Metashape

Workflow for photogrammetric models

Photogrammetry

▶ Technology of acquisition of spatial data

▶ Useful for the creation of digital clones of generic physical elements (buildings, objects, spatial surfaces, landscapes)

▶ Process based on the use of photos to create digital graphic images

▶ The results of the process are materials useful for the modeling, the drawing, the measurement, the integration of graphic information to the project

Input data

▸ Photos (taken in sequences)

▸ Images useful for the photogrammetric process must comply with specific geometric features:

      ▸ Techniques of creation of the shooting sequences

      ▸ Framing of the object (according to its morphology)

      ▸ Characteristics of the instrument used (camera)

Preliminary operations

▶ Analyse:

  ▸ The shape of the object and the material of which this is made of

  ▸ Ambient light conditions affect the effectiveness of the survey (direct light casts shade and shadows on the object)

  ▸ Surrounding environment creates obstacles for the visibility

  ▸ Repetitions of the morphology of the structure may create wrong alignments of the images

  ▸ Parts of the object, specially if this is richly decorated, need more photos to obtain a good quality result and avoid holes on the digital model

Features of the cameras

1. Focus:

   ‣ Autofocus (the focus is automatically set by the camera)
   ‣ Manual (focus is set by the user)

2. Exposure: amount of light reaching the sensor:

   ‣ Aperture: defines how much light reaches the sensor
   ‣ Shutter speed: time of exposure of the sensor at the light

Features of the cameras

f/1.4

f/2.0

f/2.8

f/4.0

f/5.6

f/8.0

Features of the cameras

1/1000	1/500	1/250	1/125	1/60
1/30	1/15	1/8	1/4	1/2

▶ Shutter speed

Features of the cameras

3. Color balance:

    ▶ Depending on the presence of different kind of light sources (solar, incandescent, neon, etc...) the objects photographed can have different color characterizations

4. ISO:

    ▶ Light sensitivity of a digital image sensor
       Higher ISO > Less environmental light is necessary
       Lower ISO > More environmental light is necessary

Features of the cameras
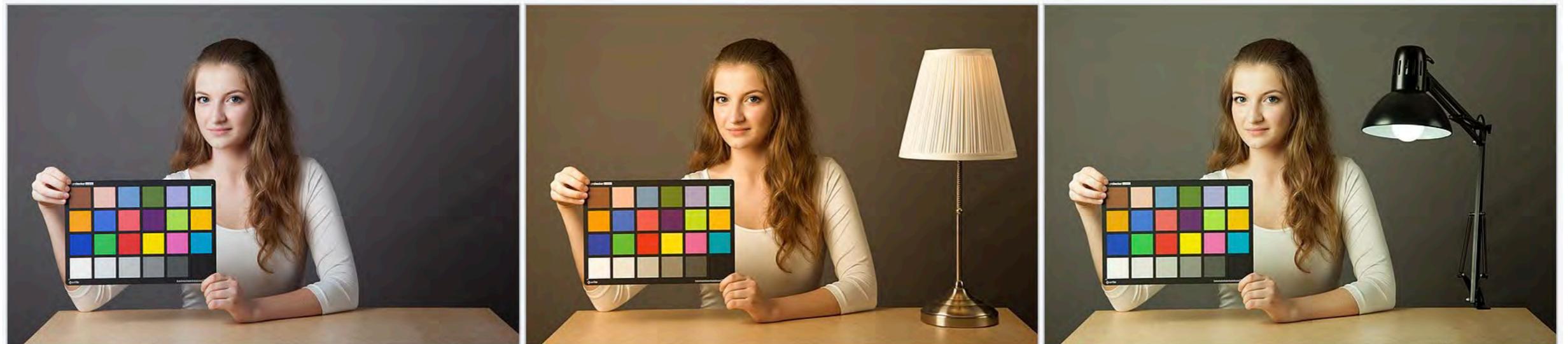
Features of the cameras

ISO 100-200

Daylight

ISO 200-400

Shade/
Indoors

ISO 400-800

Flash
Indoors

ISO 800-1600

Darker
Indoors

ISO 1600-3200

Indoors
at Night

ISO 3200+

Extra Low
Light

Features of the photos

1. Sharpness

2. Contrast and definition

3. Uniform lighting

Photogrammetric process

▸ The photogrammetric process works by identifying homologous points between the photos that make up the sequence (the same points must be present in at least two photos)
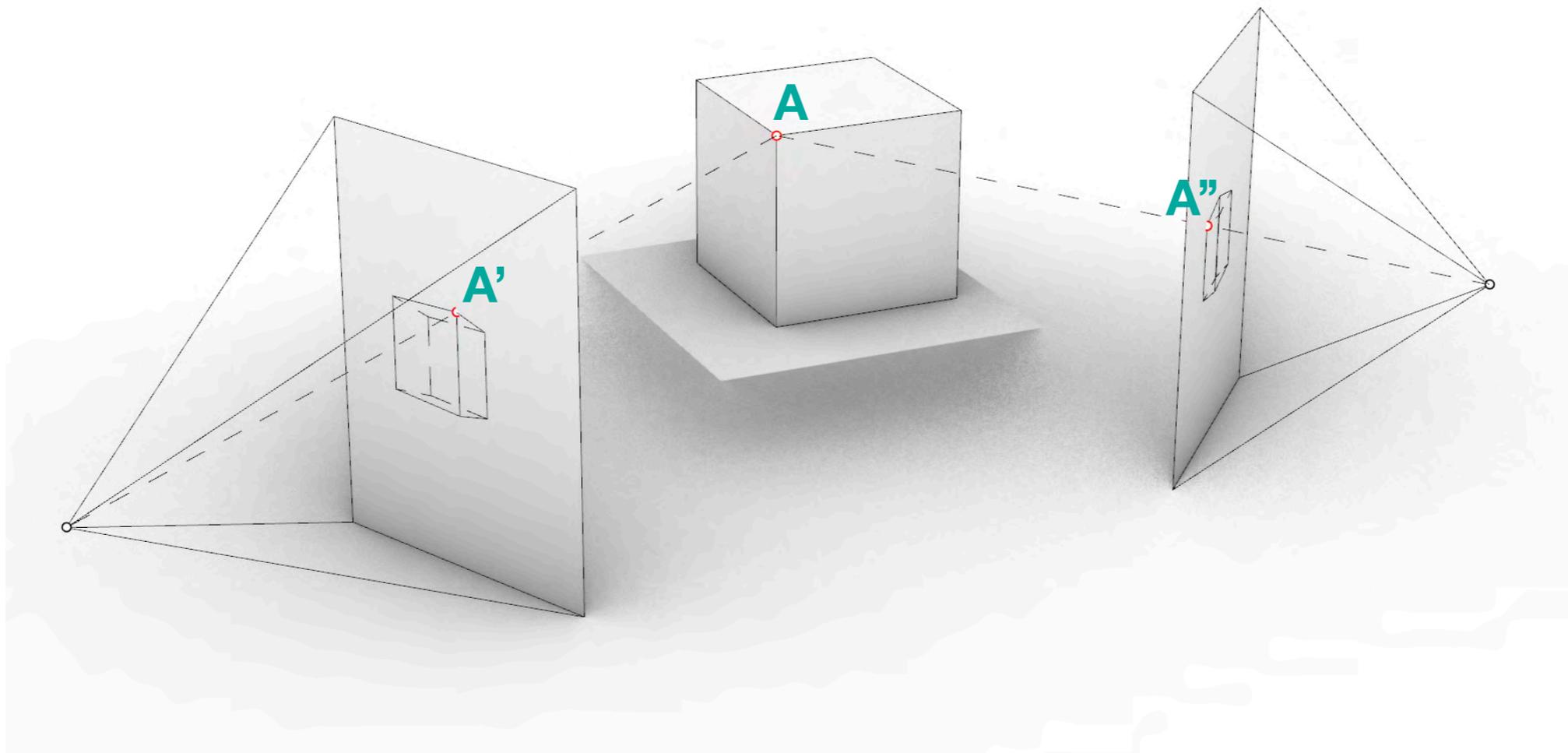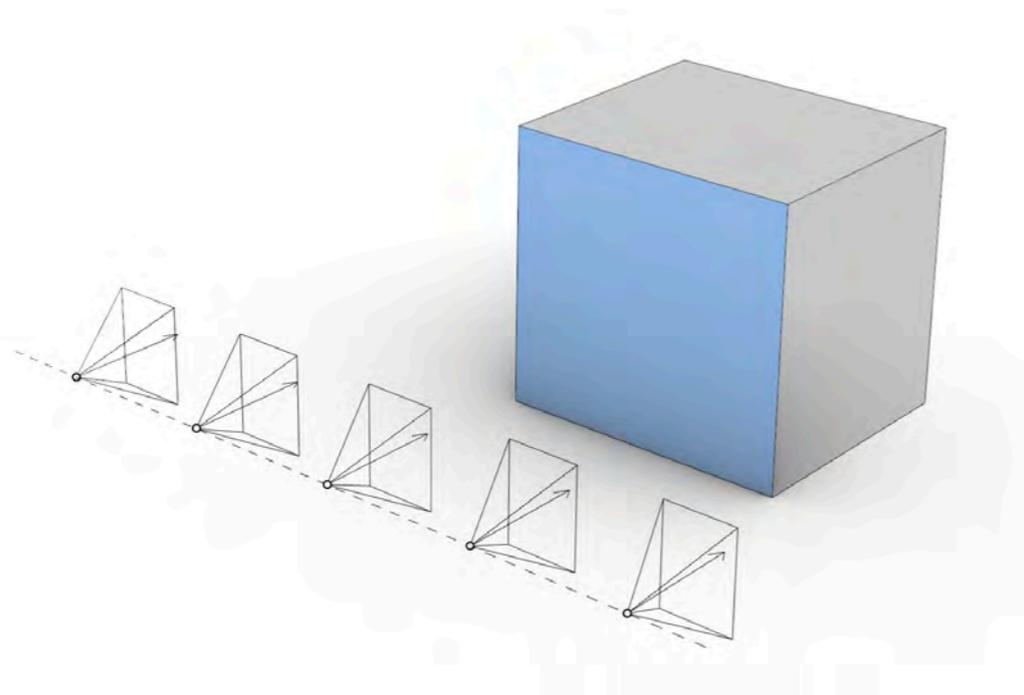
Photography techniques

The images that make up the sequence must be overlapped by 1/3, so as to ensure the presence of the same points in more photos of the sequence
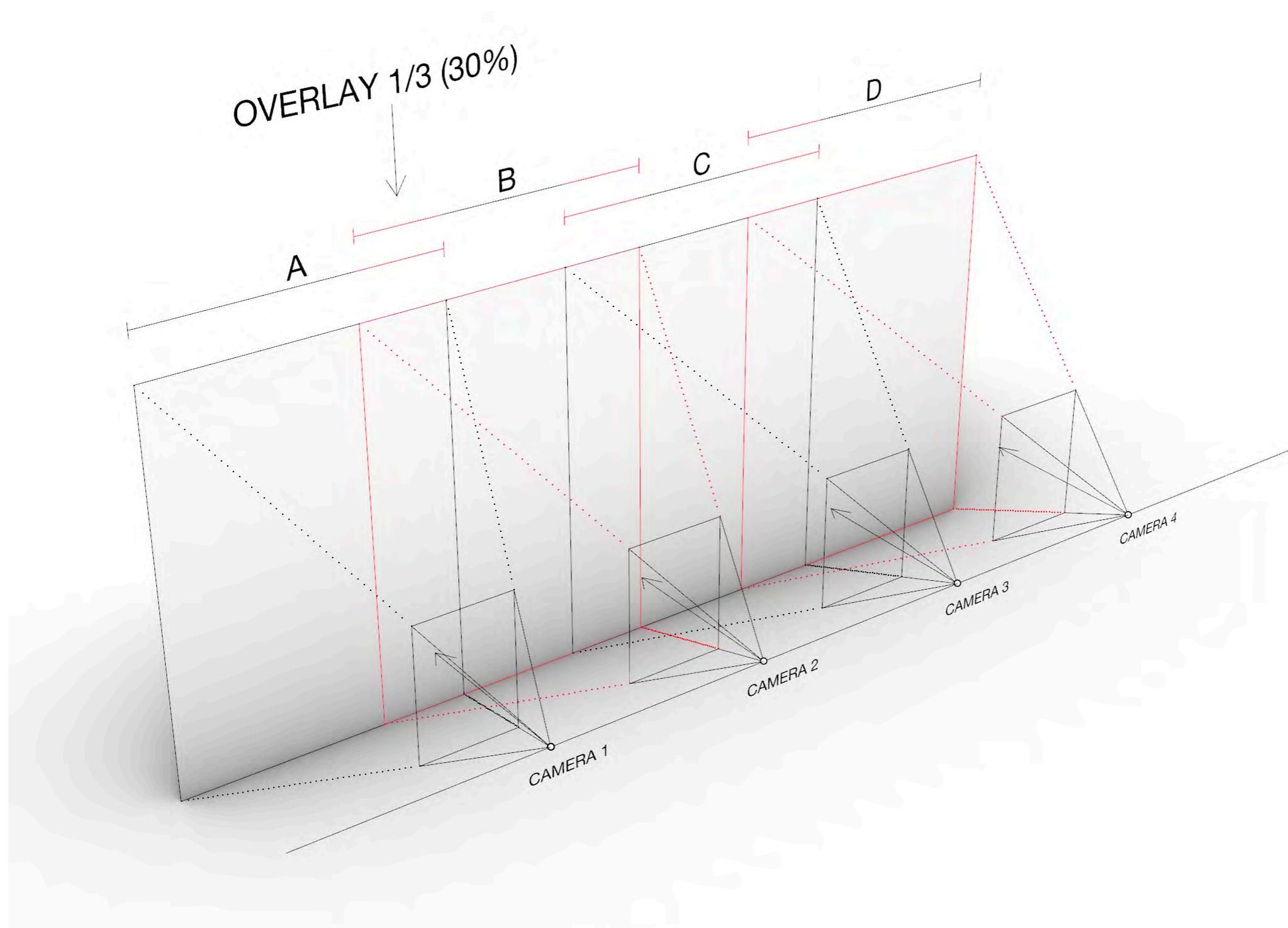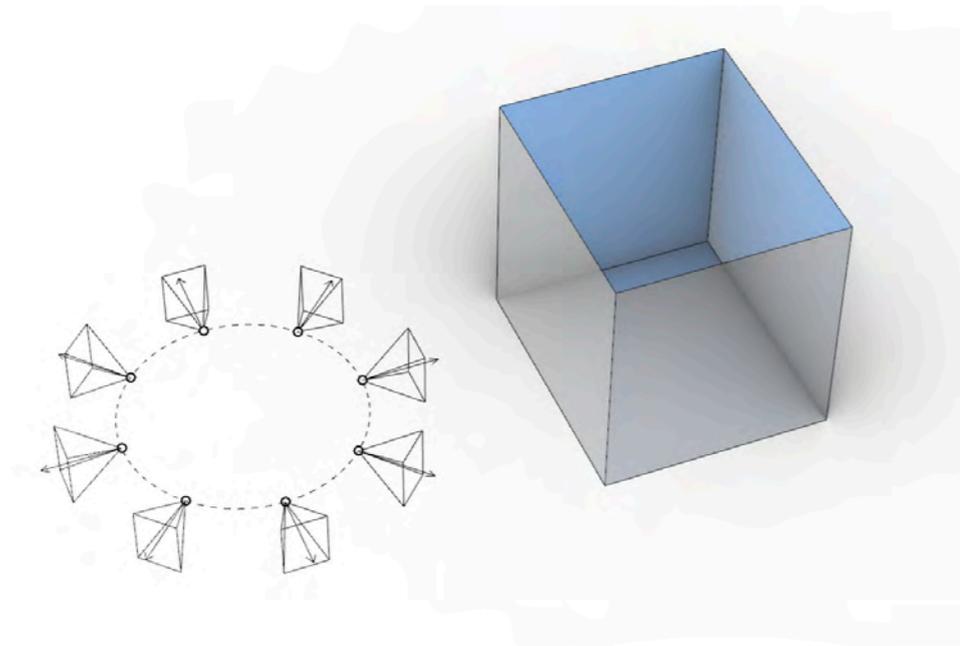
Photography techniques
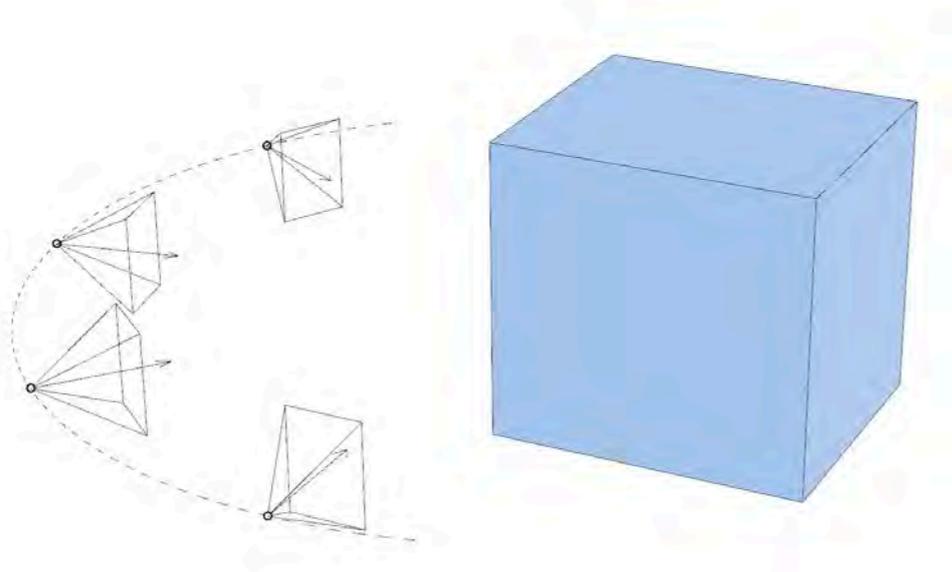
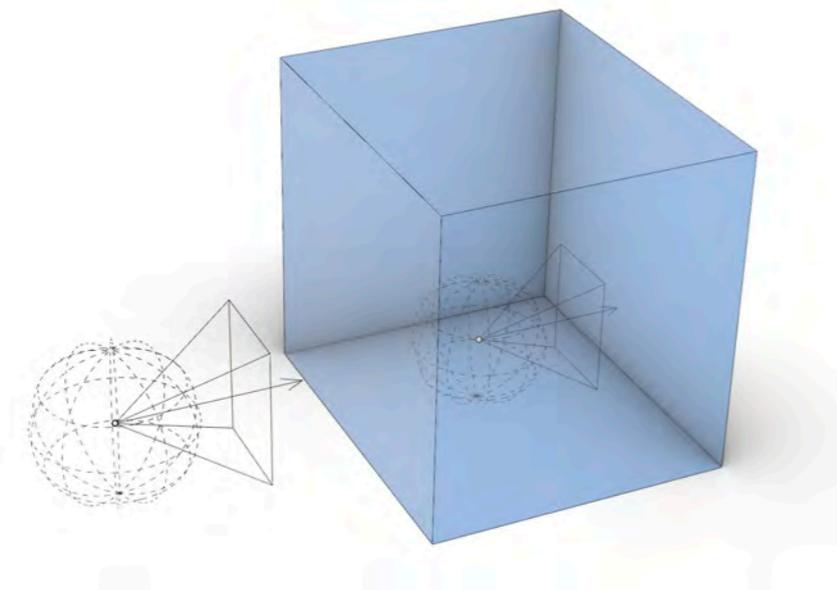Convergent: single objects, corners

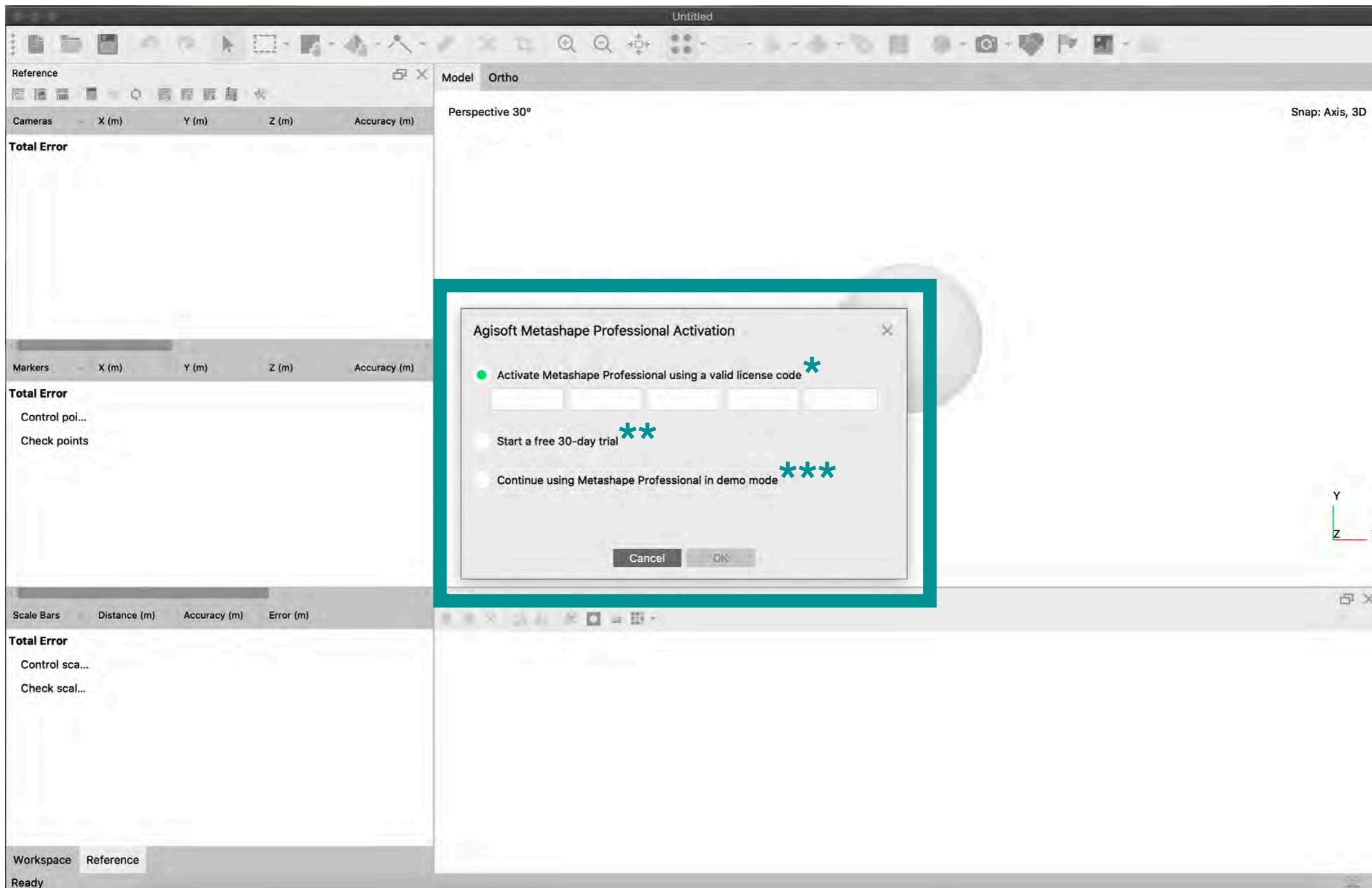Parallel single or multiple: planar surfaces, facades

Photography techniques

Cylindrical: internal planar surfaces, closed spaces

Spheric: closed spaces

Metashape graphic interface

Select the activation mode:
appears when opening the software for the first time when there is not yet a license key.

* Licensed version, requires entry of the license code provided when purchasing the software
** Trial version, complete (allows to save and export datas), valid for 30 days
*** Demo version, allows processing but does not allow saving and export the files (it has no time limit)
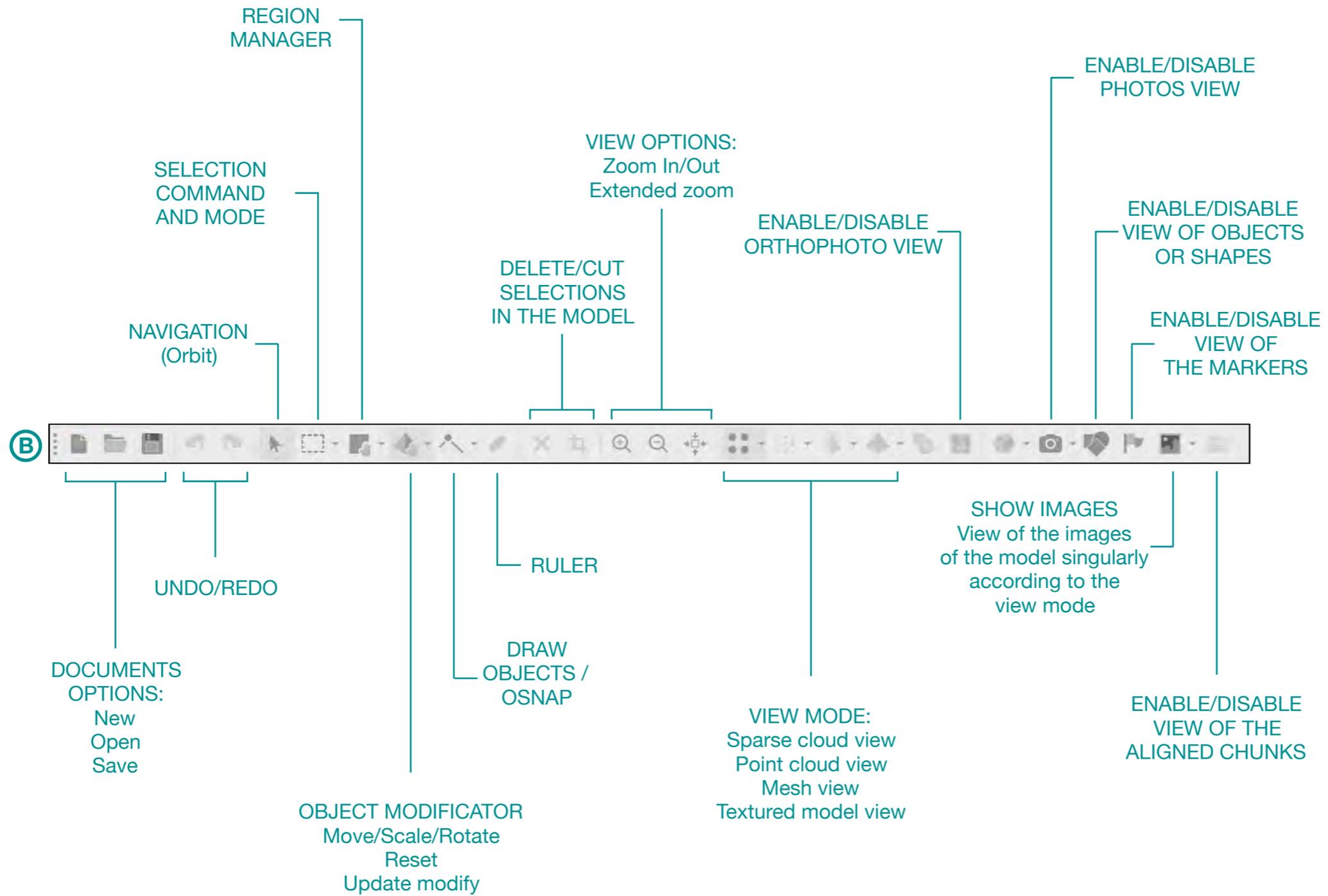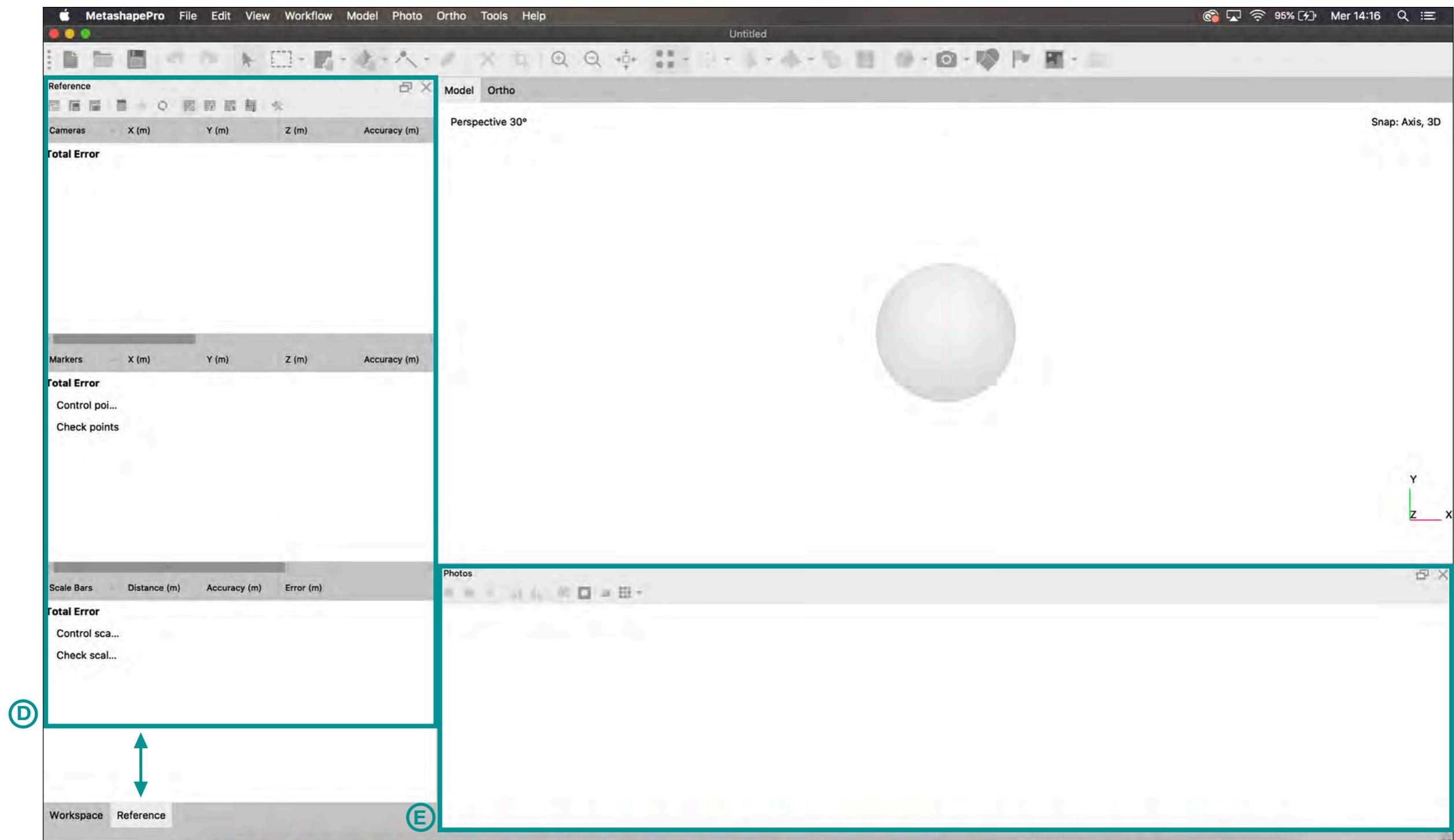
1
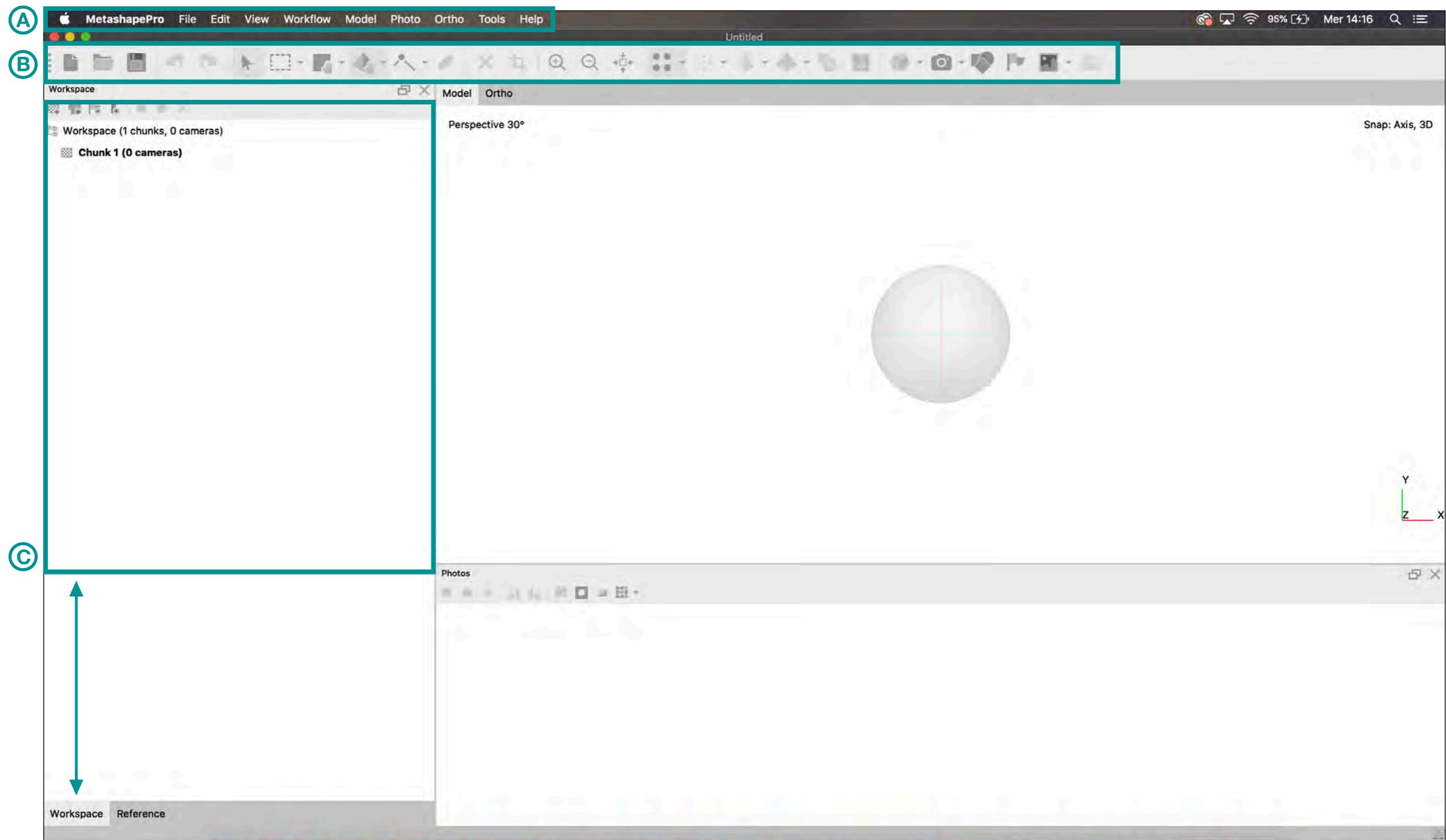
Graphic interface:

A Menu bar
B Toolbar
C Workspace set in the form of chart, summarizes the datas according to their hierarchy

REGION
MANAGER

SELECTION
COMMAND
AND MODE

VIEW OPTIONS:
Zoom In/Out
Extended zoom

ENABLE/DISABLE
PHOTOS VIEW

ENABLE/DISABLE
VIEW OF OBJECTS
OR SHAPES

ENABLE/DISABLE
ORTHOPHOTO VIEW

ENABLE/DISABLE
VIEW OF
THE MARKERS

NAVIGATION
(Orbit)

DELETE/CUT
SELECTIONS
IN THE MODEL

SHOW IMAGES
View of the images
of the model singularly
according to the
view mode

RULER

UNDO/REDO

DRAW
OBJECTS /
OSNAP

DOCUMENTS
OPTIONS:
New
Open
Save

VIEW MODE:
Sparse cloud view
Point cloud view
Mesh view
Textured model view

ENABLE/DISABLE
VIEW OF THE
ALIGNED CHUNKS

OBJECT MODIFICATOR
Move/Scale/Rotate
Reset
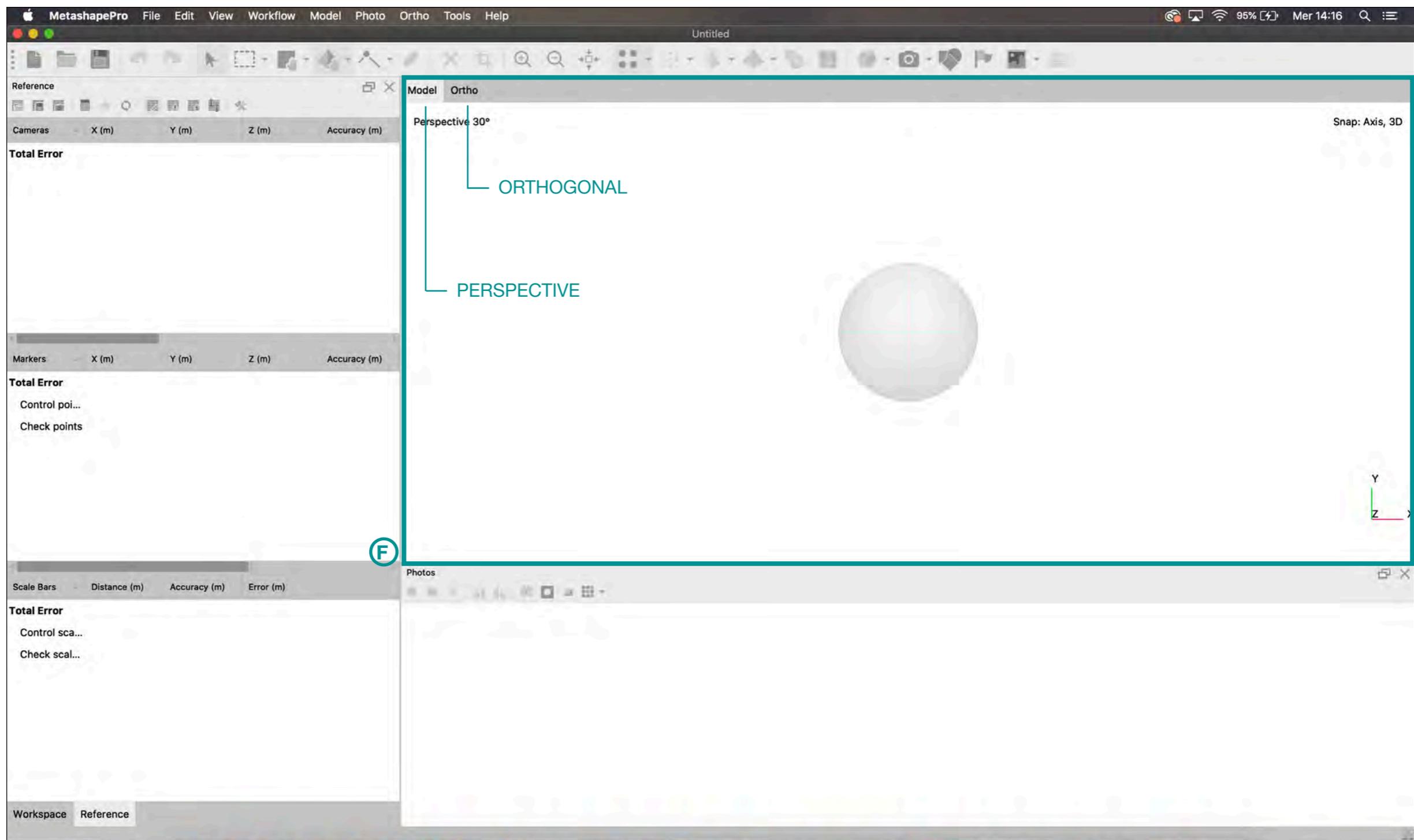Update modify

Graphic interface:

B Toolbar

3

Graphic interface:

D Data manager area for the evaluation and manual input of numerical coordinates values
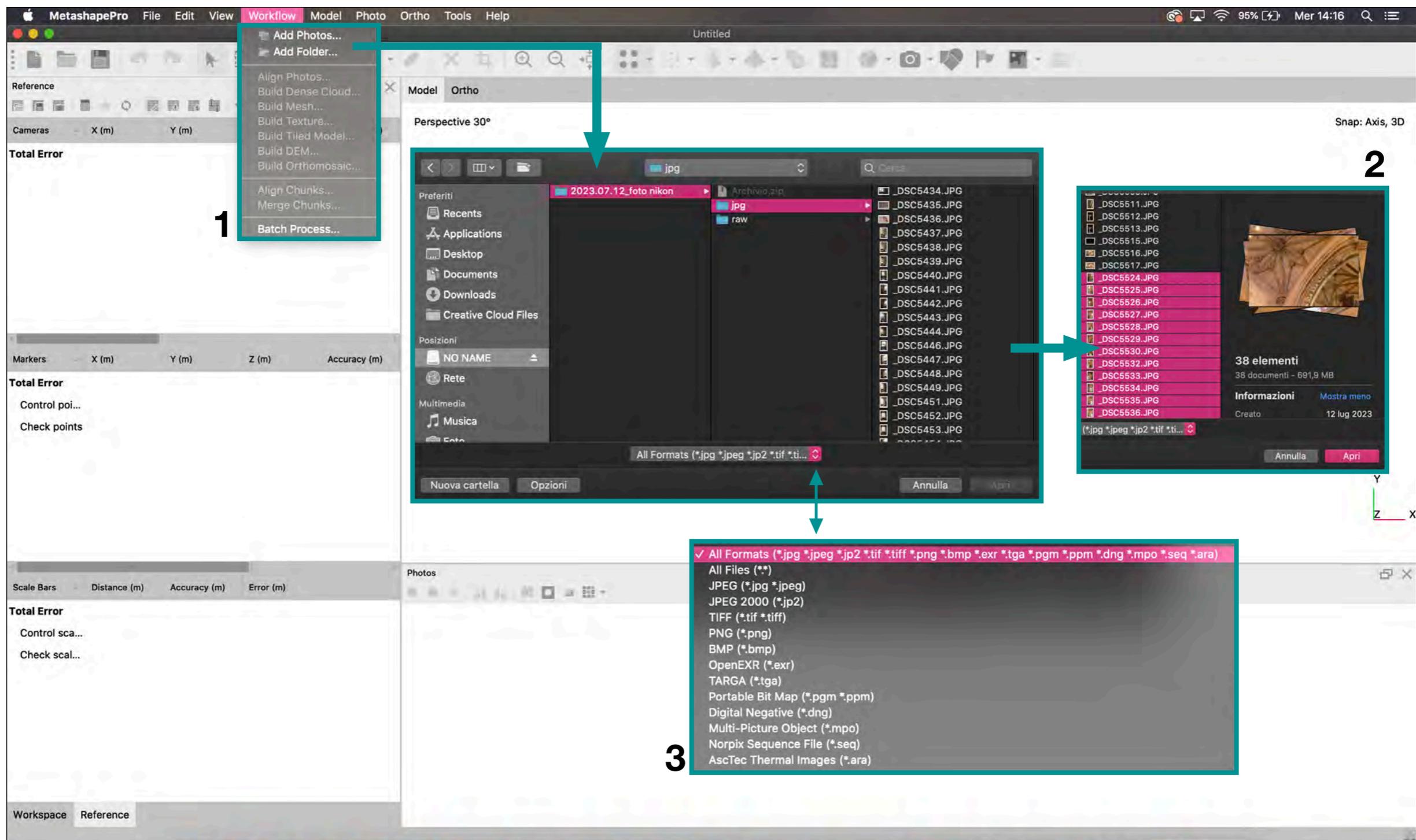
E Preview of the imported images (source datas)

ORTHOGONAL

PERSPECTIVE

Graphic interface:

F View of the model

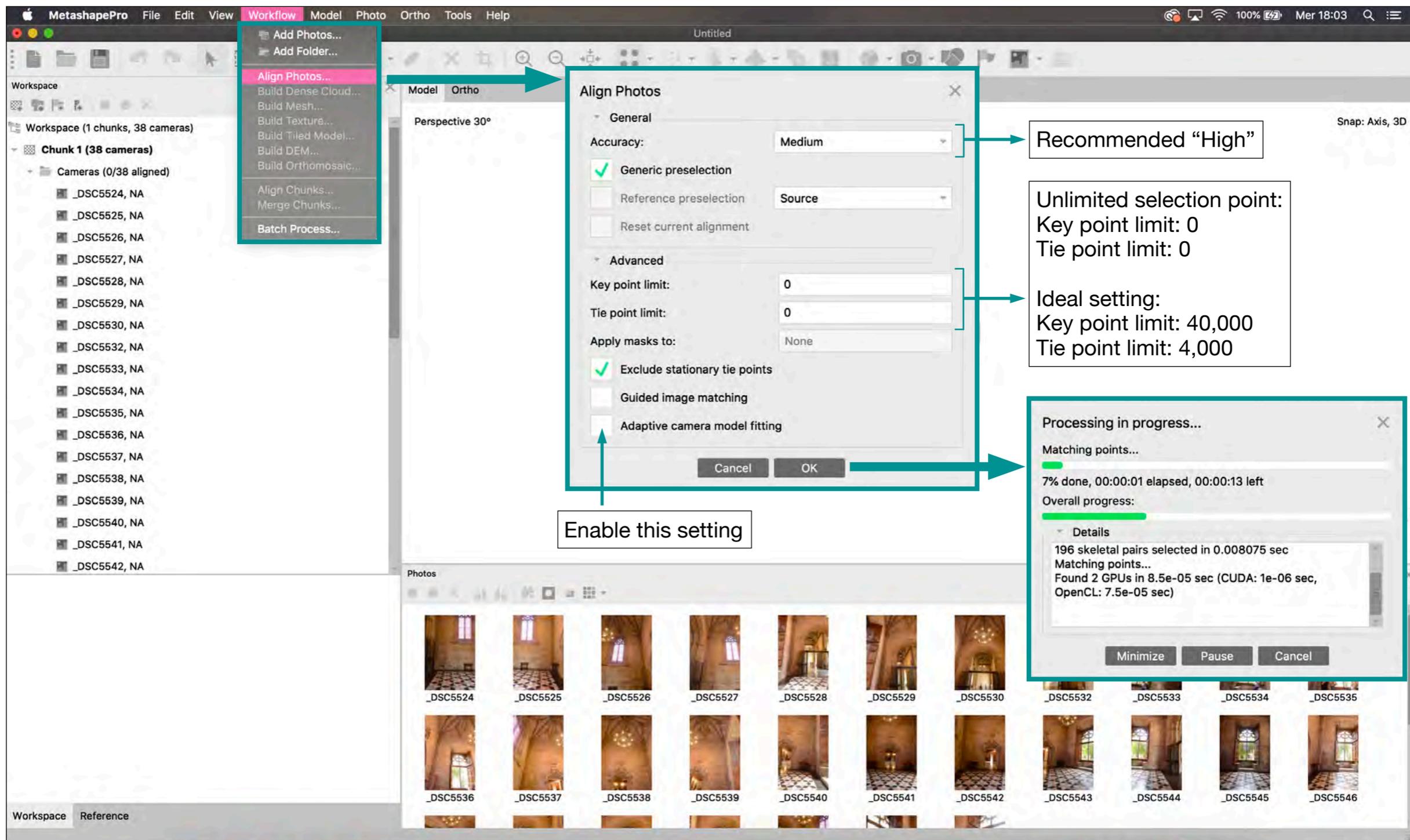# Photogrammetric process
with Metashape

Workflow:

Import source images from menu bar: Workflow > Add Photos / Add Folder (1).
Select "Add Folder" if the images to be imported have already been selected and organized into folders in the saving destination. Select the set of images (or the folder that contains them) from the window (2).
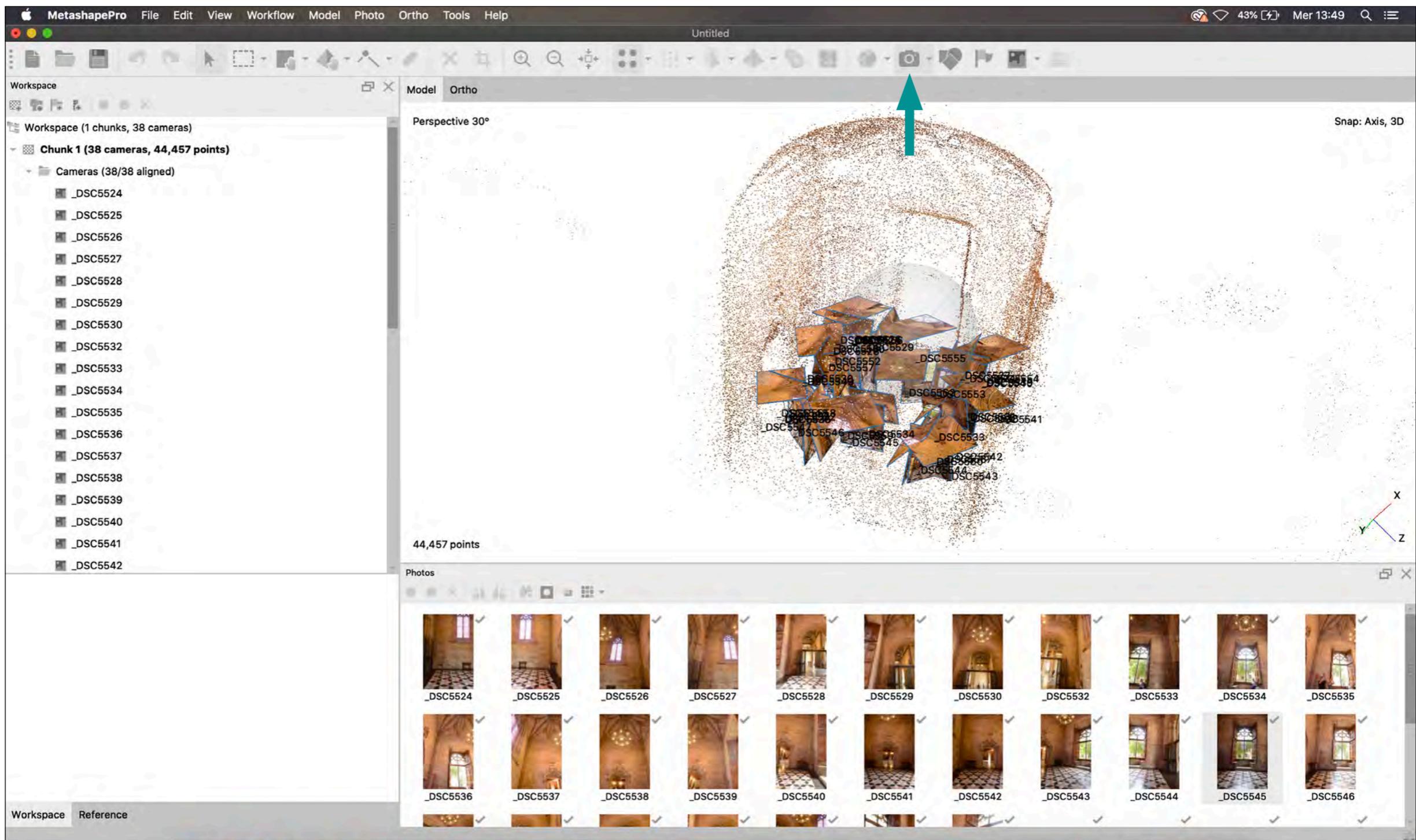From the drop-down menu you can view supported formats (3).

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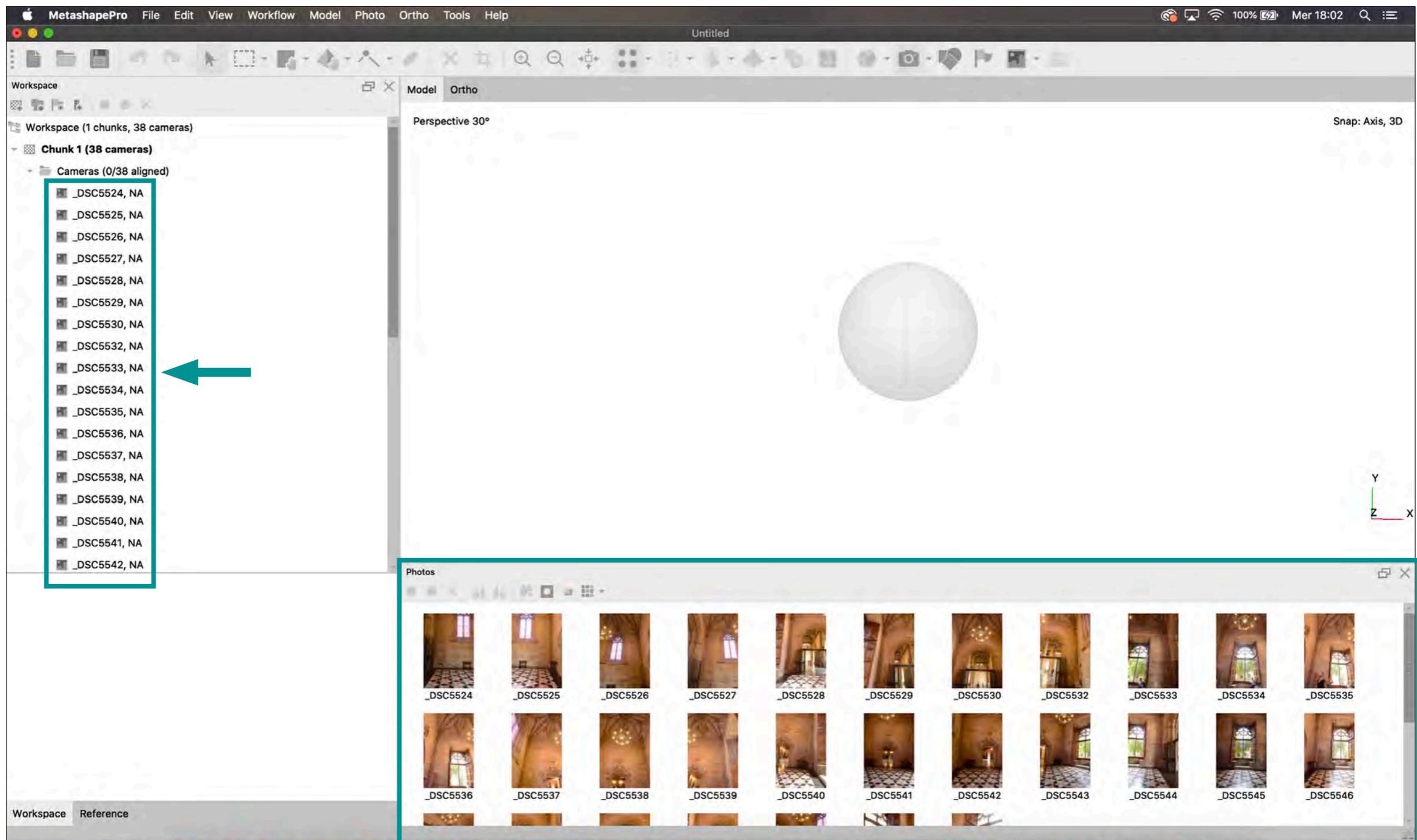
Workflow:

Once imported the images, these will be visible as large icons in the preview window. In the Workspace the images will be followed by the acronym NA (not aligned) because they have not yet been processed by the software: there are in fact 38 imported cameras of which aligned 0 out of 38.

Align photos:

From the menu bar select:
Workflow > Align photos > enter settings in the window

Recommended "High"

Unlimited selection point:
Key point limit: 0
Tie point limit: 0

Ideal setting:
Key point limit: 40,000
Tie point limit: 4,000

Enable this setting

Align photos:

Visualization of the sparse cloud created by the alignment of the images: the model consists of the homologous points identified between the images; their placement in space is given by the presence of these points by at least two images (due to the appropriate overlap of the same). The visualization of the cameras placed in the model with image preview (green arrow) is active.

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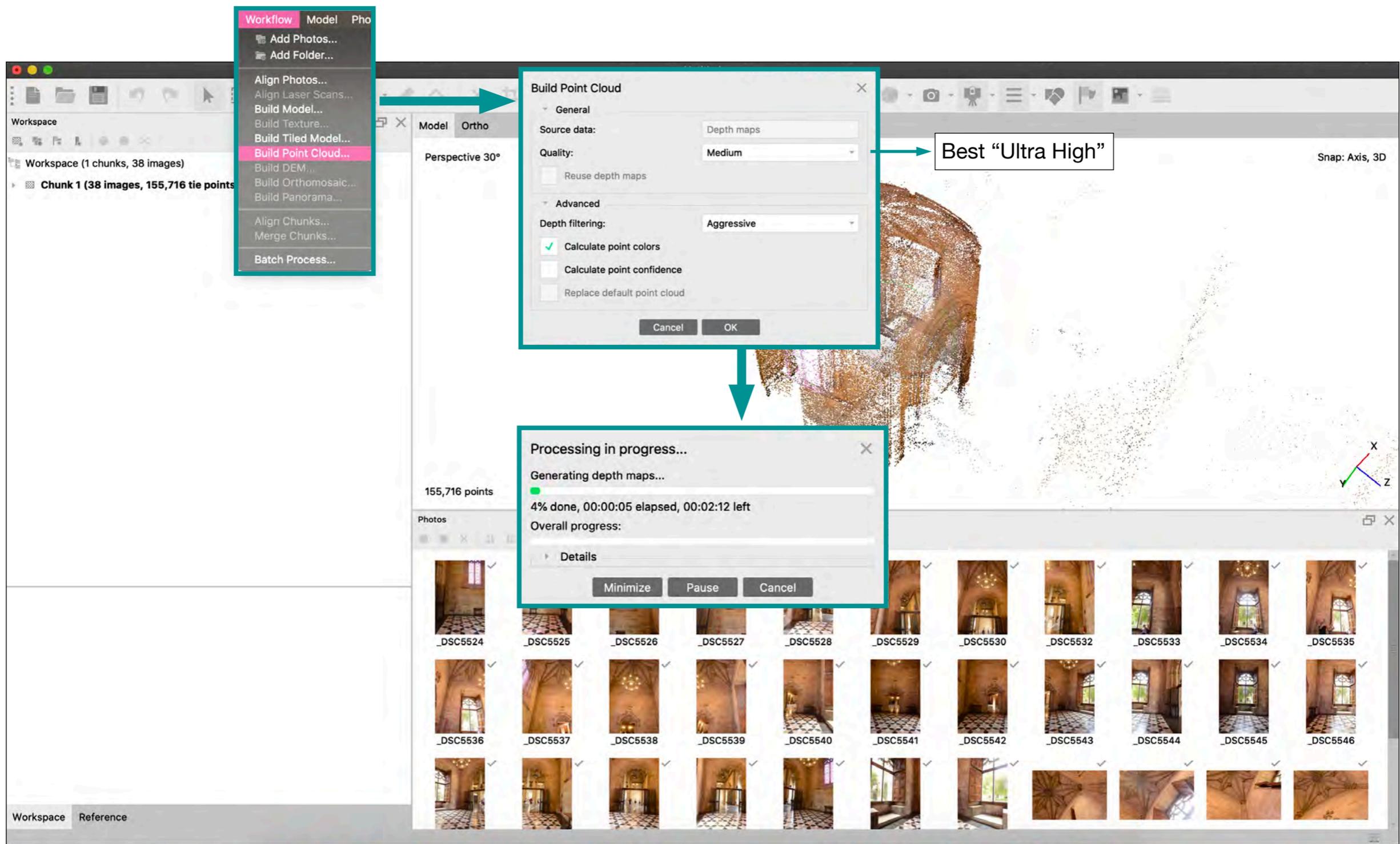
Build Point Cloud:

Once created the Sparse cloud by the alignment of the images, the software will create the additional points that describe the architecture detected, leaning on the homologous points identified in the alignment of the cameras.
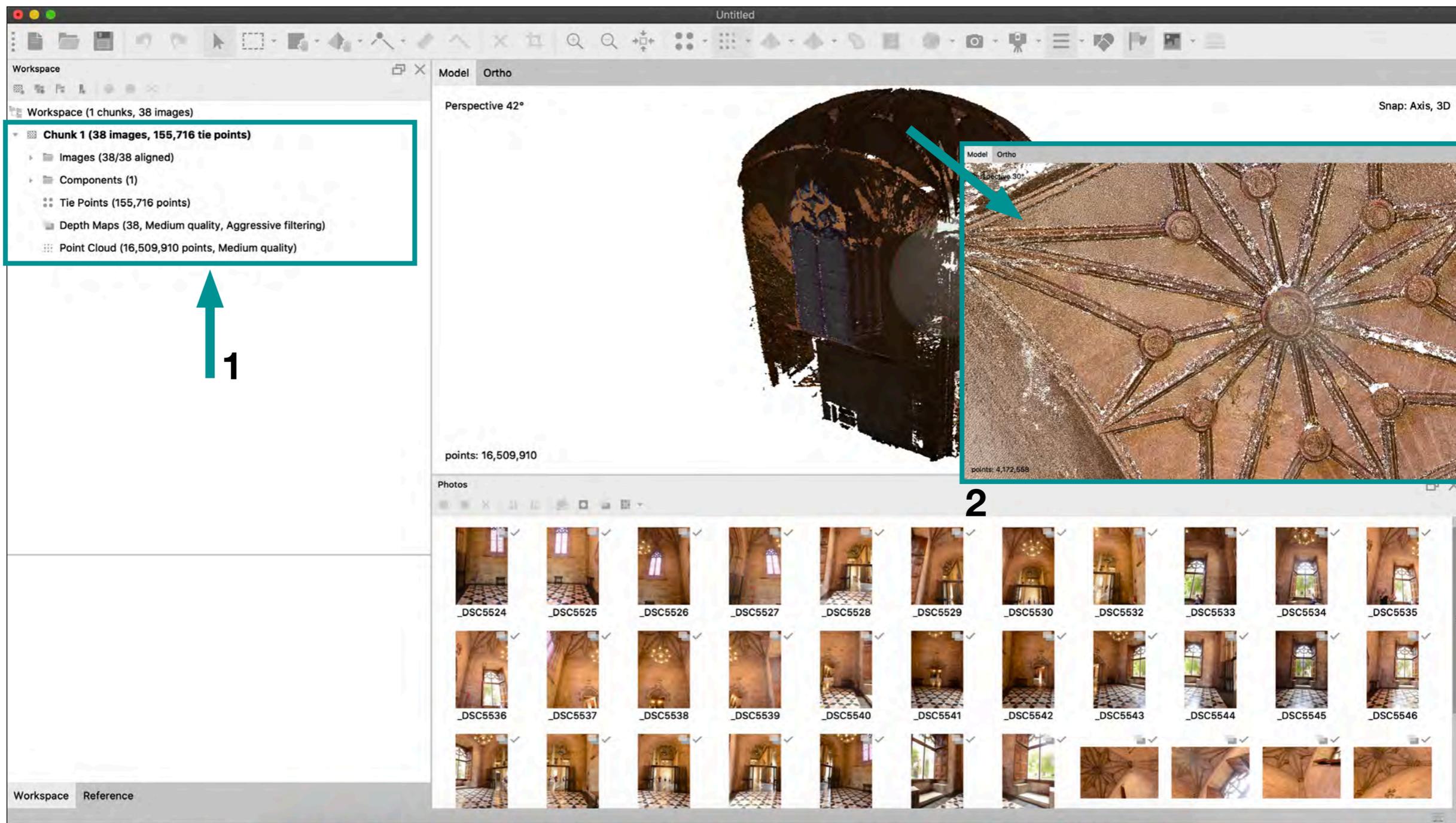
Point Cloud:

The workspace will display the sequence of operations carried out and the values of the created elements (1): the point cloud is constituted in the example from 16,509,910 points (visible also from the window of the model). These values vary depending on the settings chosen for each step of the process. In the proposed example the architecture is seen from the outside and will be dark in the general view, because the images were taken inside; in an internal view the colors will be colored according to the real surface (2).
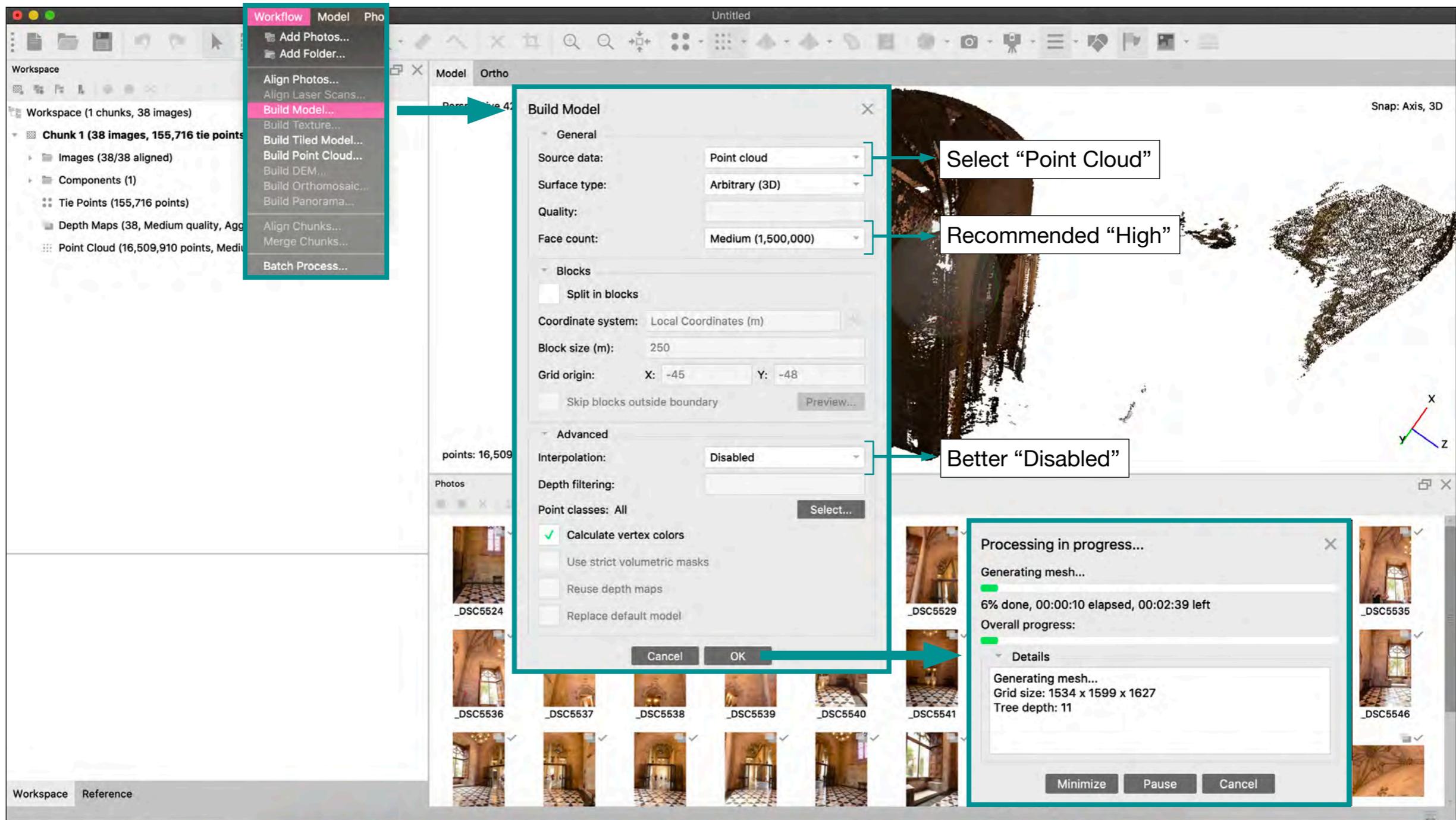
Model as Mesh surface:

This step is based on the point cloud created previously through the trilateration; it will consist of a group of triangles whose sides are drawn according to the rule of the shortest path between the points, always taking into account the maximum number of faces to be obtained according to the preferences set by the user.

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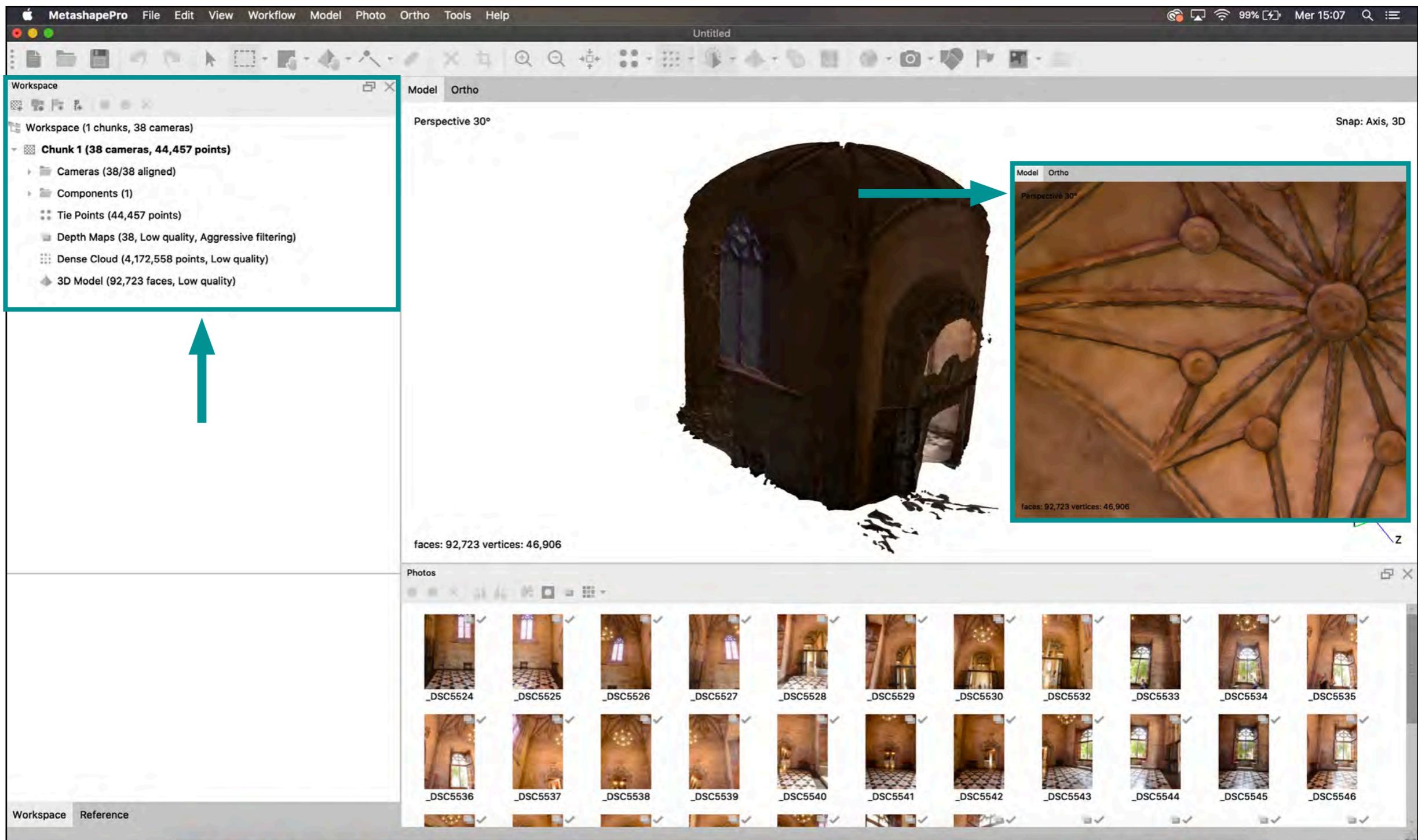
Mesh surface:

The workspace will update with the addition of the newly generated 3d model.
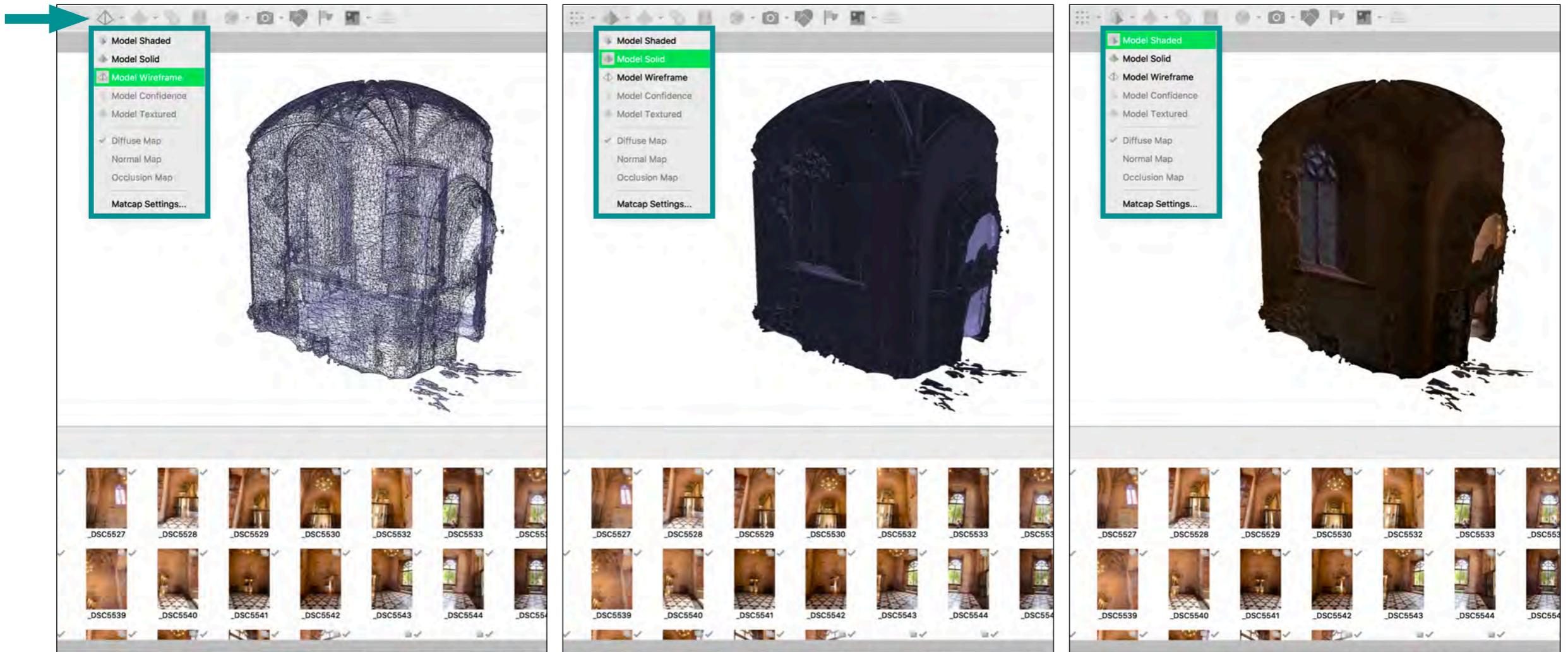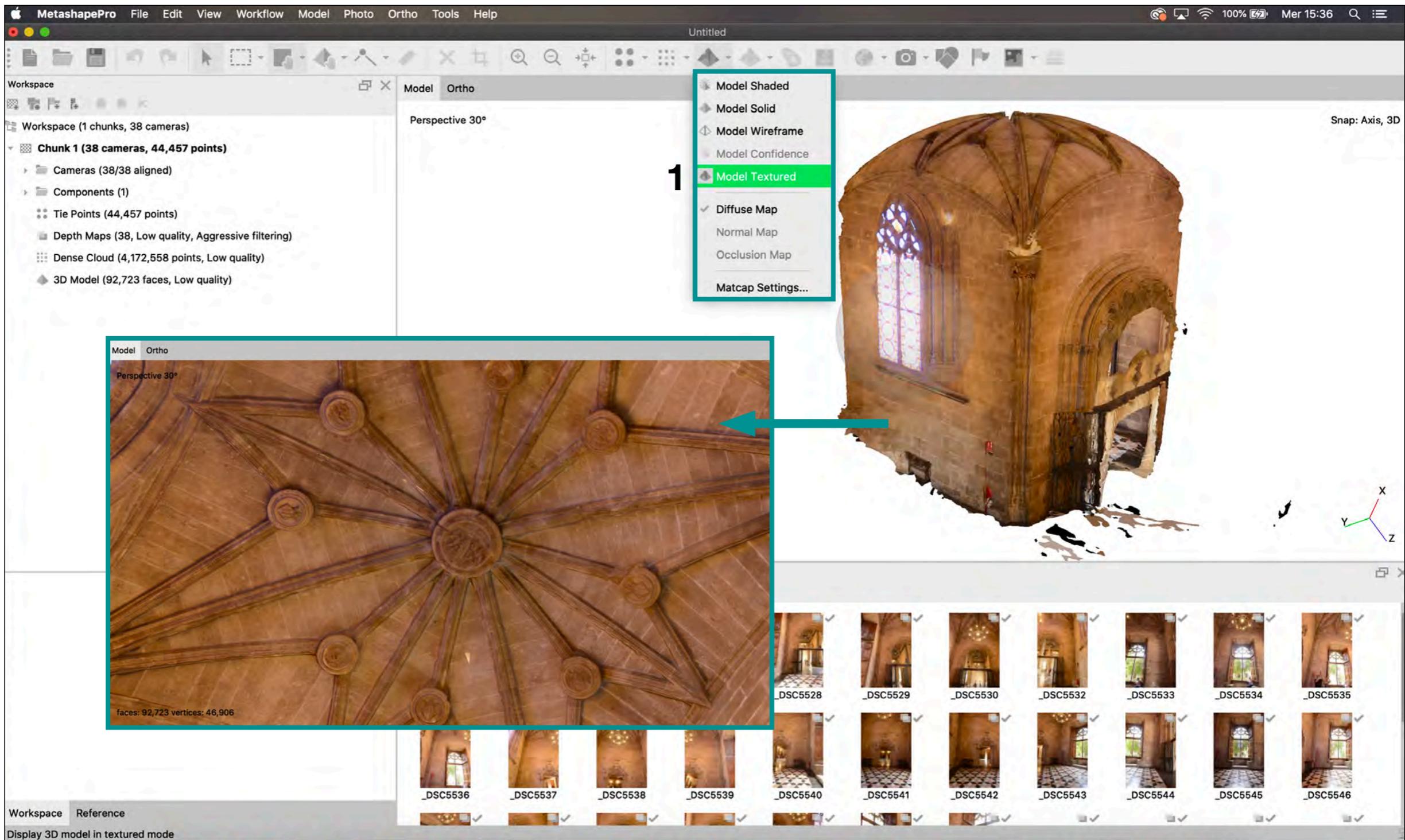
Mesh view mode:

To facilitate the visualization of the model Metashape provides, at this step, different view modes: shaded, solid or wireframe. Preferences can be set from the template icon in the toolbar (the icon itself will change depending on the selected mode).

Best to enter value 1 for number of textures to generate
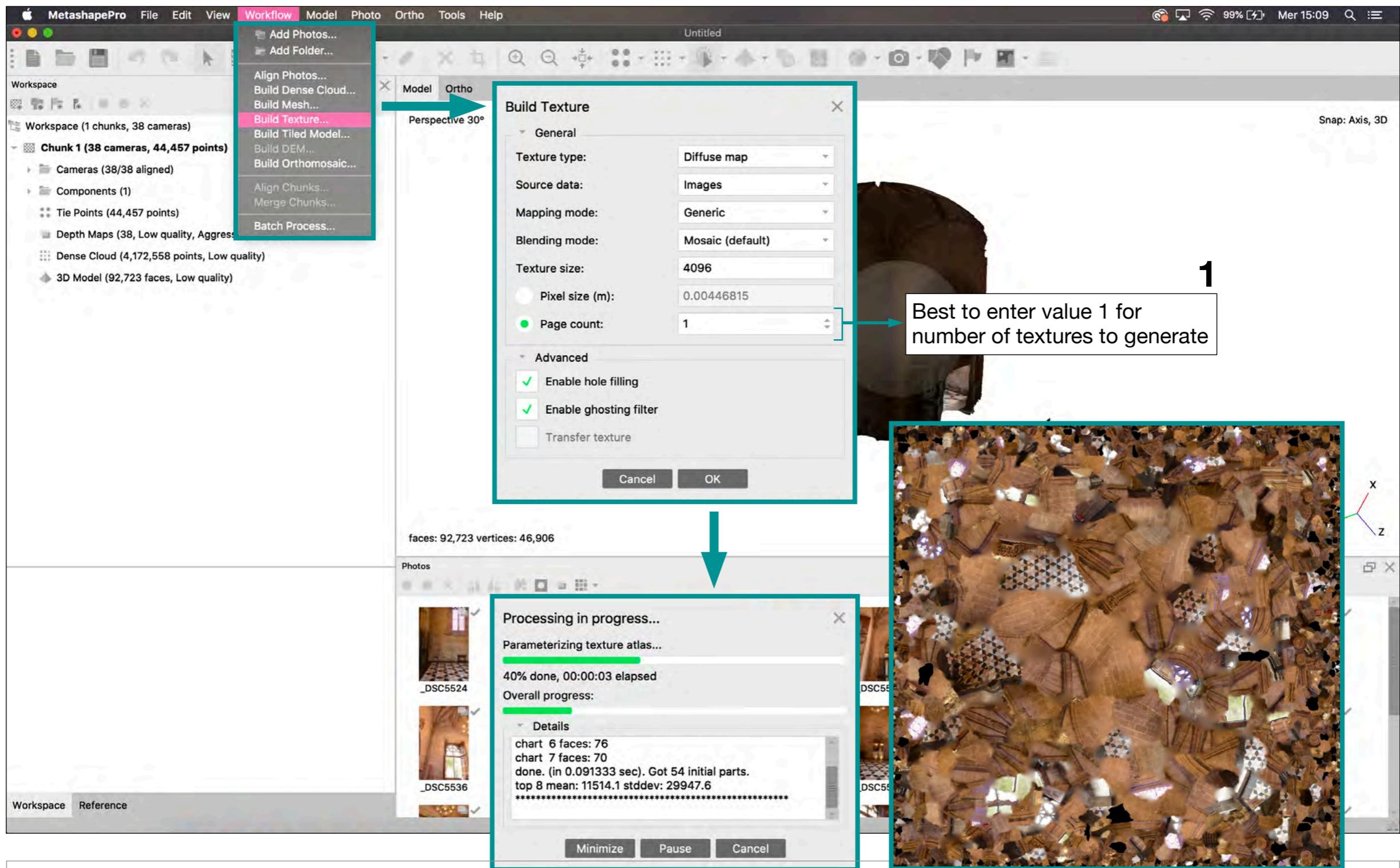
Texture:

From the source images Metashape generates one or more textures, depending on the number that is requested by the user (1): in the case of a single texture this is assigned to the entire model, if you choose to generate more textures these will be assigned to more parts of the model. The choice varies according to the complexity of the architecture on which apply the texture. The texture will be generated as image format and automatically saved by the software in the same folder containing the source images. The content of the image will appear in the form of a mosaic.

Texture:

The software applies the texture to each of the faces that make up the mesh model. The "Textured" view mode will appear among the model display styles (1)

Other features
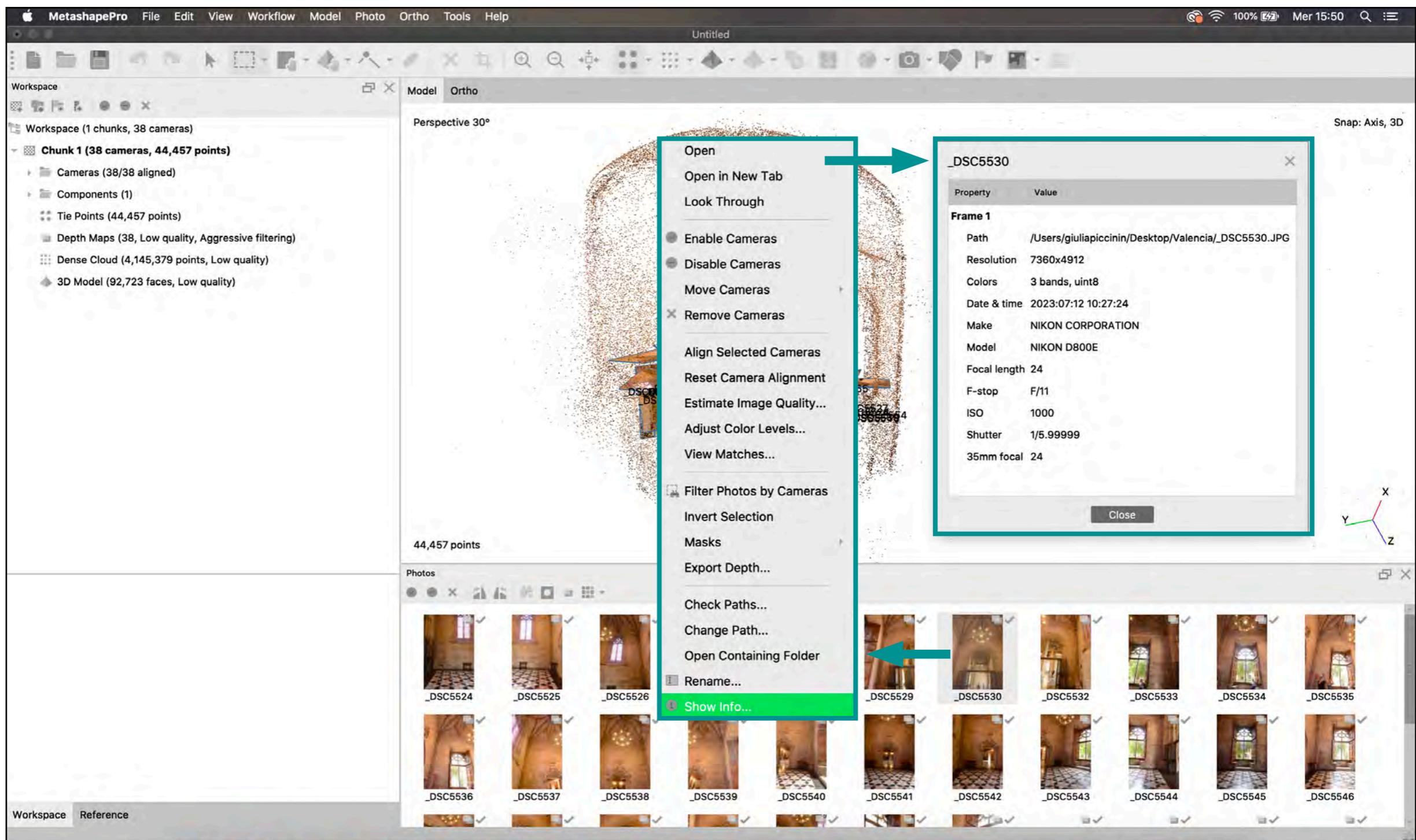
Cameras Exif data:

The Exif data is incorporated into the images within the software and allows it to determine the arrangement of the cameras in the virtual space. Data can be displayed by right-clicking on the image > Show info...
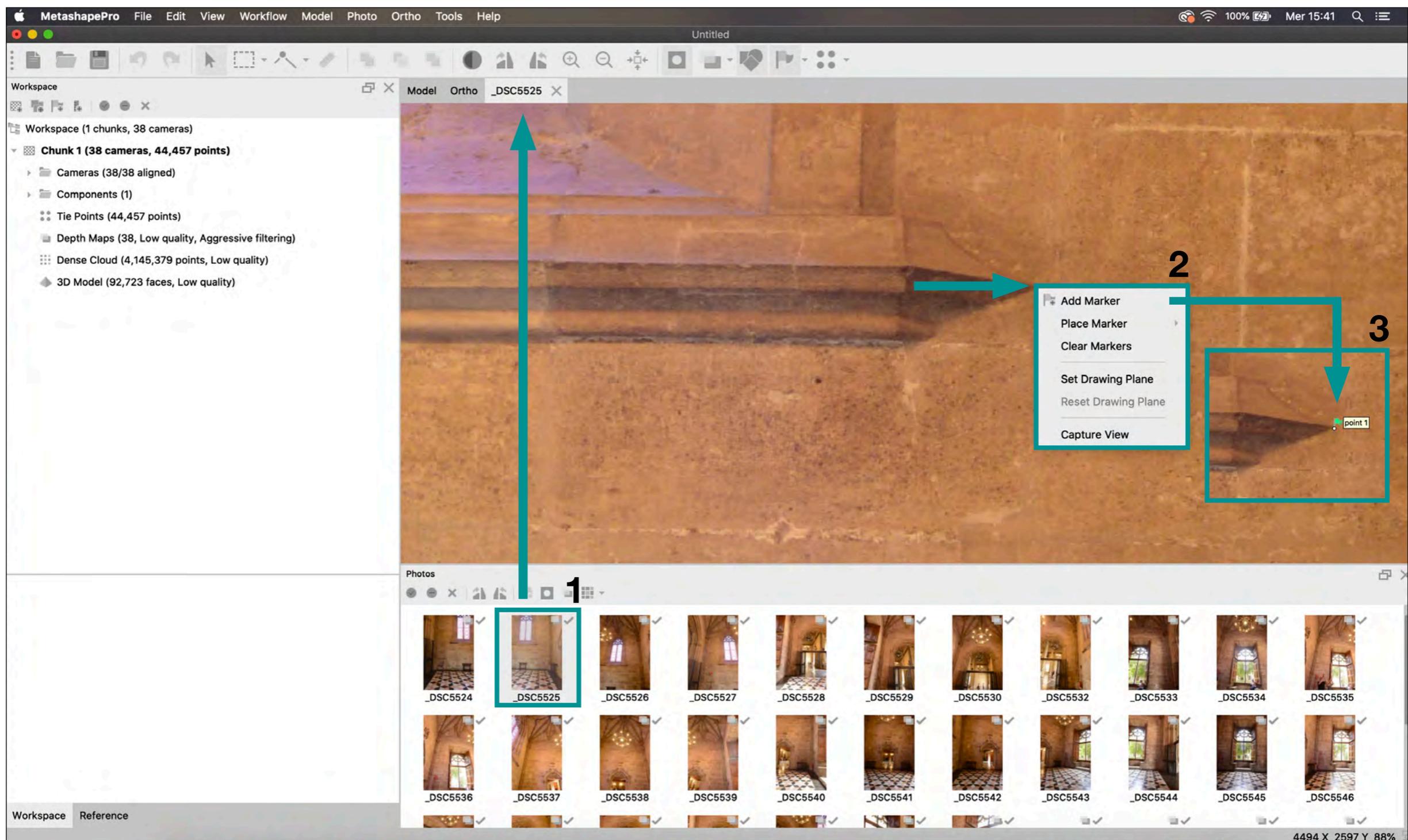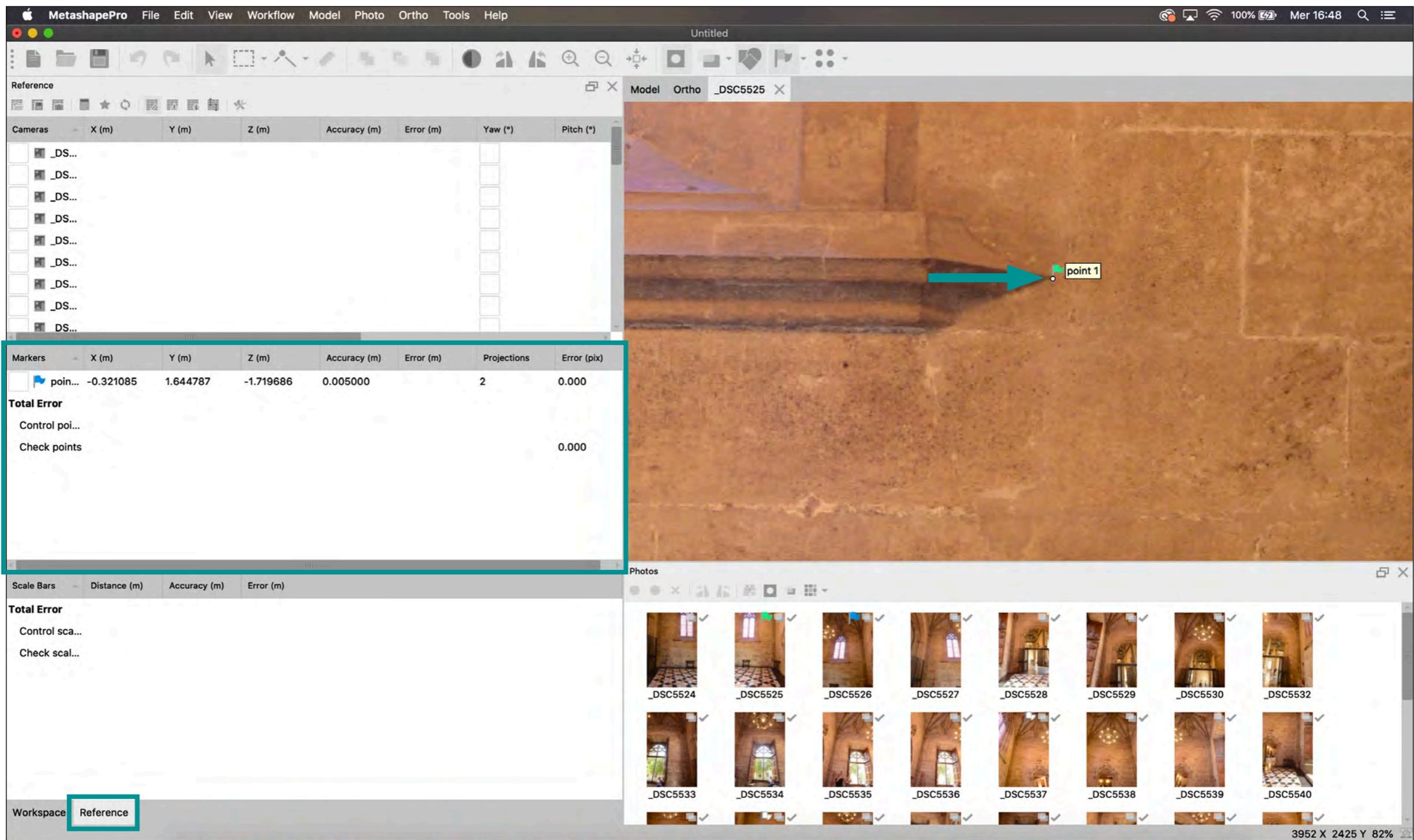
Markers:

To facilitate the identification of the correct alignment of the images but also to be able to scale and orient the model correctly, it is necessary to add manually significant points of which we know the characteristics detected in the field by adding markers to the model. Double click left mouse button on the photo to open it (1) > place in the position where we need to insert the marker > right mouse button (2) > Add Marker (create new marker) (3) or Place marker (if already existing because previously added in other images).
Clear markers deletes all markers in the model.

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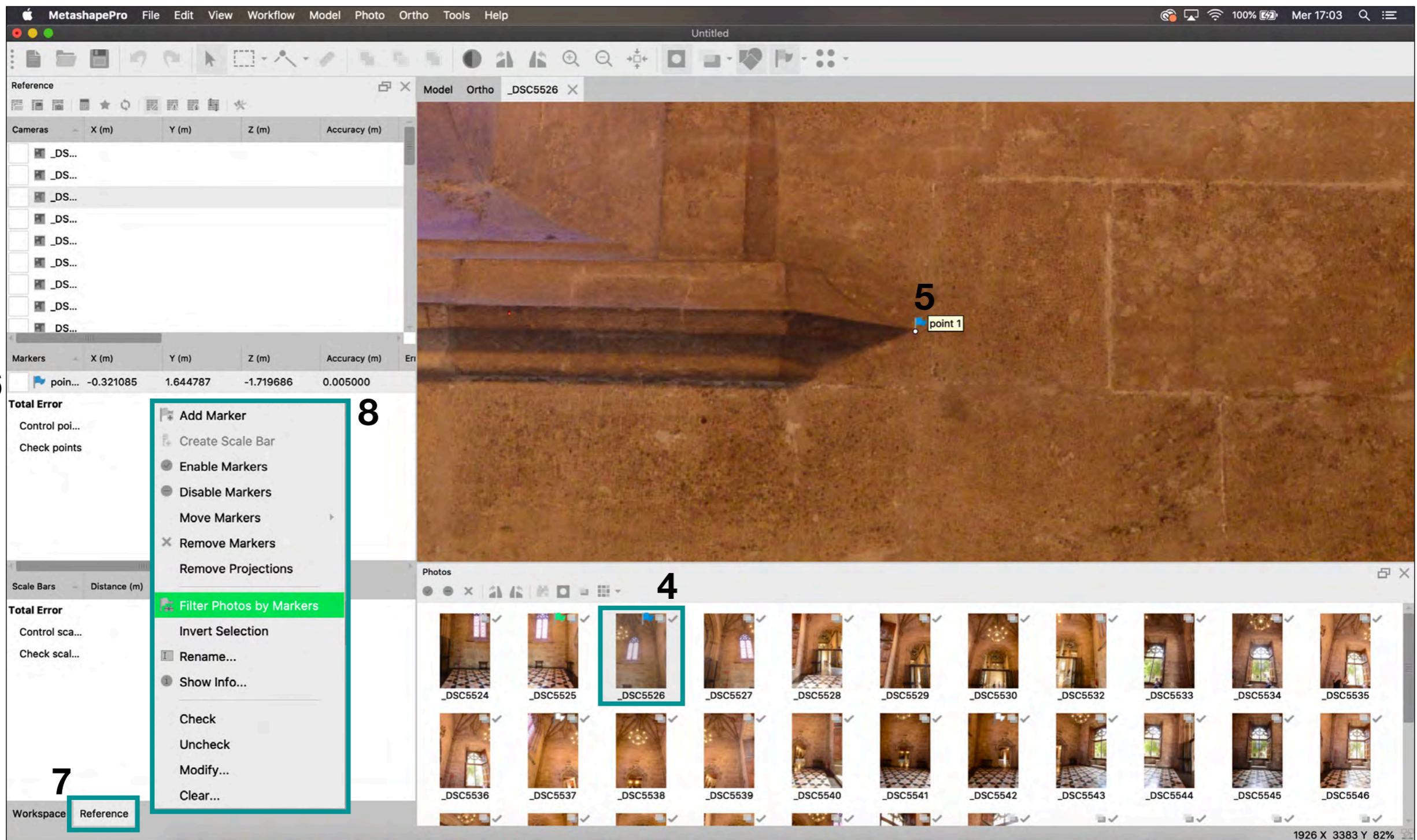
Markers:

Manually relocate the marker for each photo where the reference point appears and is visible (if the marker is present but is not visible do not relocate the marker) (4-5). By right-clicking on the marker name (6) from the "Reference" panel (7) you can filter the grouping of photos containing that marker with "Filter Photos by Markers" (8). Once the marker has been relocated (which will turn out to be blue), the marker is assigned the green color.

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Markers:

From the "Reference" panel where the list of markers inserted in the model will appear, for each marker enter the x, y, z coordinates detected on the place during the survey phase (double click left mouse button on the cell referred to each coordinate).
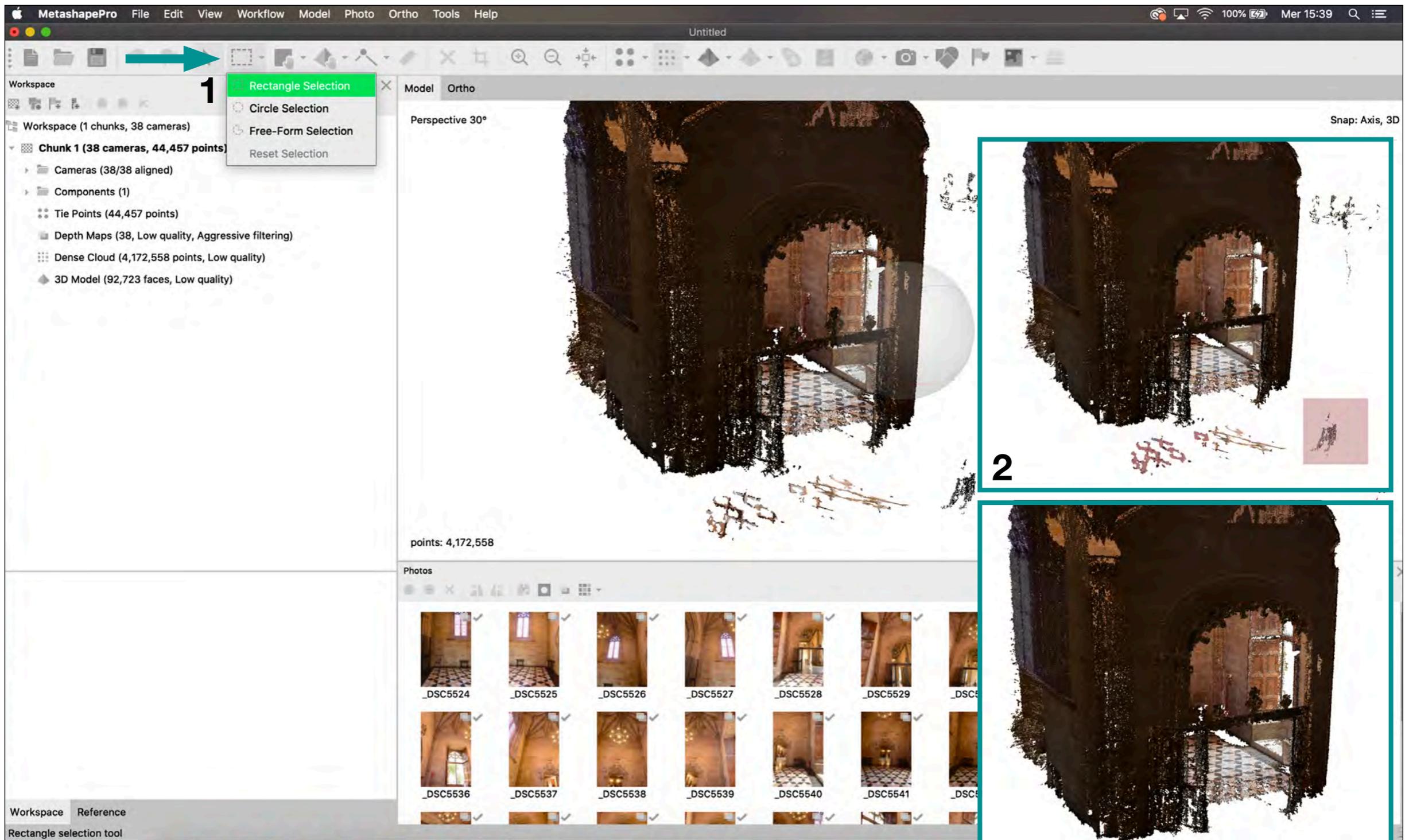
Selection and delete unnecessary points:

From the model in "Pointcloud" view mode, activate the selection command (1) > select the areas of points to remove (2) > delete with "Delete" from keyboard or command X by toolbar (3).
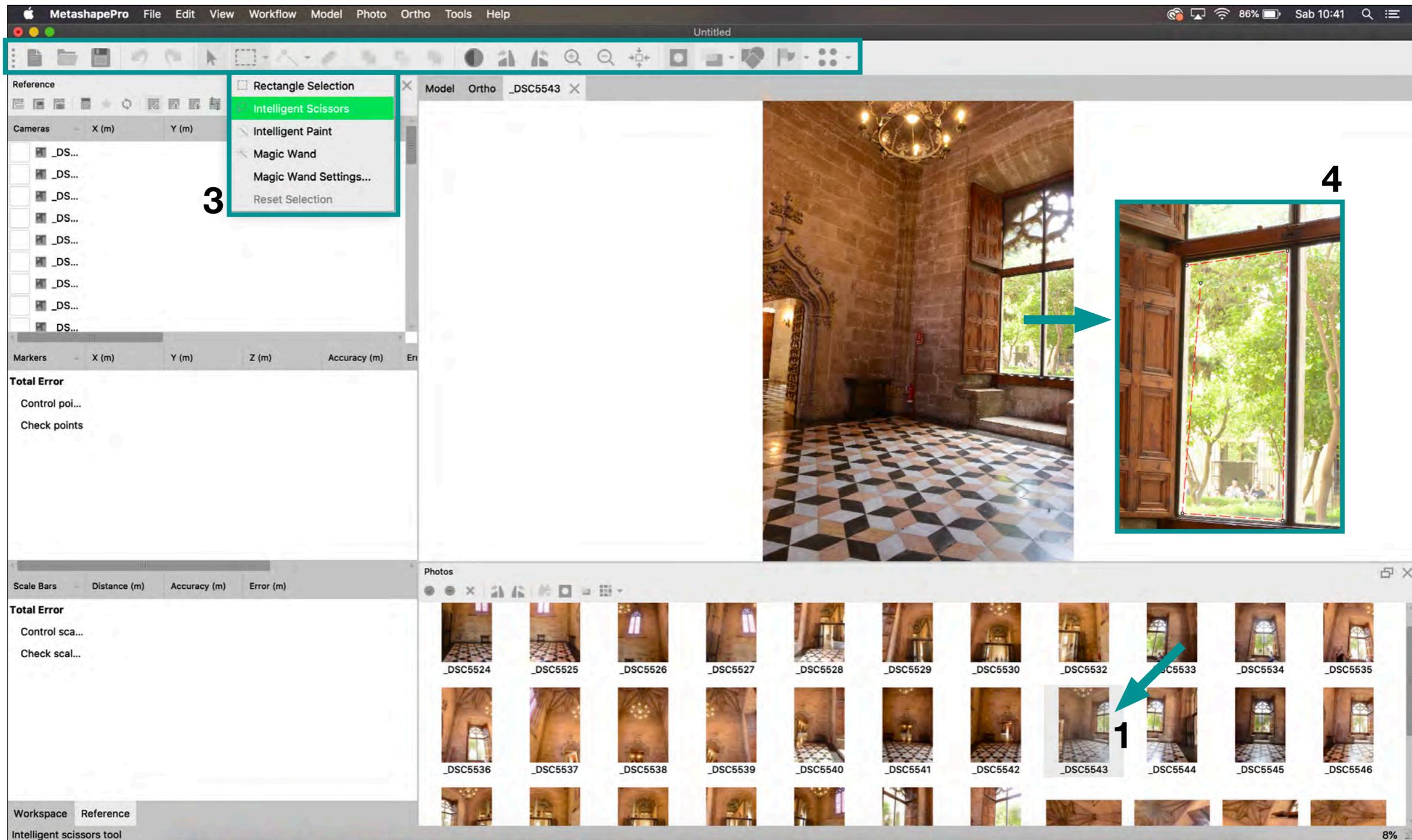
Masks:

To facilitate the alignment process and the identification of points in the images, it is useful to remove from the images the parts that create critical situations (backlight, particularly exposed areas, non-uniform color to other images, areas not involved in the process) or that do not allow an appropriate alignment. It is appropriate in these cases to clean the images with the use of masks. Select the image by double clicking the left mouse button (1) by activating the image editor (the toolbar will be modified according to the operations to be done) (2). Use one of the available selection methods taking care to include the area in a closed polyline (3). The path will be displayed with red dotted line (4).
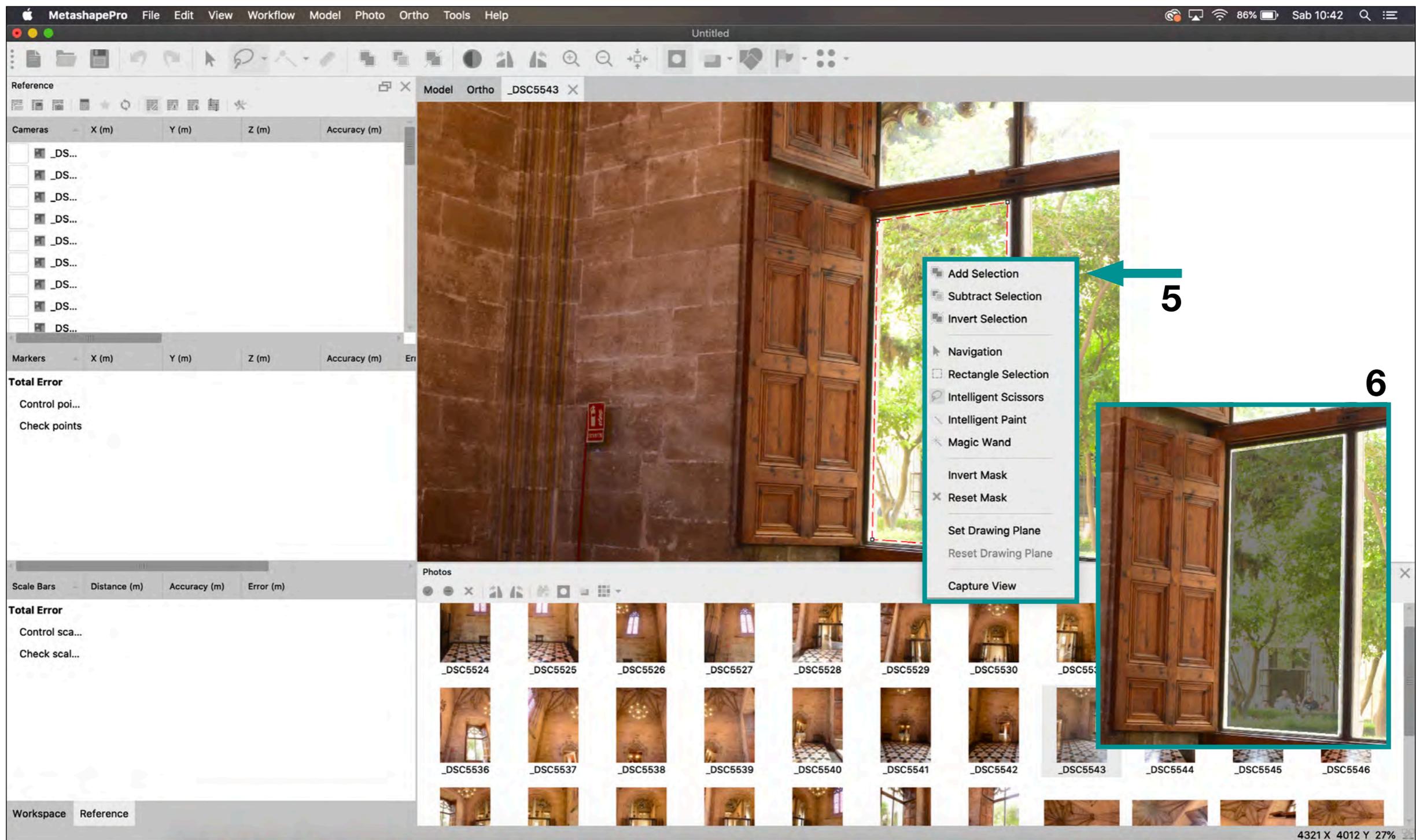
Masks:

Once finished selecting the area to exclude from the process > right mouse button > Add selection (5). The selected area is marked by a transparent gray hatch and the outline with white continuous line (6). This area will be excluded from the process. Important: exclude too large portions of image could lead to the exclusion of the entire image in the process of alignment by the software, as there will no longer be homologous points belonging to other photos; even areas that do not interest the user in the final result can still be useful to the software to identify homologous points and complete the process. When it's possible, is preferred to delete unnecessary areas from the point cloud or mesh.
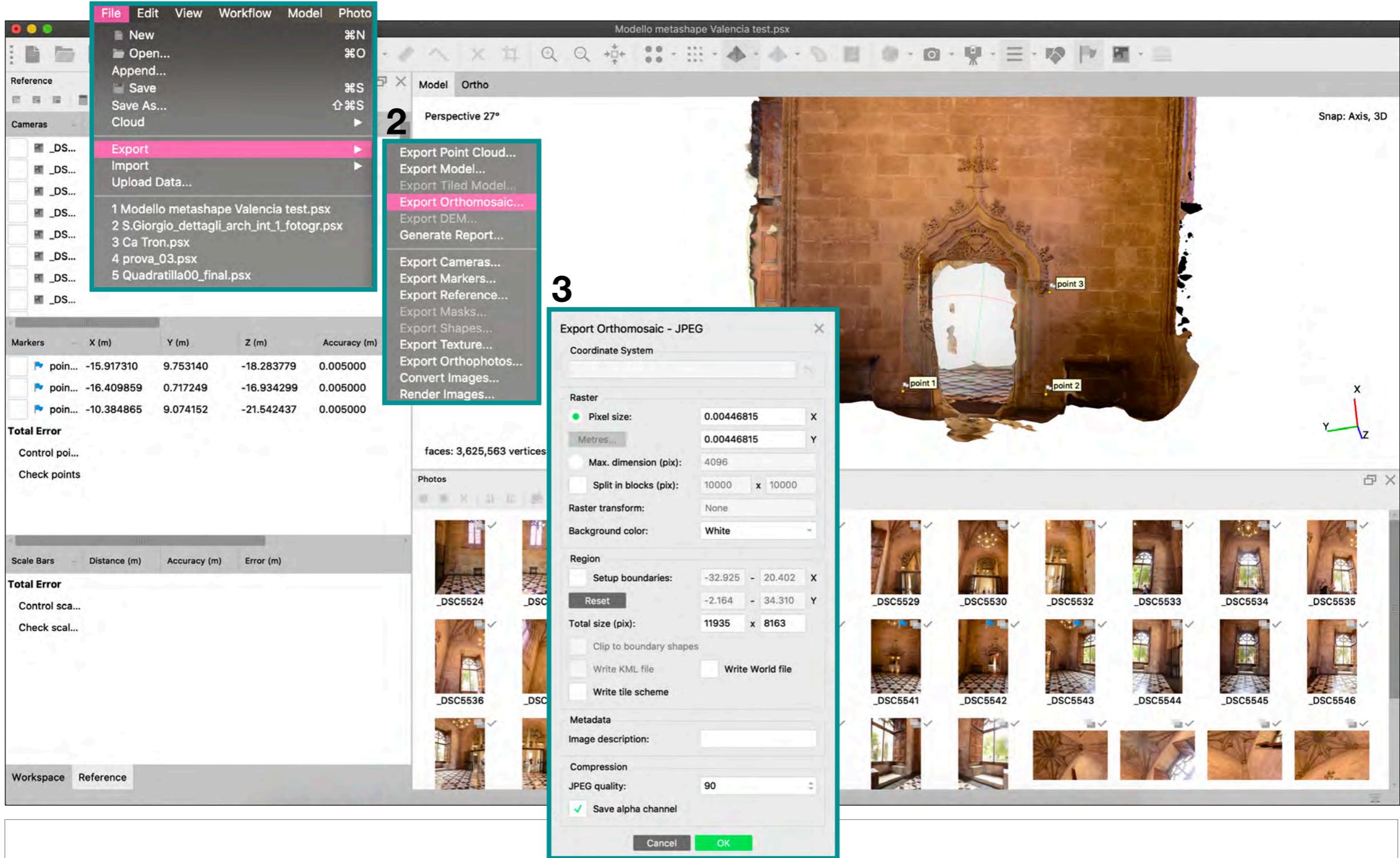
Export data
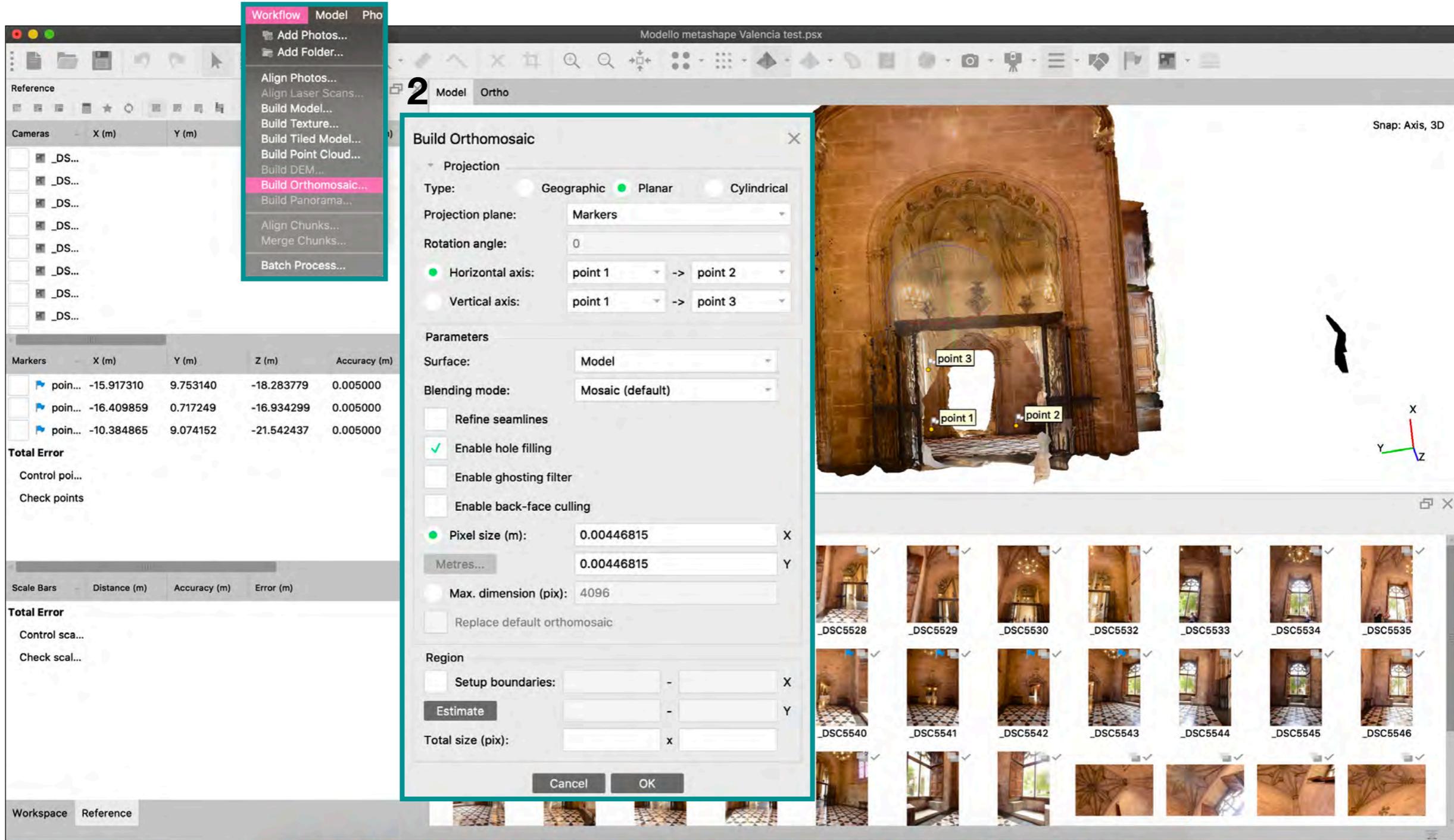
Orthomosaic with markers:

Once obtained the 3d model, there are different options for exporting it. To obtain orthographic views of the surfaces we can create an orthomosaic taking as reference 3 markers which will define the horizontal axis of the image and the vertical one.
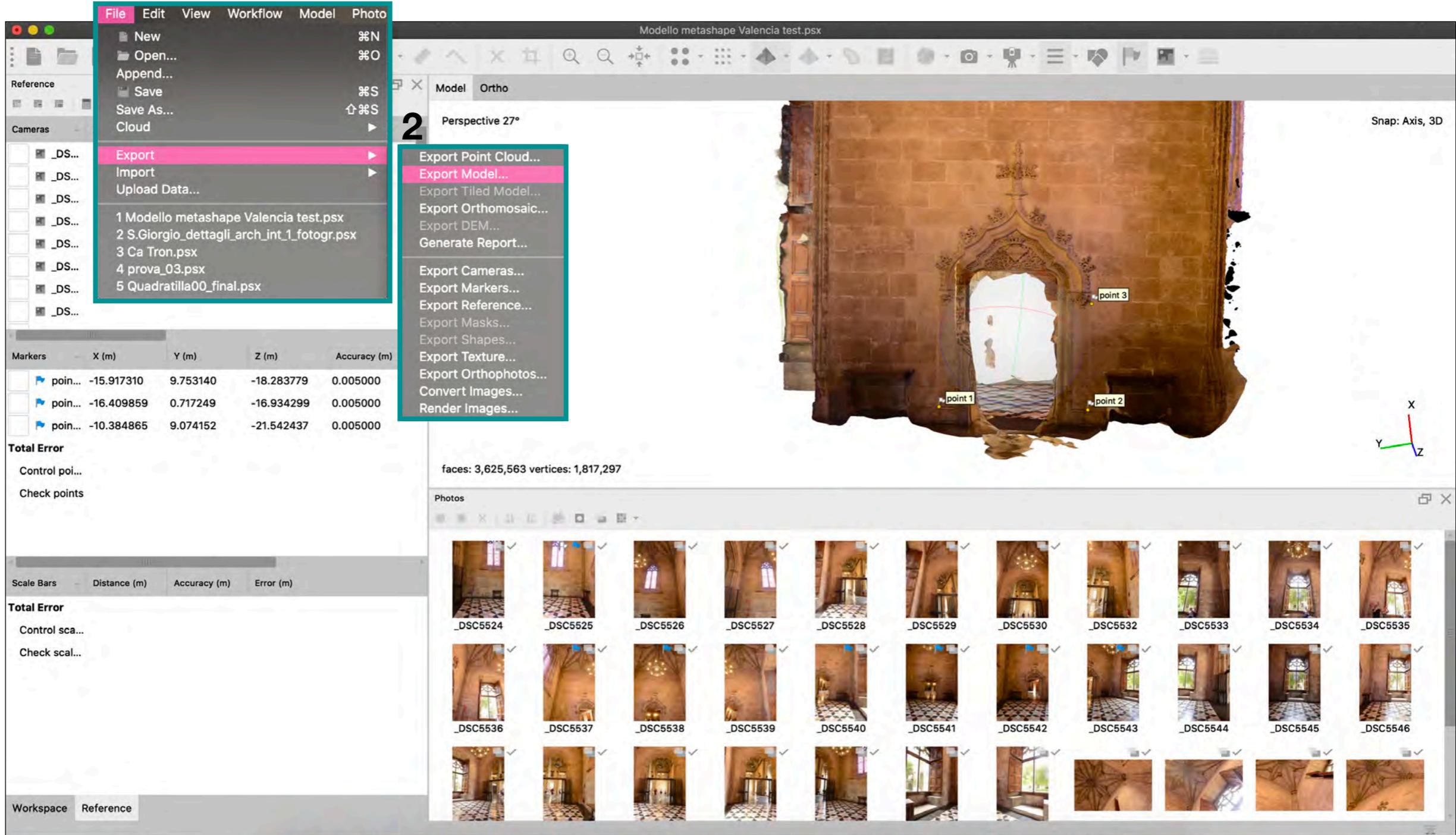
Orthomosaic with markers:

Only once created the orthomosaic it is possible to save it: File > Export > Export Orthomosaic

Orthomosaic with markers:

Exporting the orthomosaic we can save it as a image file and chose the file format, in the example a .jpg file

Export models:

From the export options (File > Export) we can also export the 3d model of the object as Point Cloud (p. 10) or as a textured mesh surface (pp. 12-16).