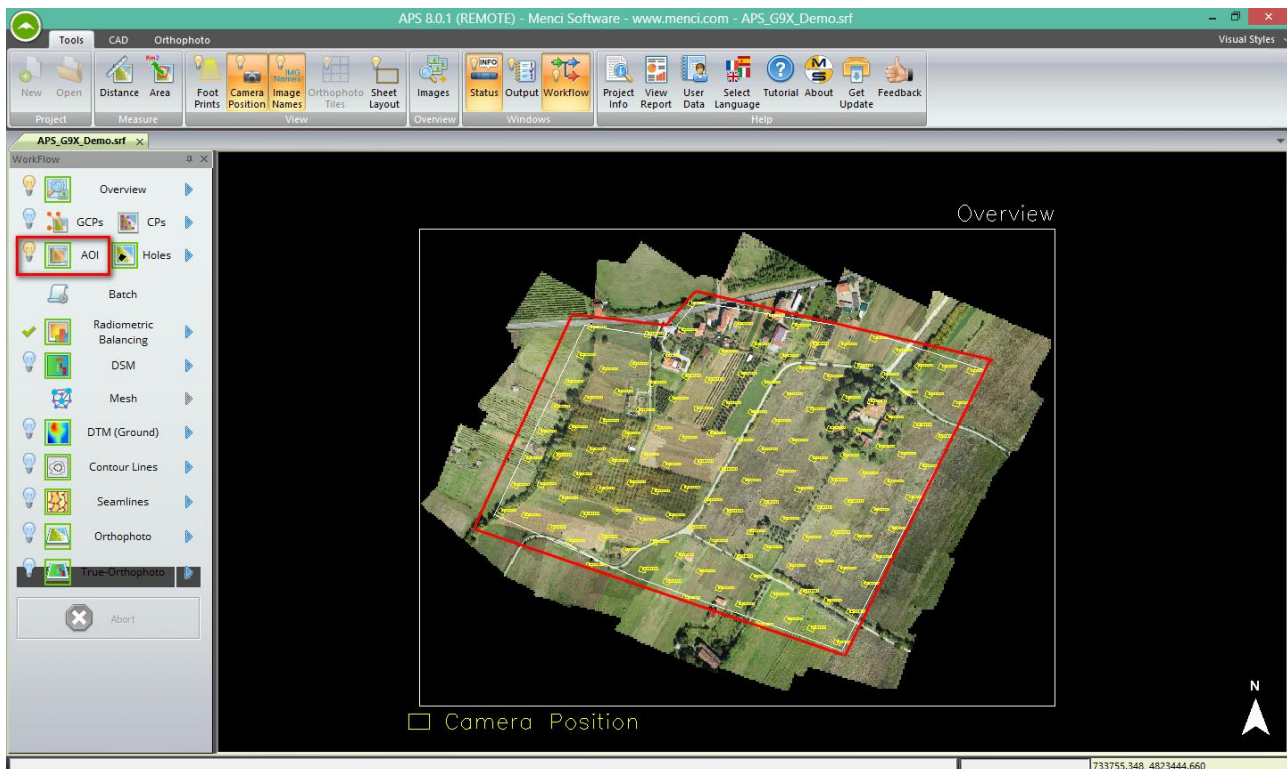


## Area Of Interest (AOI)

If you need to process a subpart of the total project area, you can draw an AOI (area of interest) on the raster overview.

NOTE: define a bounding AOI in order to surround the dataset and exclude poor quality border area.

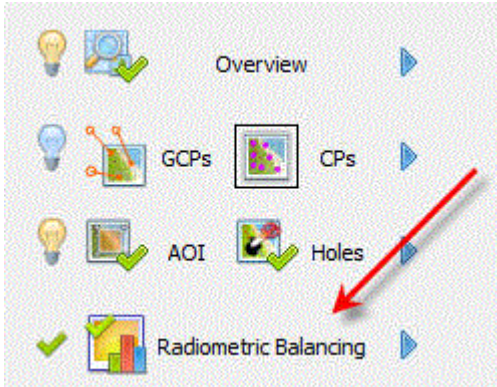
Normally you can consider an area just beyond the "drone" coverage area (see the sample).



To draw an AOI left click on the mouse, to close it, right click and select Close.

## Radiometric Balancing

APS supports the radiometric color balancing of point cloud and orthomosaic. If you want to apply that correction you need to click on related button and start the process.



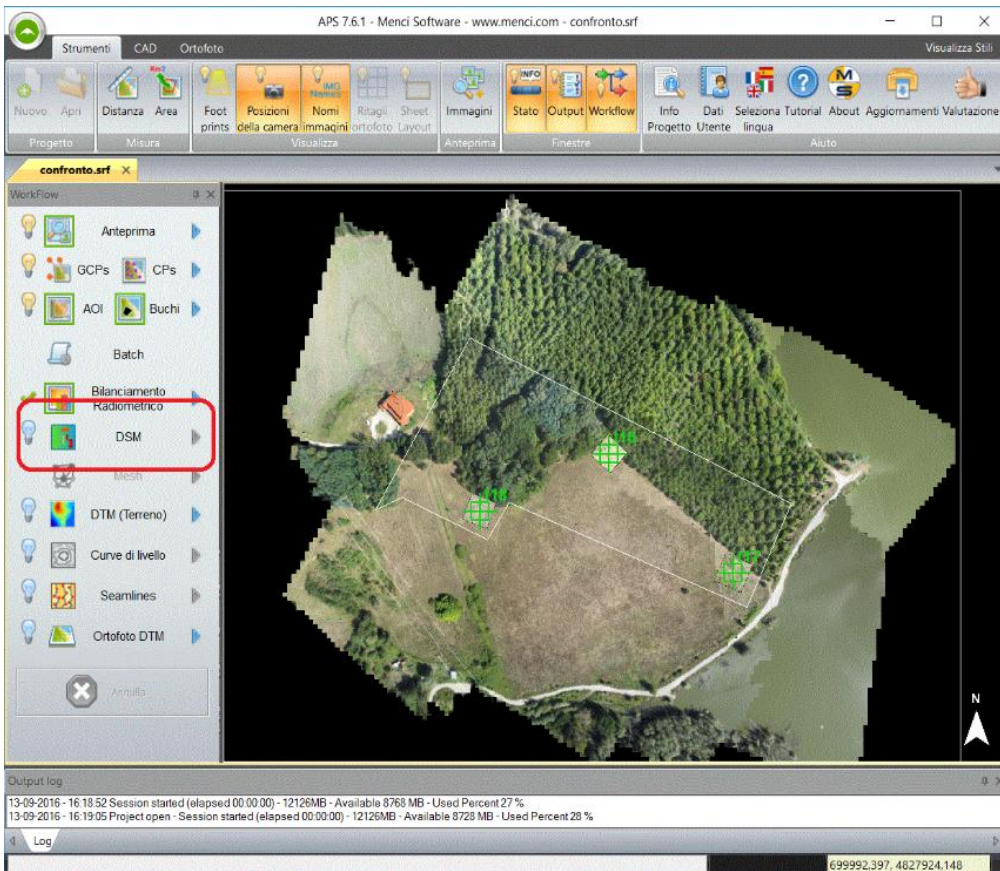
A different balance is computed for each sensor type. When the process is completed, a balanced low-res overview will be displayed.

You can switch between sensor type balances using the arrows at bottom.

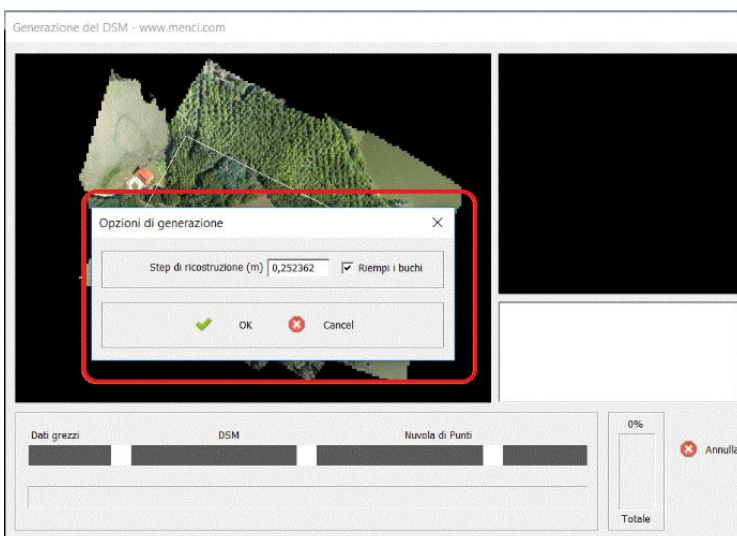


## DSM & Point cloud

DSM procedure builds the surface 3D model.



Before starting the process you need to input the DSM resolution step, expressed in meters. The default step is the optimal resolution value: any lower value produces an interpolated DSM. Anyway the default step can be rounded to the bigger integer in order to make the DSM resolution clear for human users.



By selecting "Fill DSM holes" any hole in the final result will be interpolated and filled.

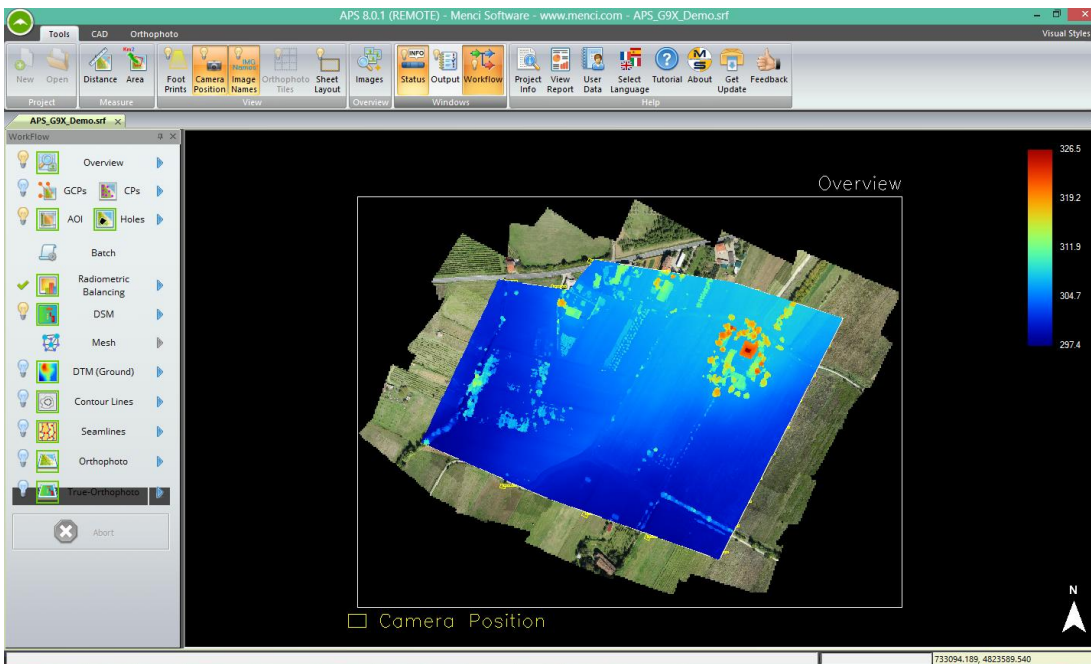
DSM extraction process consists in three automatic steps:

1. Raw data extraction
2. DSM filtering
3. Point Cloud generation.

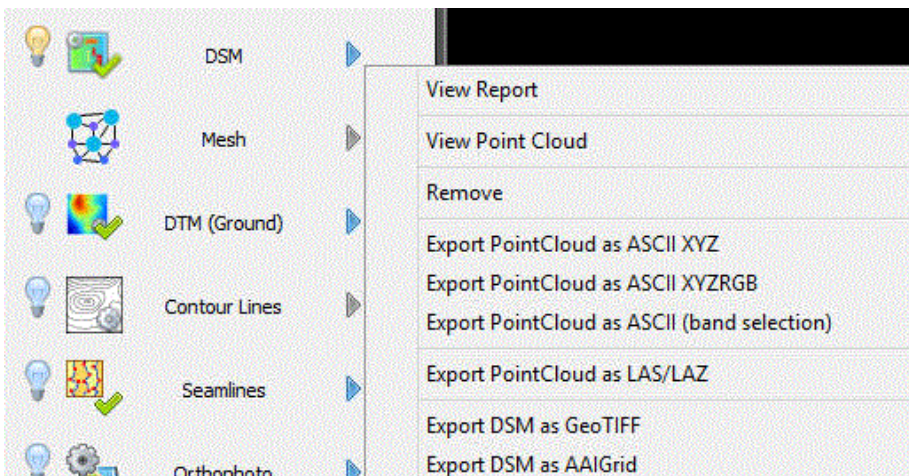
Once the process is finished APS asks if you want to see generated point cloud.

DSM 2D raster data displays elevations using a colorimetric scale.

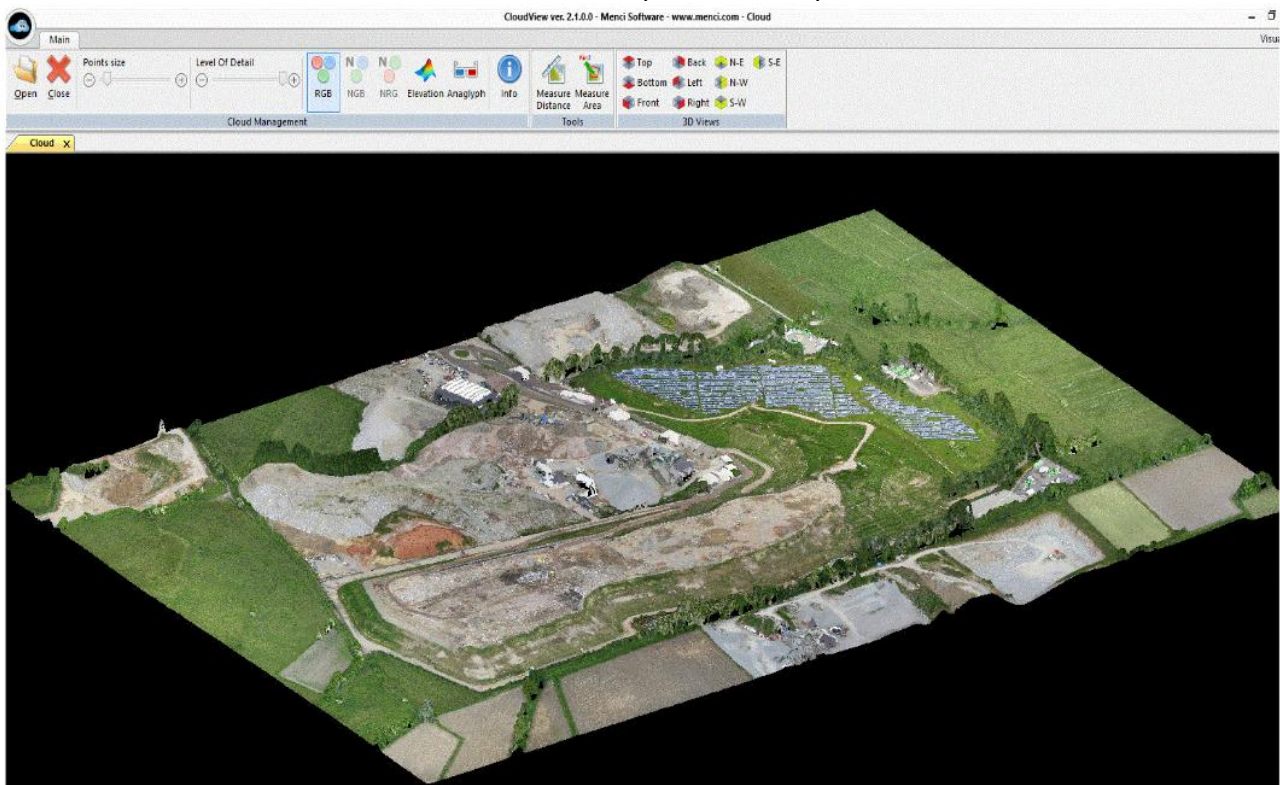
The relationships between colors and elevations will be shown on right side of CAD window.



To view 3D Point Cloud you have to click on "more" button and select "View Point Cloud".



The free cloud stream viewer CloudView will be opened in a separated window.

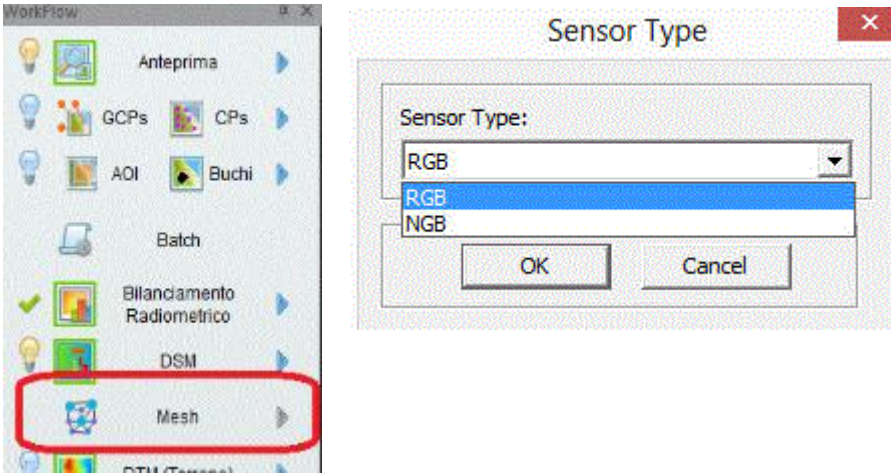


CloudView supports different cloud representations (for example if the cloud include NGB o NRG channels), predefined 3D views and basic measurements.

Generated point cloud (that one is stored inside project's "Grid" subfolder) includes all color bands coming from different sensor types of the project.

# MESH

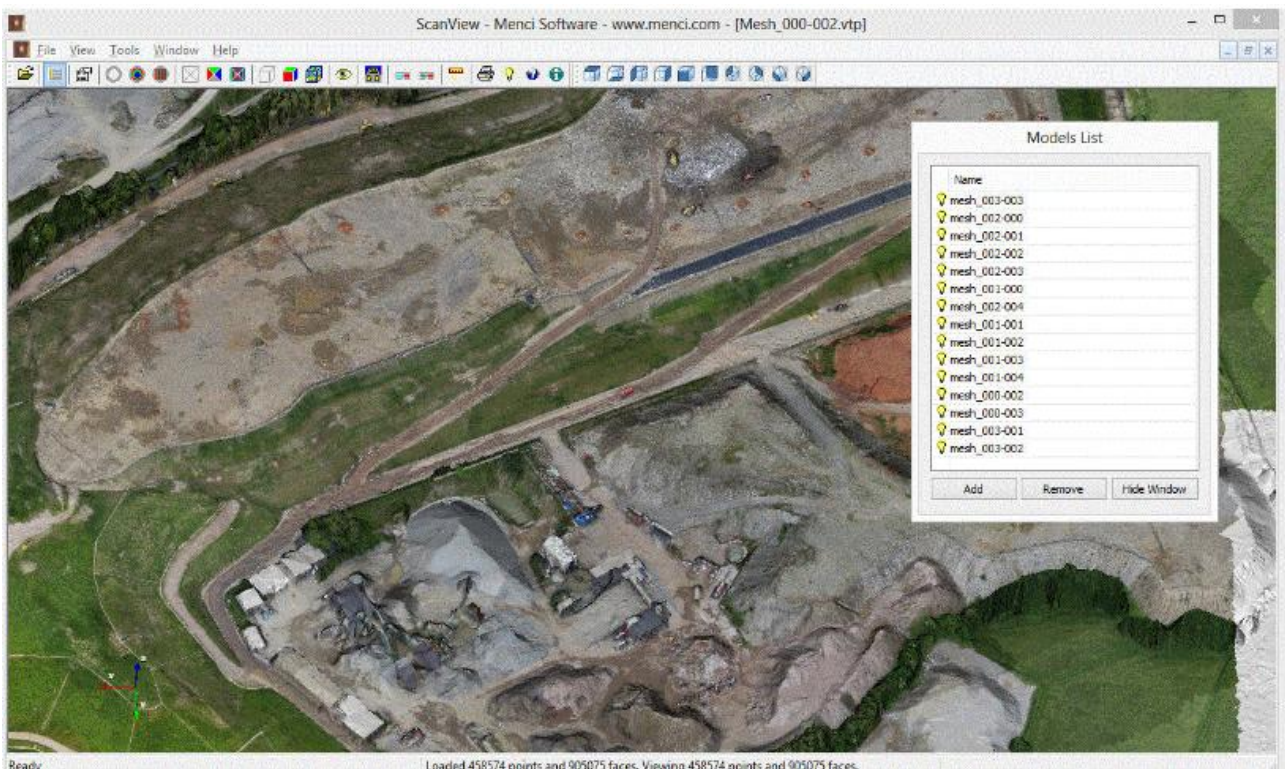
Once the DSM is available, APS can apply a triangulation to it and generate a mesh. You can add or not textures to meshed surface.



If you select textured mesh and more than a sensor is defined in the project, you have to select from which kind of sensor APS will extract raster data.

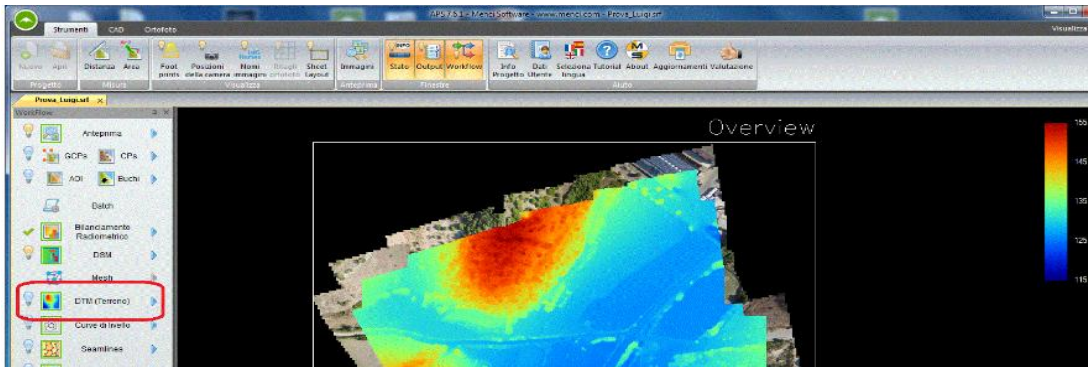
After process is finished, the result is visible inside ScanView free viewer (if you don't have it ask for free installation to Menci Software).

The mesh can be exported to common vtp, obj and ply file formats.

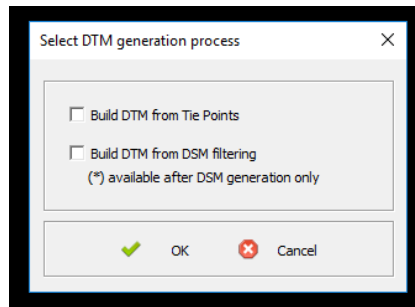


## DTM

Now you can extract the DTM by button DTM in the WorkFlow panel.



When you start the DTM command you can select which method apply.



Here you can choose between building DTM from Tie points or by filtering DSM.

If you choose "filtering DSM", you have to select the "scenario" that better fit your dataset AOI (country, suburban, urban and metopolitan).

The right scenario depends by density and size of over-ground object inside the AOI.

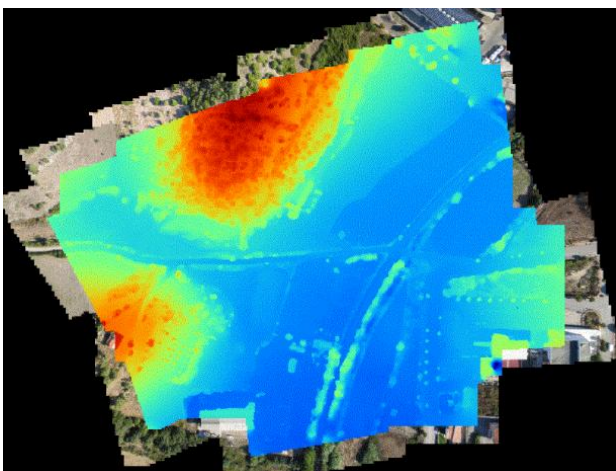
Another customizable parameter is the "curvature threshold", expressed in radians.

Curvature threshold means the limit under which slopes are considered "ground".

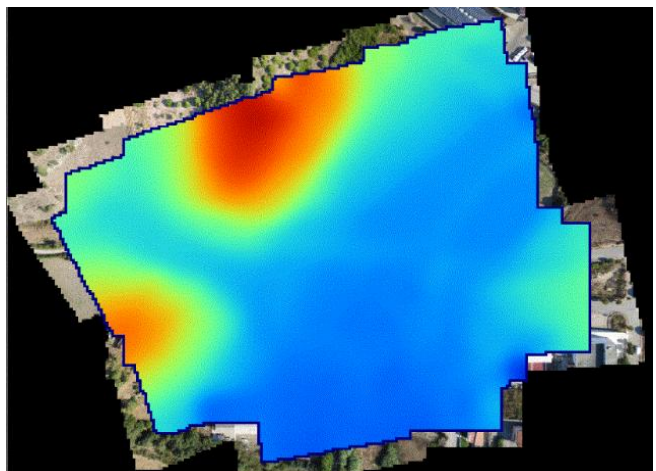
If a slope is bigger than the curvature threshold, the surface object that includes this slope is removed as over-ground (tree, building, etc.).

Combining the scenario with the curvature threshold you can refine the ground filtering.

DSM before.

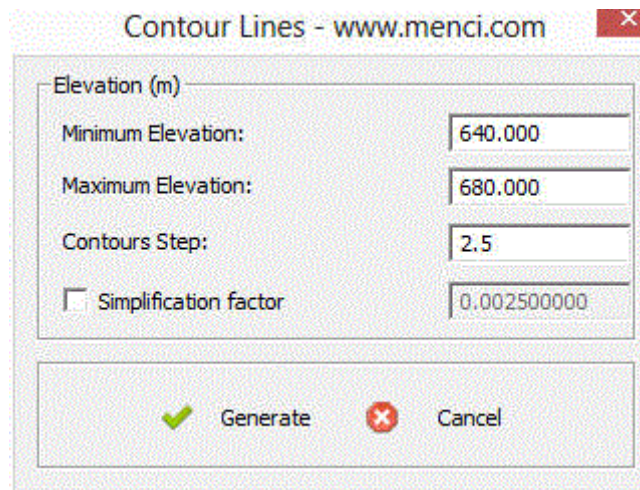


DTM after filtering.

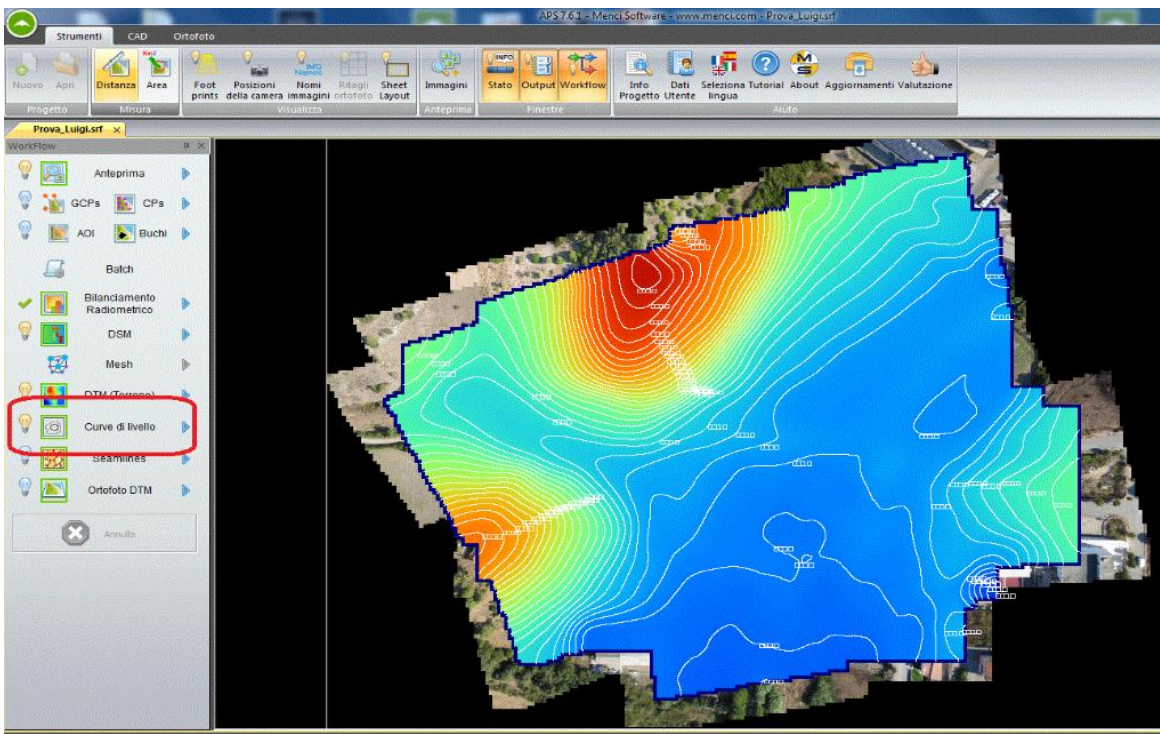


## CONTOUR LINES

Contour lines are based on ground data. When you click on contour lines button you have to select the minimum and maximum elevation approximated by lines and the elevation step between lines. The simplification factor is used to simplify output lines by discarding some vertices. Simplification value must be greater than zero and lower than the contour step. The default value is contour step / 1000.



After contour lines will be computed, they will be displayed on DTM.



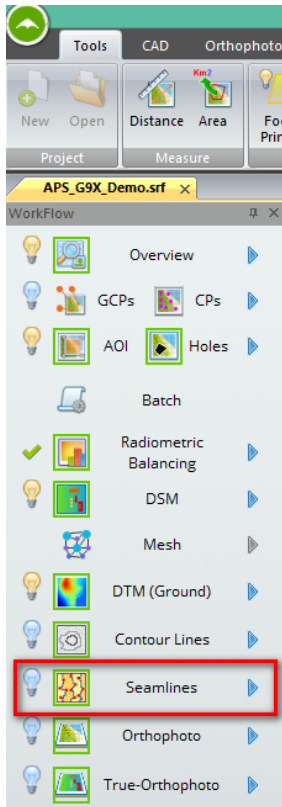


## SEAMLINES

APS allows the automatic generation of seamlines and their editing.

It is a very useful tool especially for the next orthophoto generation step, but it isn't strictly required:

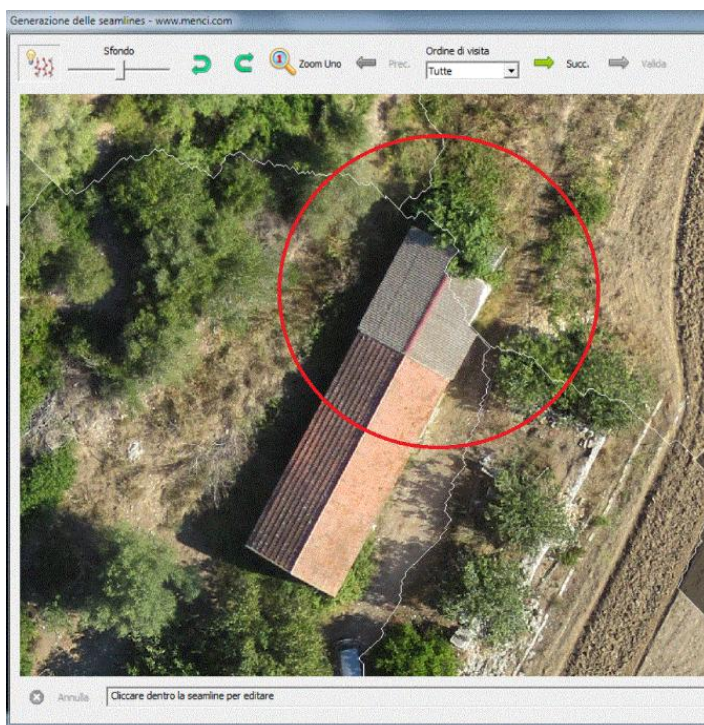
if you choose to not use editable seamlines, APS will extract and use approximated seamlines for internal purposes.

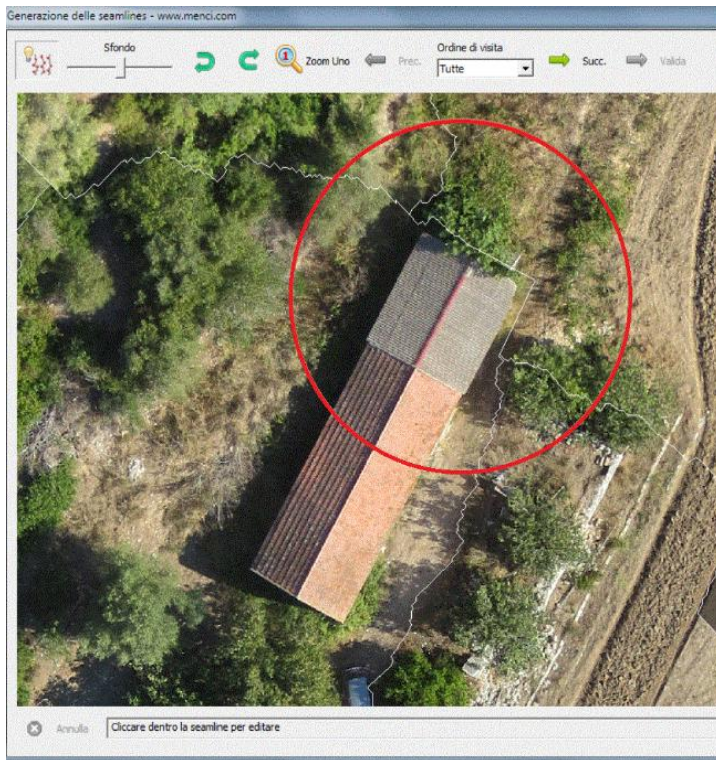


Once you click "Seamlines" button the software automatically starts with generation of seamlines, warping images on target area map.



Seamlines editing provide you a controlled result on orthomosaic generation. You are able to decide which part of every image composes the mosaic, by including in the same image all elements of given subject (for example building roofs). Click inside the seamline to edit. Click to draw an area and press right mouse button to apply changes.

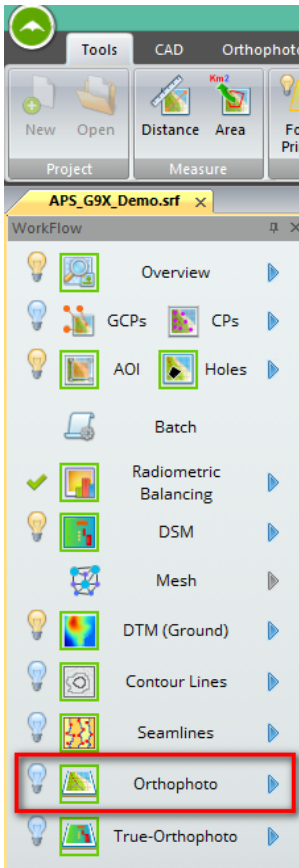




Validate editing of seamline by button "Validate All" that lead directly to the next seamline to edit.

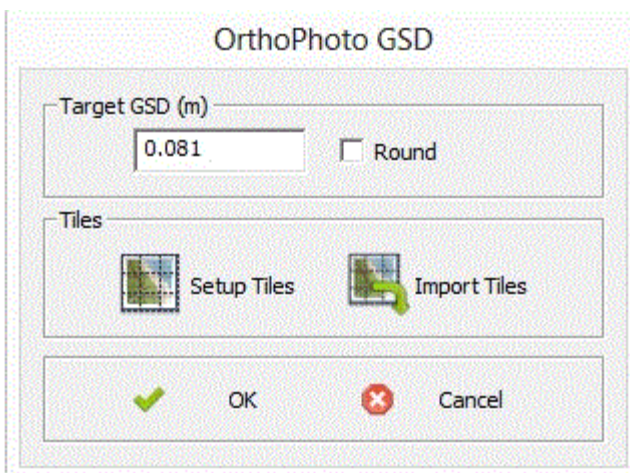
## ORTHOPHOTO

To build the orthomosaic you have to process DTM before. If DTM has not been generated APS will build it automatically.

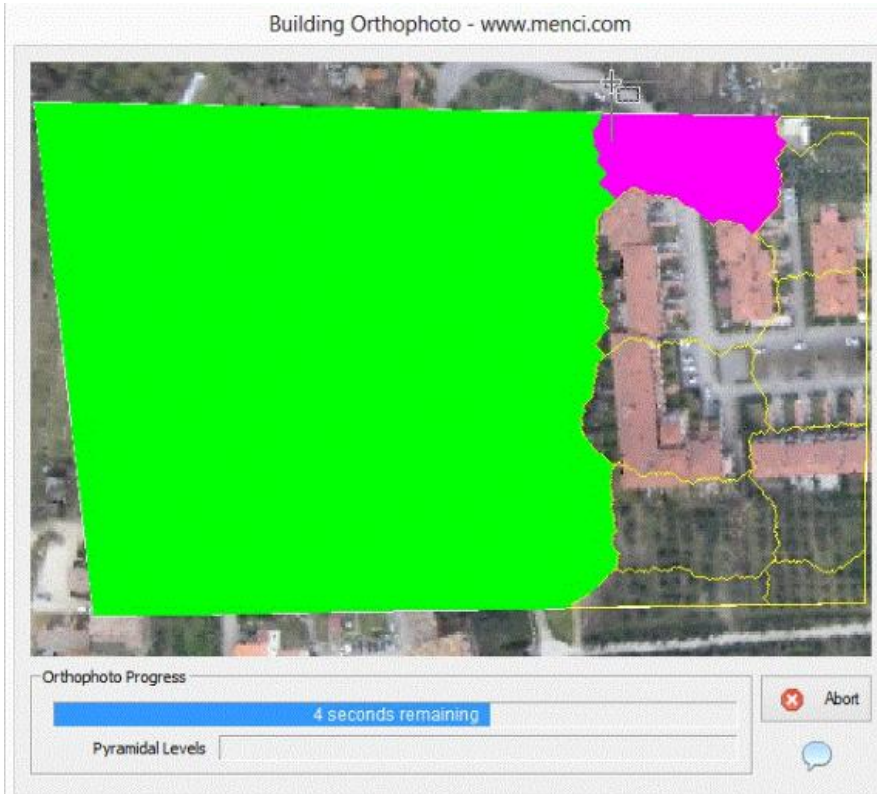


Before starting the process you need to type the target GSD (ground sample distance) resolution, expressed in meters.

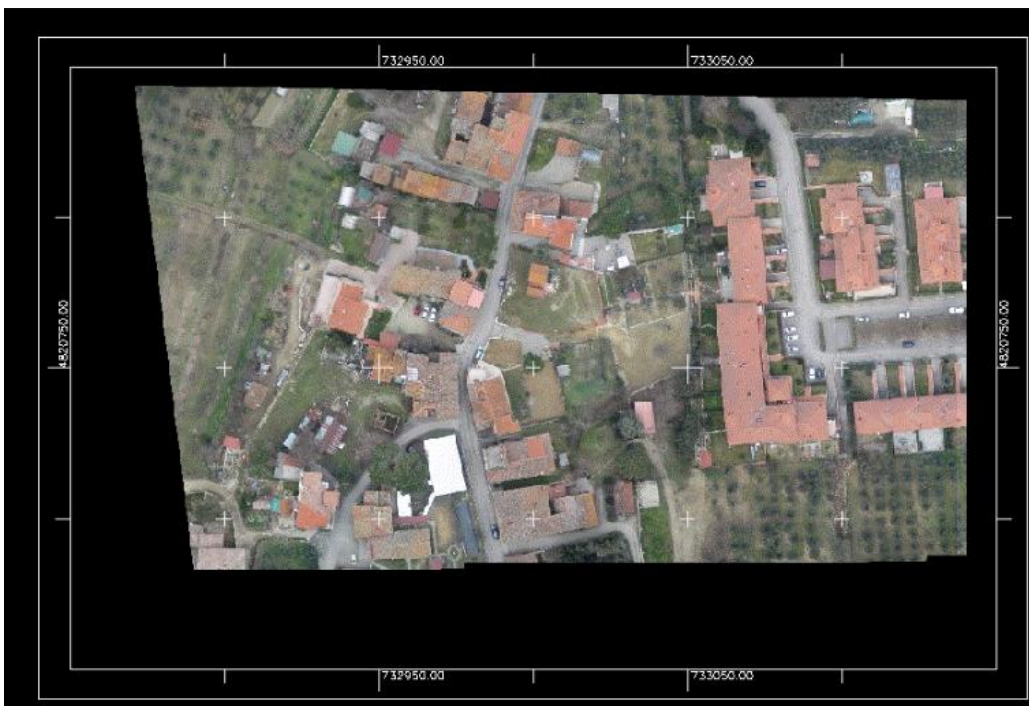
Proposed value is the optimal, but you are free to round that value to a bigger one.



If the radiometric balancing step was done, its result will be automatically included into orthomosaic production.

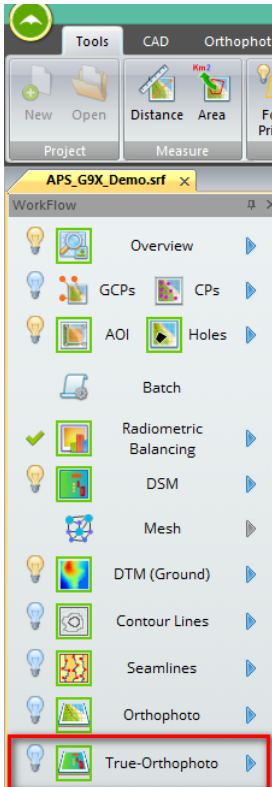


When the process ends, orthophoto automatically opens.



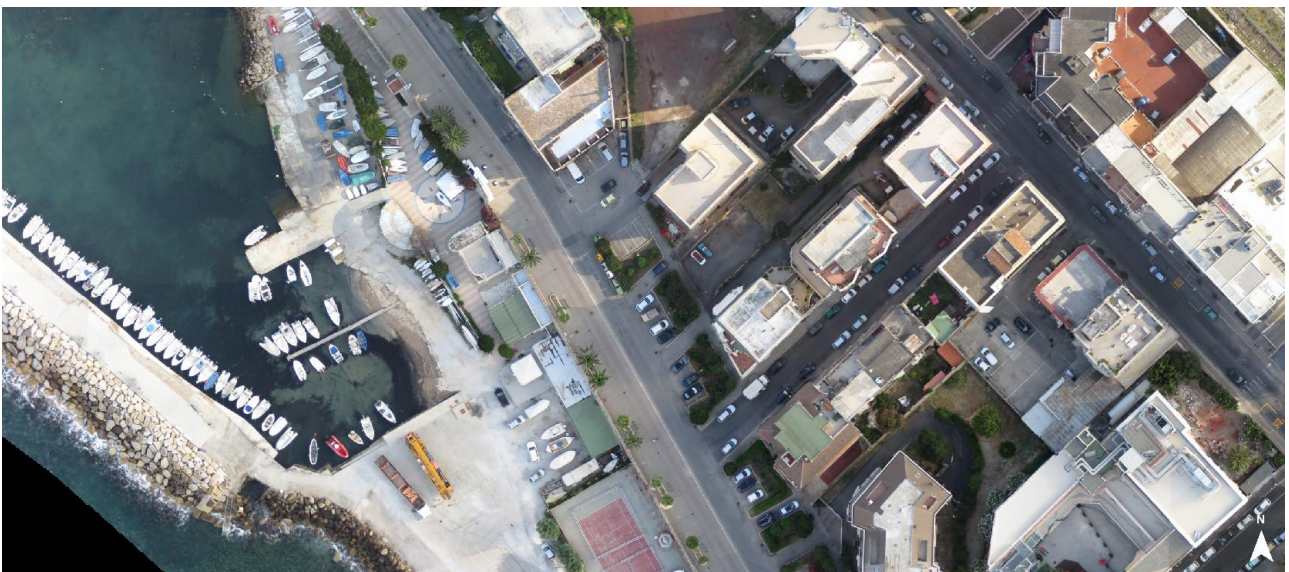
## TRUE ORTHOPHOTO

To get the true orthomosaic you have to process DSM before. If DSM has not been generated APS will build it automatically.



Before starting the process you need to type the target GSD (ground sample distance) resolution, expressed in meters.

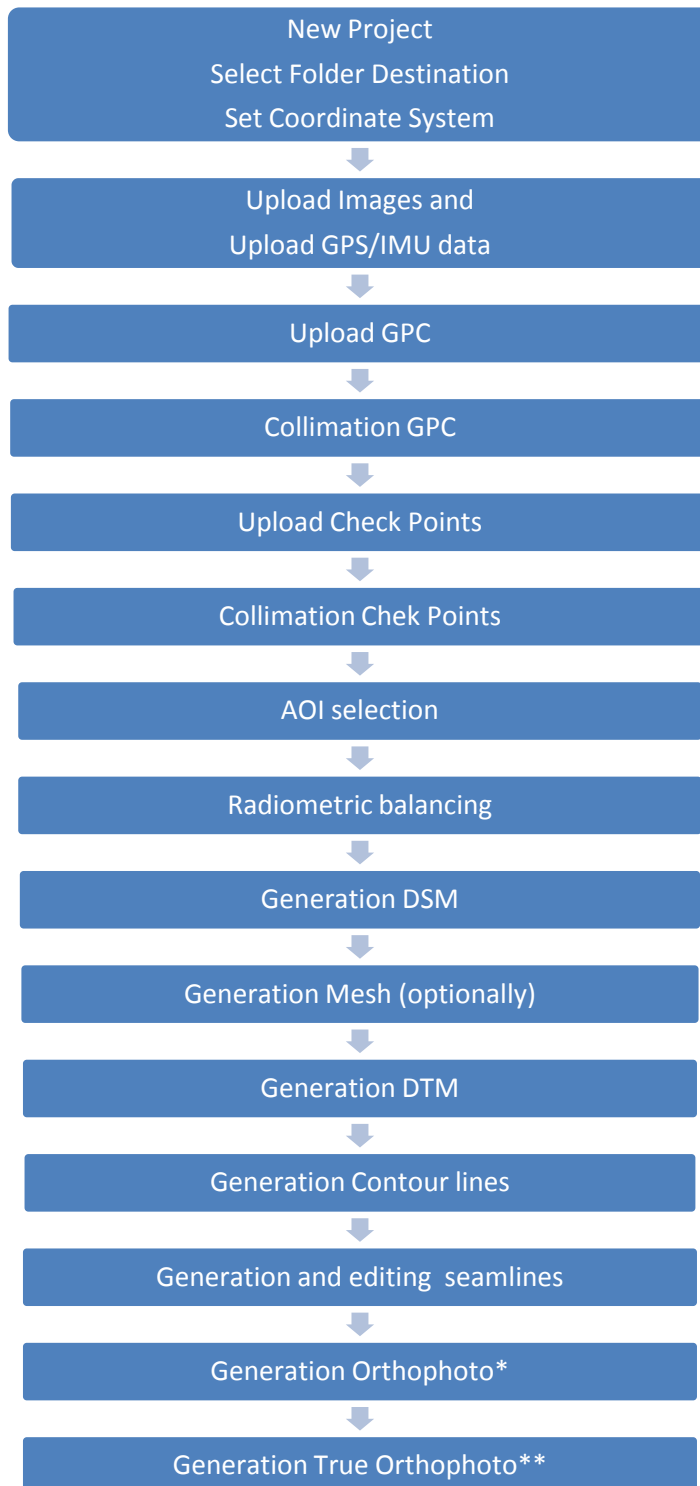
Proposed value is the optimal, but you are free to round that value to a bigger one



## GLOSSARY:

- **DEM:** a Digital Elevation Model is a digital model or 3D representation of a terrain's surface.
- **DSM:** a Digital Surface Model represents the surface and includes all objects on it (buildings, trees, ...).
- **DTM:** a Digital Terrain Model represents the bare ground surface without any objects like plants and buildings.
- **Orthophoto:** an orthophoto, orthophotograph or orthoimage is an aerial photograph geometrically corrected ("orthorectified") such that the scale is uniform: the photo has the same lack of distortion as a map. Unlike an uncorrected aerial photograph, an orthophotograph can be used to measure true distances, because it is an accurate representation of the Earth's surface, having been adjusted for topographic relief, lens distortion, and camera tilt.
- **Normal:** In geometry, a normal is an object such as a line or vector that is perpendicular to a given object.
- **Camera Passport:** file that describe the camera geometric parameters by lens focal, distortions and sizes.
- **Camera Calibration:** process to extract a camera passport from an image dataset acquired by a given camera
- A **polygon mesh** (MESH) is a collection of vertices, edges and faces that defines the shape of a polyhedral object in 3D computer graphics and solid modeling. The faces usually consist of triangles, quadrilaterals or other simple convex polygons, since this simplifies rendering, but may also be composed of more general concave polygons, or polygons with holes.
- **Seamline:** a line of junction formed by sewing together two images along their margins. They are propaedeutic to orthomosaic.
- **Ground Control Point** or Check Point: a point located on the ground by precise surveying that when identified on aerial photographs provides the control necessary for producing a photomap.
- **GSD:** ground sample distance is the distance between adjacent pixel centers projected on the ground.

# APS WORKFLOW



\* To build Orthophoto you have to process DTM before and eventually edit the seamlines.

\*\*To buld True Orthophoto you have to process DSM before. DTM is not strictly necessary.