DIGITISATION OF HERITAGE

TRAINING COURSE

Tech4Heritage

Tech4Heritage

PROGRAMME

1- Introduction to Photogrammetry

1.1 3D heritage documentation techniques

1.2 History of photogrammetry as a 3D documentation technique

1.3 Basics of photogrammetry

1.4 Photogrammetry vs. scanner: a basic comparison

1.5 Uses and applications of photogrammetry in heritage

2 - Camera basics and data capture

2.1 Data capture: introduction and basic concepts

2.2 Imaging strategies (I): large structures and spaces

2.3 Imaging strategies (II): small and medium sized objects

2.4 Lighting control

2.5 Camera basics

2.6 Practical tips for capturing photos

2.7 Other media and accessories: poles and drones

3 - Processing workflow and 3D model editing

3.1 Download, installation and activation

3.2 User interface and menus

3.3 Workflow

3.3.1 Photo Quality

3.3.2 Aligning meshes

3.3.3 Positioning of the model

3.3.4 Creating and Cleaning the Dense Cloud

3.3.5 Creating Meshes and Textures

3.3.6 Scaling of photogrammetric models in Metashape

3.3.7 Exporting models

4 - Photogrammetry and Drones

4.1 How to operate the drone

4.2 Capturing photos from the air

4.3 Drone Harmony App for planned flights

4.4 Metashape workflow for data processing

4.5 Uses and Applications of Aerial Photogrammetry in Cultural Heritage

1- INTRODUCTION TO PHOTOGRAMMETRY

1.1 3D HERITAGE DOCUMENTATION TECHNIQUES

1.2 HISTORY OF PHOTOGRAMMETRY AS A 3D DOCUMENTATION TECHNIQUE

1.3 BASICS OF PHOTOGRAMMETRY

1.4 PHOTOGRAMMETRY VS SCANNER: A BASIC COMPARISON

1.5 USES AND APPLICATIONS OF PHOTOGRAMMETRY IN CULTURAL HERITAGE


Fíala del carnisser
by Museu d'Arqueologia de Catalunya
2
5
1
3
Select an annotation
HD

3D MODEL ?

Image Capture Technologies - Photogrammetry

Volume Capturing Techniques - 3D Scanning

Direct modelling using a 3D design program

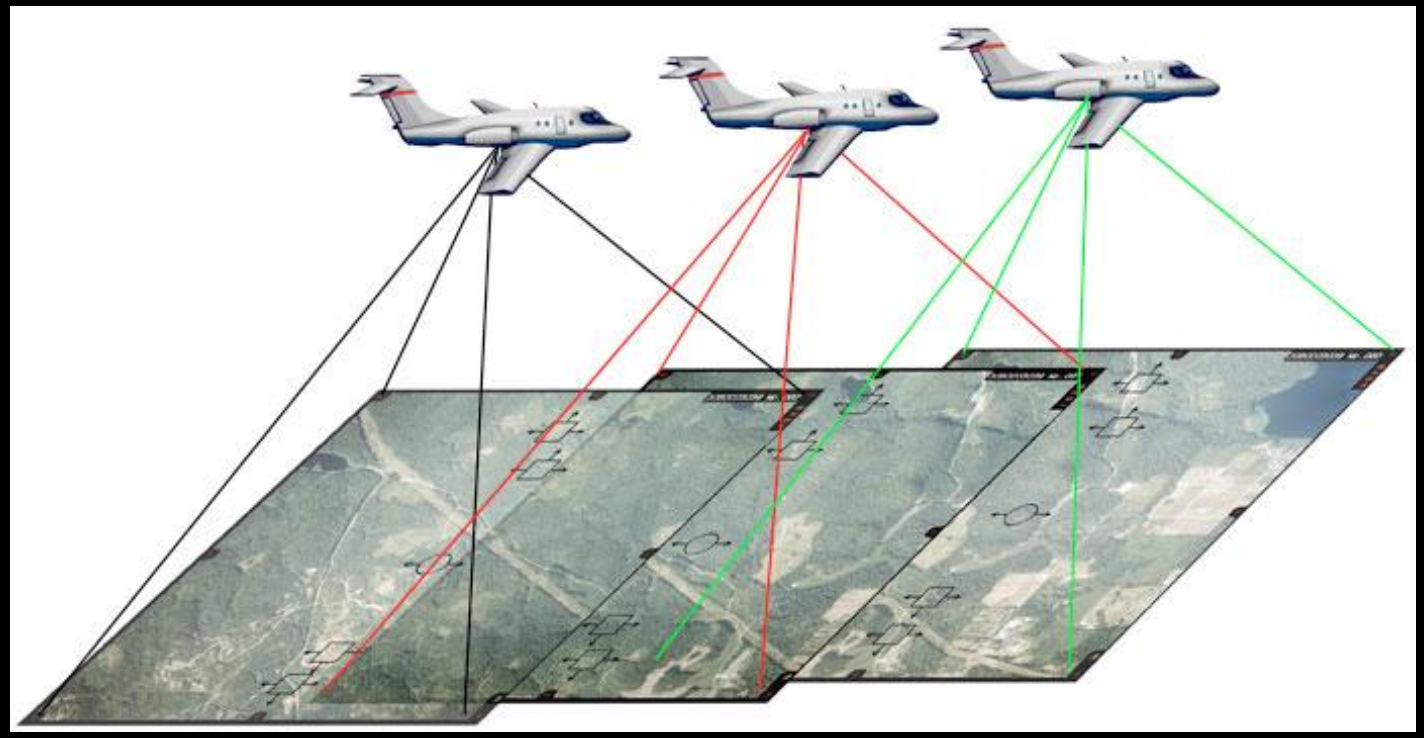
What is Photogrammetry?

The “art, science and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting photographic images and patterns of electromagnetic radiant imagery and other phenomena.” (American Society for Photogrammetry and Remote Sensing 1980)

Aerial and analogue photogrammetry (1950-1990)

- Recording large areas from the air was the first application of photogrammetry. Widely used to document large cities or archaeological sites.

- In the 1970s, analogue terrestrial photogrammetry began to be practiced, in this case to document buildings and large archaeological sites by obtaining orthophotos – rectified images that lose all perspective and can be used as planimetry.

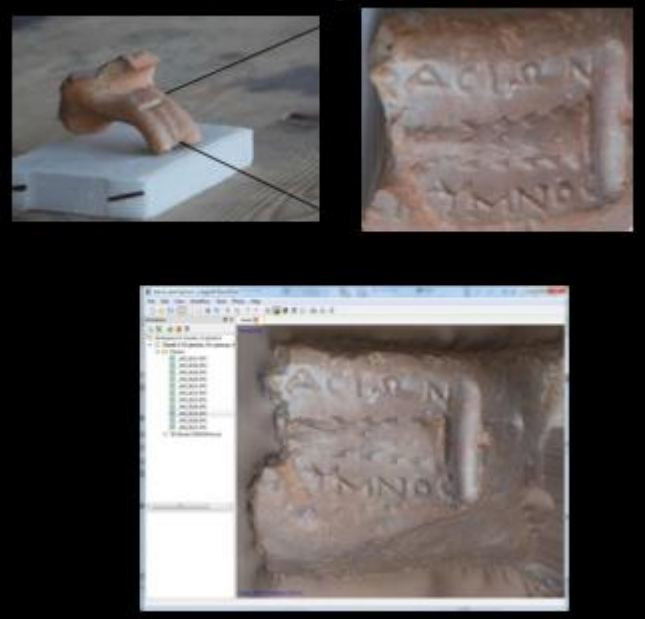


Digital Photogrammetry (1990-Current)

In recent years, there has been an increase in the use of photogrammetric data for Archeology, due to the combination of several factors:

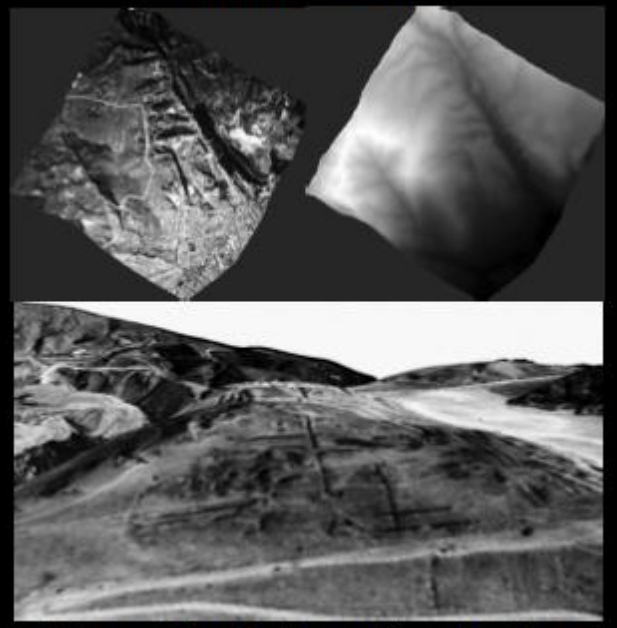
- Development of affordable photogrammetric processing software packages;
- The progress of digital cameras, with cheap models capable of capturing high quality images;
- Improvement in the processing capacity of personal computers;
- In the aerial case, the use of unmanned devices (UAVs or drones) as platforms for capturing high-resolution low-altitude aerial images.

Close-range DSLR Scale



Amphora stamps from Ancient Athenian Agora
(with American School of Classical Studies at Athens

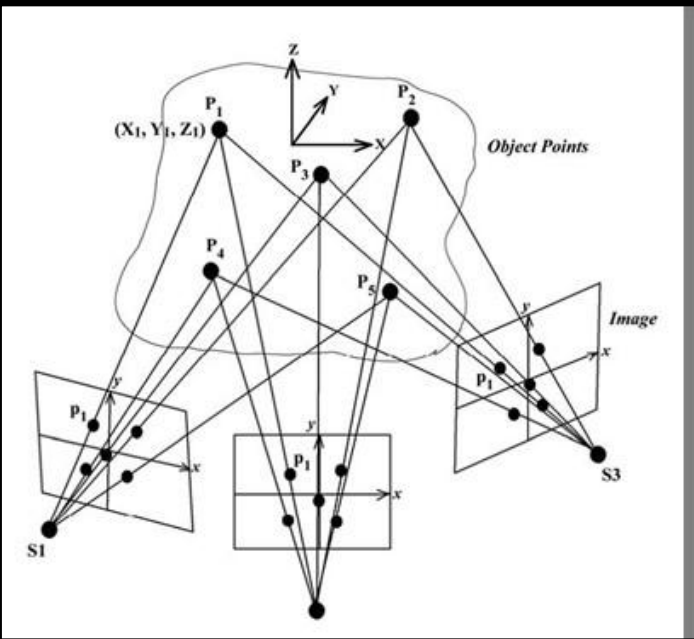
Aerial Photo Scale

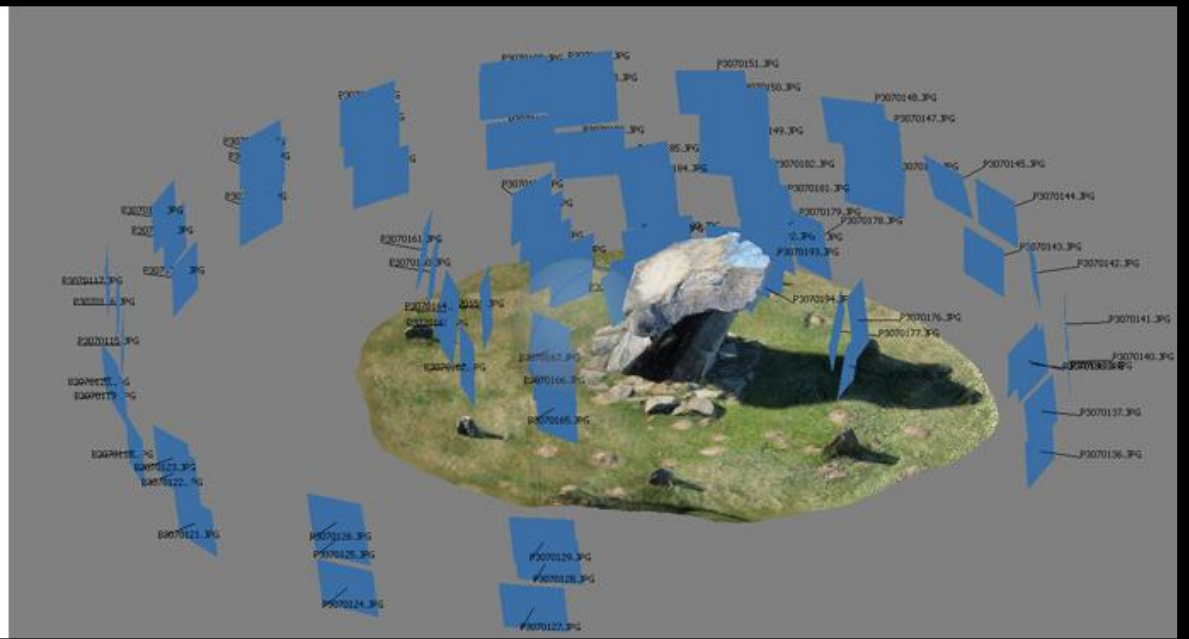


DEM generated from historic images of Cusco, Peru Cotsen Institute/UCLA Geomatics Field school 2009)

Photogrammetry: the production of 3D models from photographs

- Photogrammetry consists of making 3D models from photographs. The photographs are taken in such a way that the images can later be superimposed on each other.

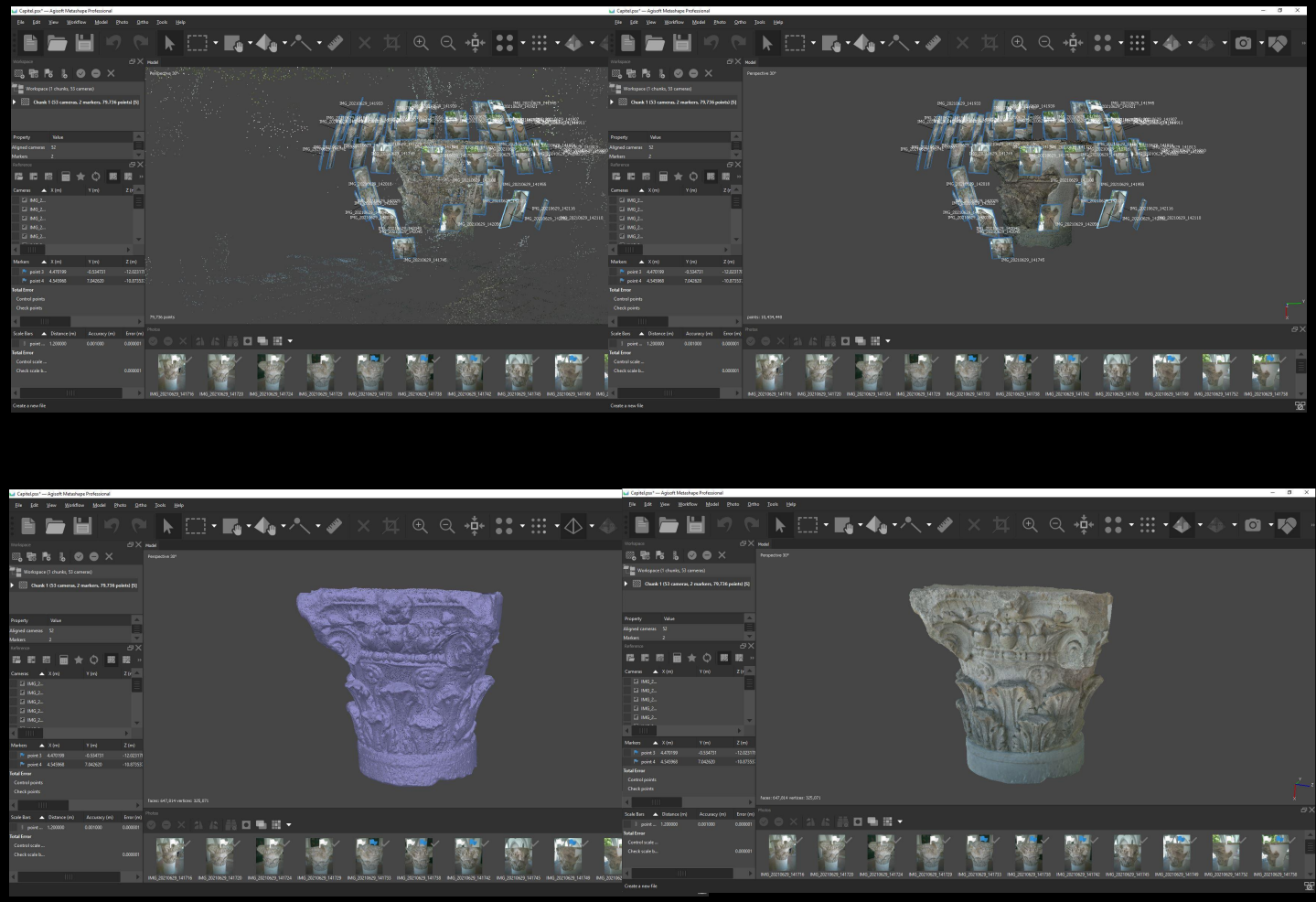





Naïve Processing
Default/Blackbox processing
Easier results for visualization
Quick results
123D Catch
Visual SFM
PhotoModeler Scanner
Photoscan
Rigorous parameter selection
Goal and project specific pipeline
More metrically reliable
Time and computation intensive

Photogrammetry: the production of 3D models from photographs

- A specialised program processes the images, finds coincident points, and then calculates their location in three-dimensional space to produce a point cloud, which reproduces the shape of the original object. If these points are joined with lines, a network of triangles, or mesh, is created, on the surface of which it is possible to add the colours and textures captured in the photographs. At the present time the most frequently used photogrammetry programs are Metashape and ReallityCapture.



3D scanner, registering position points

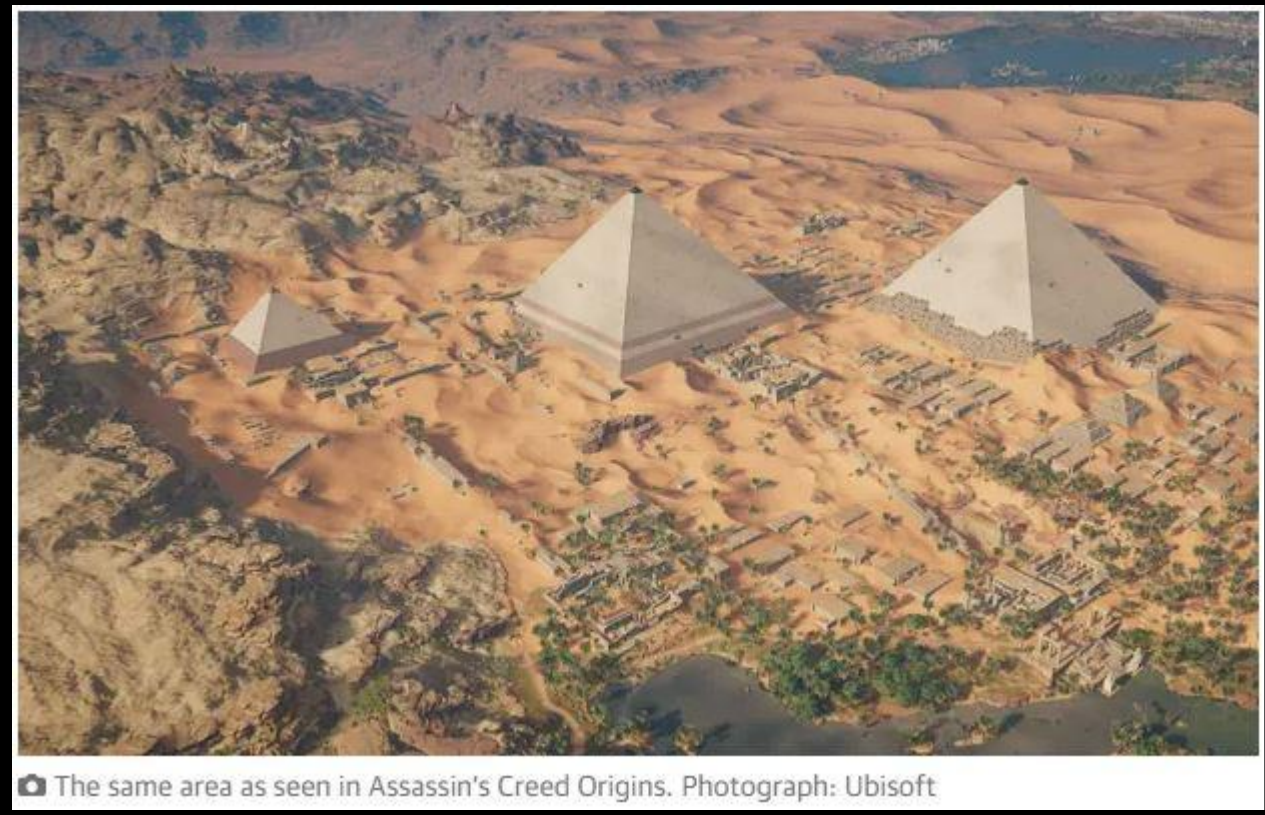
- 3D scanners register position points using laser beams, in the case of laser scanners or, in the case of structured-light 3D scanners, by means of projecting stripes of white light.

- The laser scanner works by firing a laser beam at the surface of an object, which is then sent back to the device in such a way that the position of the point of impact is registered. An extremely precise three-dimensional image of the scanned object's shape is produced by the automatic repetition of this procedure over every few millimetres of the object's surface. This information is then processed, using programs such as Leica Cyclone, Scene or ReCap, to produce a point cloud which, as with photogrammetry, enables three-dimensional models to be created.

1.5 USES AND APPLICATIONS OF PHOTOGRAMMETRY IN CULTURAL HERITAGE

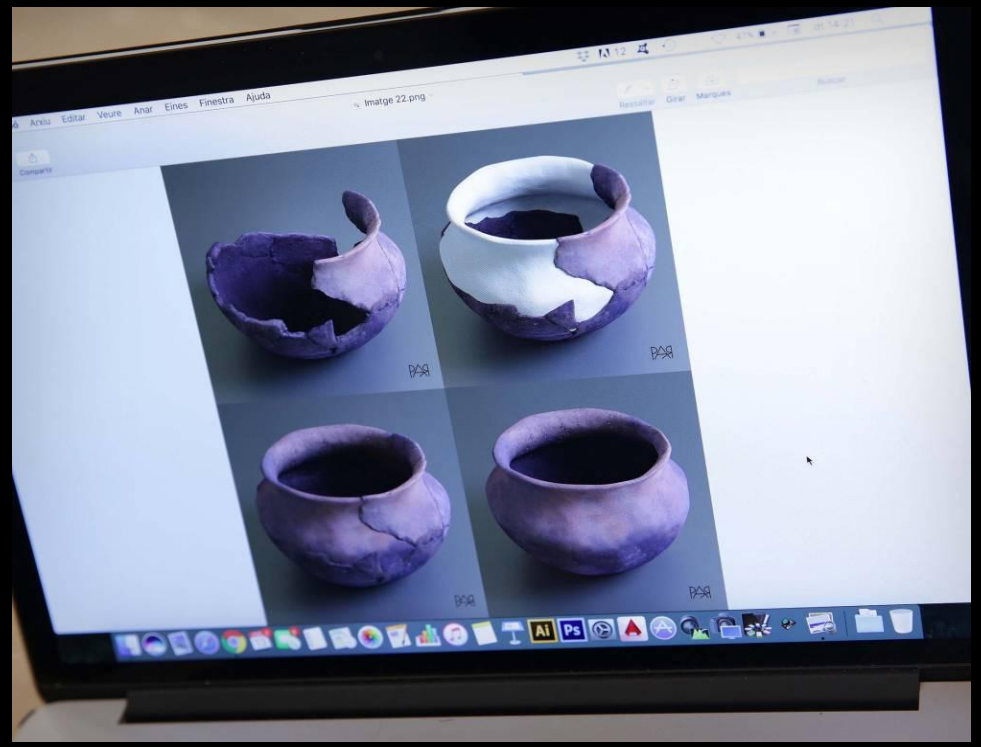
3D models have been used for many years for special effects in cinema and 3D videogames. They have also been used in cultural heritage for decades, but only very occasionally. Over recent years, however, technical advances have been such that many institutions, and people working in the field of cultural heritage, now have this technology within reach. With it they can perfect some of their previous procedures and they can also use it to explore completely new avenues.

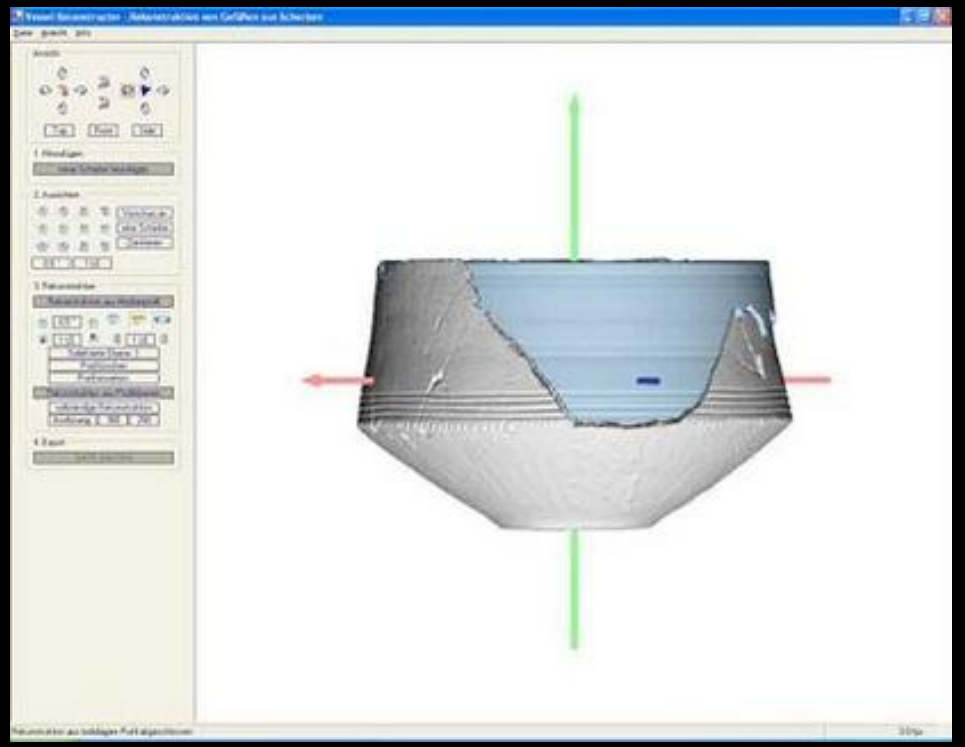
The Giza Plateau painted by Jean-Claude Golvin. Photograph: Jean-Claude Golvin



The same area as seen in Assassin's Creed Origins. Photograph: Ubisoft

- **Restoration/conservation:** In the field of restoration the use of 3D models can detect deterioration and deformations that would otherwise be invisible. It can also be used to create a register of these flaws over time by capturing data at regular intervals. In the case of fragmented works, it makes it possible to study the way in which the fragments fit together, without having to touch them, and it also makes it possible to create moulds of the missing pieces, or supports which are perfectly adapted to the pieces themselves.

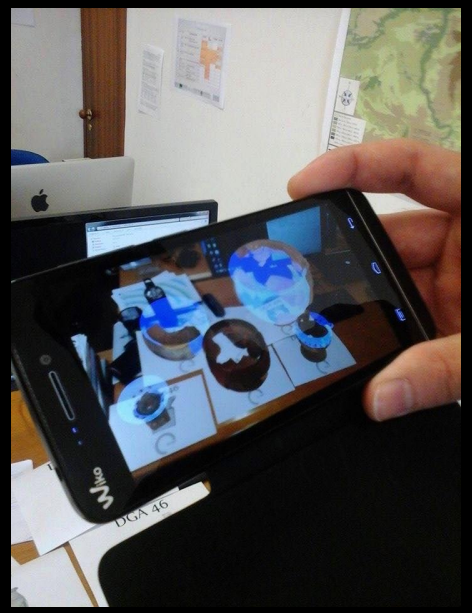


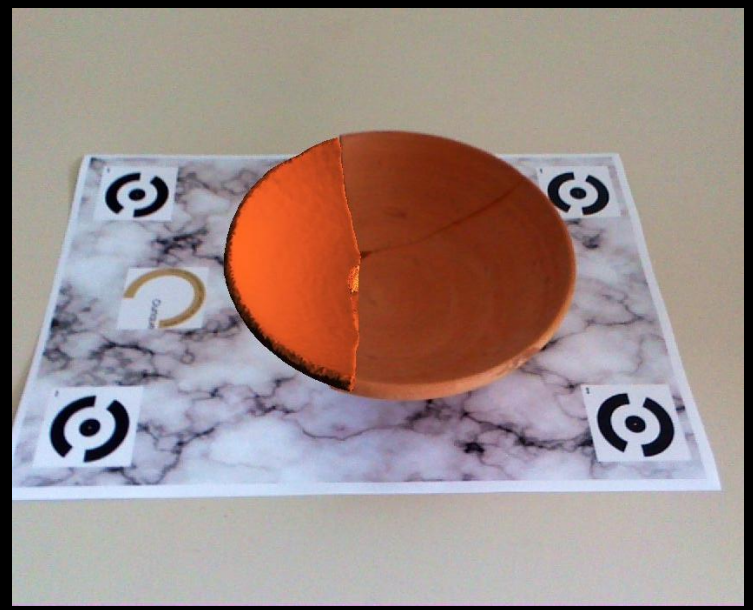


- **Documentation:** For years the documentation accompanying elements of cultural heritage, especially buildings, has been produced with the use of photography and plans. In a few years' time, it will be difficult to find documentary databases without 3D models because they constitute an integrated registry of information, and they provide a visualisation that is much closer to reality. In the case of buildings at risk, or in areas of conflict, detailed documentation such as this can be a very useful tool for use in partial or total reconstruction.

- **Research:** When we publish a 3D model of a Baroque sculpture or a prehistoric axe, we are placing a very valuable resource at the disposal of researchers throughout the world. To be able to see the object from all points of view, to be able to amplify the image, and even change the position of the light source illuminating it in order to find irregularities on its surface, is almost like having the original object in one's hand.

- **Dissemination:** The ability we now have to show three-dimensional objects via the Internet on any device, including tablets and mobile phones, means that we can reach a very wide public and make cultural heritage more accessible to a younger audience. 3D models also open up new possibilities for communication, such as Augmented Reality, in which the object appears on screen, integrated into the environment being captured by the camera of a mobile phone, or Virtual Reality whereby, with some simple cardboard VR glasses, it is possible to see the object in three dimensions in a completely realistic way.





2 - CAMERA BASICS AND DATA CAPTURE

2.1 DATA CAPTURE: INTRODUCTION AND BASIC CONCEPTS
2.2 IMAGING STRATEGIES (I) - LARGE STRUCTURES AND SPACES
2.3 IMAGING STRATEGIES (II) - SMALL AND MEDIUM SIZE OBJECTS
2.4 LIGHTNING CONTROL
2.5 CAMERA BASICS
2.6 PRACTICAL TIPS FOR CAPTURING PHOTOS
2.7 OTHER MEDIA AND ACCESSORIES: POLES, TRIPODS AND DRONES

2.1 DATA CAPTURE: INTRODUCTION AND BASIC CONCEPTS

PLANNING

Know your object/site beforehand and adapt your workflow

Know the ultimate purpose of our work. This may imply different levels of detail, resolution and precision may be required.

The "outputs" or infographic materials we must produce (3D file, video virtual tour, web viewer, orthophotos, integration into virtual recreation, etc.)

The “audience” for which said products are intended.

Required level of geometric accuracy: The accuracy we want reflected from the real object in our geometric model.

Detail level (“resolution”) of the three-dimensional model: is determined by the number of polygons in the three-dimensional model.

Surfaces to scan: we will determine them depending on the type of object, the purpose of the work and possible constraints

2.1 DATA CAPTURE: INTRODUCTION AND BASIC CONCEPTS

ANALYSIS

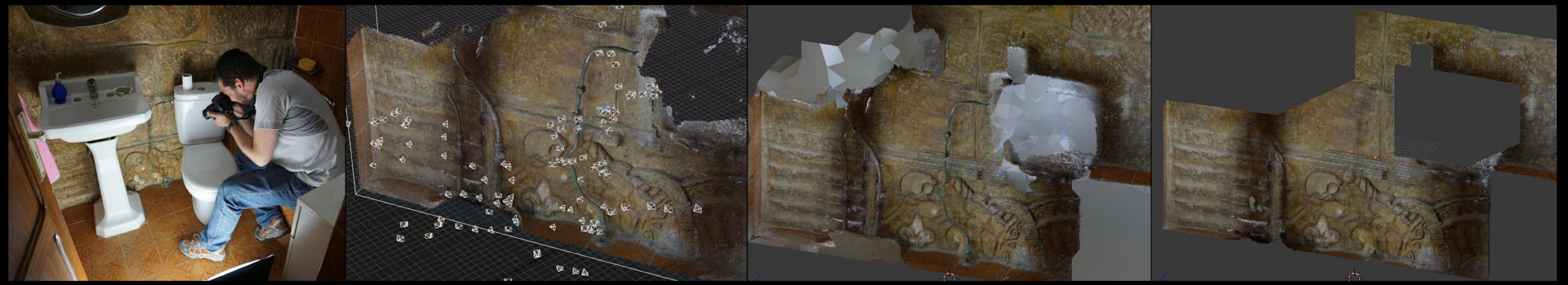
Object size: photogrammetry can be useful both for small objects (for example, a coin) and for large surfaces (a building or an archaeological site), however, obviously, both require different equipment to do it correctly (from a macro lens for small objects, even a drone for large surfaces).

ANALYSIS

Location: when objects cannot be moved, their location can completely affect capture (available angles, narrow surroundings, elevation, orientation, etc.). In some cases we will need accessories or special equipment.

ANALYSIS

Obstacles: We must consider the possibility that foreign bodies interfere with data collection (vegetation, presence of the public, objects or equipment on the public road, etc.) We may need prior cleaning, narrow the area or dismantle some installation .



ANALYSIS

Contrast: it is convenient for the object to stand out as clearly as possible against the background, which can be easily achieved in studio conditions, but almost never when done in situ.

2.1 DATA CAPTURE: INTRODUCTION AND BASIC CONCEPTS

ANALYSIS

Lighting: being able to take photographs with controlled lighting or depending on the existing conditions (especially outdoors) is important to make decisions that allow us to obtain adequate photographs.

Brightness, shadows and backlighting: these are the main constraints for the photogrammetric software to obtain good geometry. We will see later how to mitigate its effects.

Things to avoid

- Very dark surfaces
- Reflective surfaces
- Transparent surfaces (including water)
- Uniform textures and solid color surfaces
- Moving light sources/shadows
- Capturing your own shadow

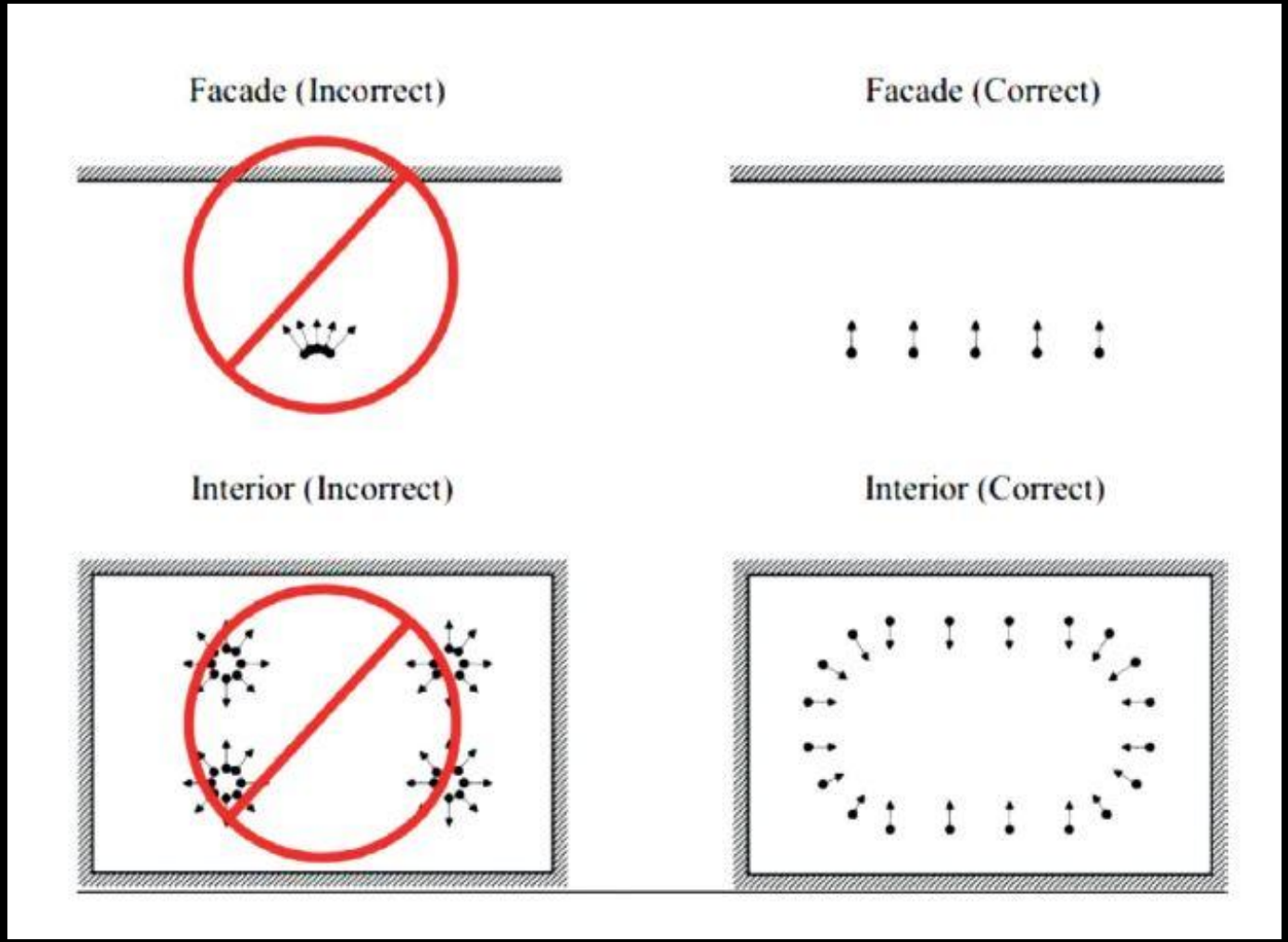
ASPECTS TO CONSIDER WHEN TAKING PHOTOGRAPHS

Planning the camera position

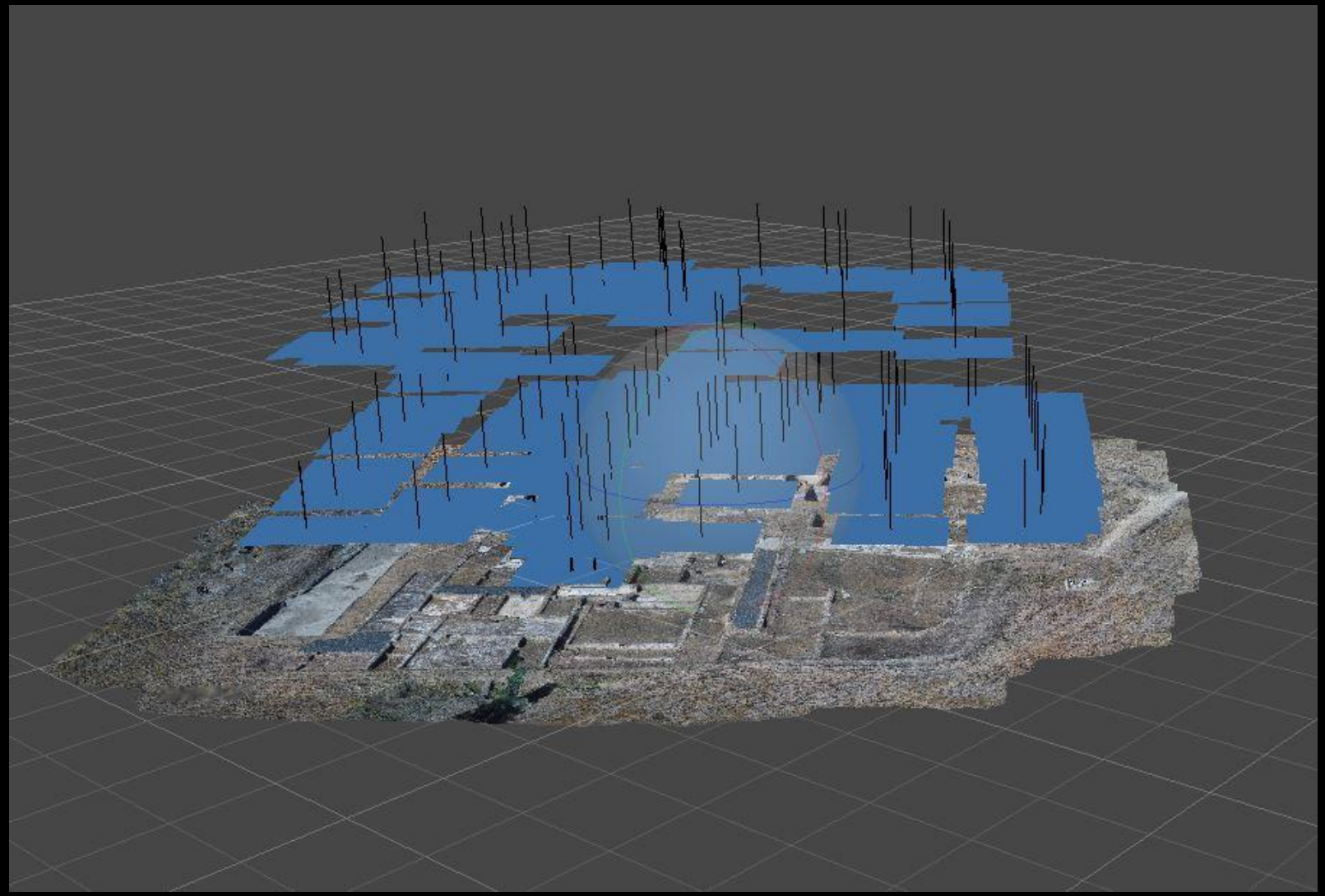
Overlap of the images at least 60%

Provide some detail in keypoints/features

Move Camera between shots



2.2 IMAGING STRATEGIES (I) - LARGE STRUCTURES AND SPACES



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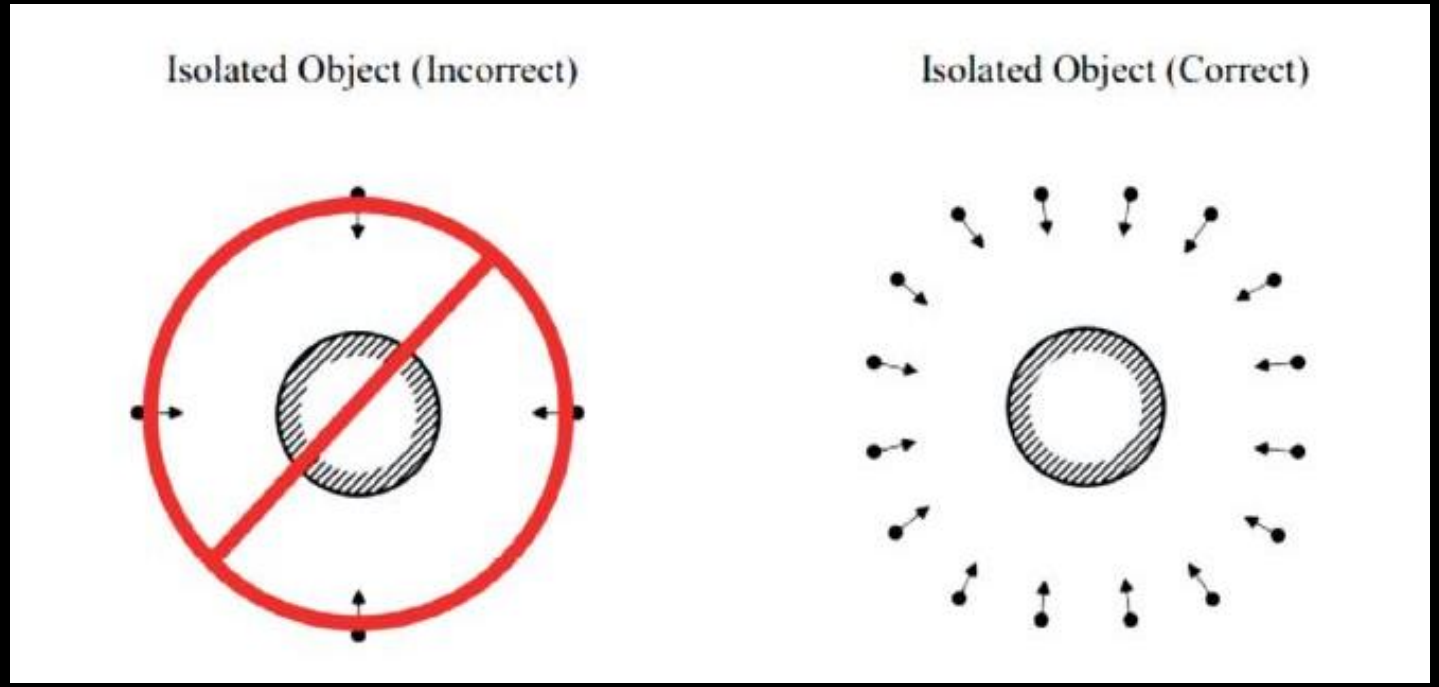


2.3 IMAGING STRATEGIES (II) - SMALL AND MEDIUM SIZED OBJECTS

Setup the lightning and shooting environment

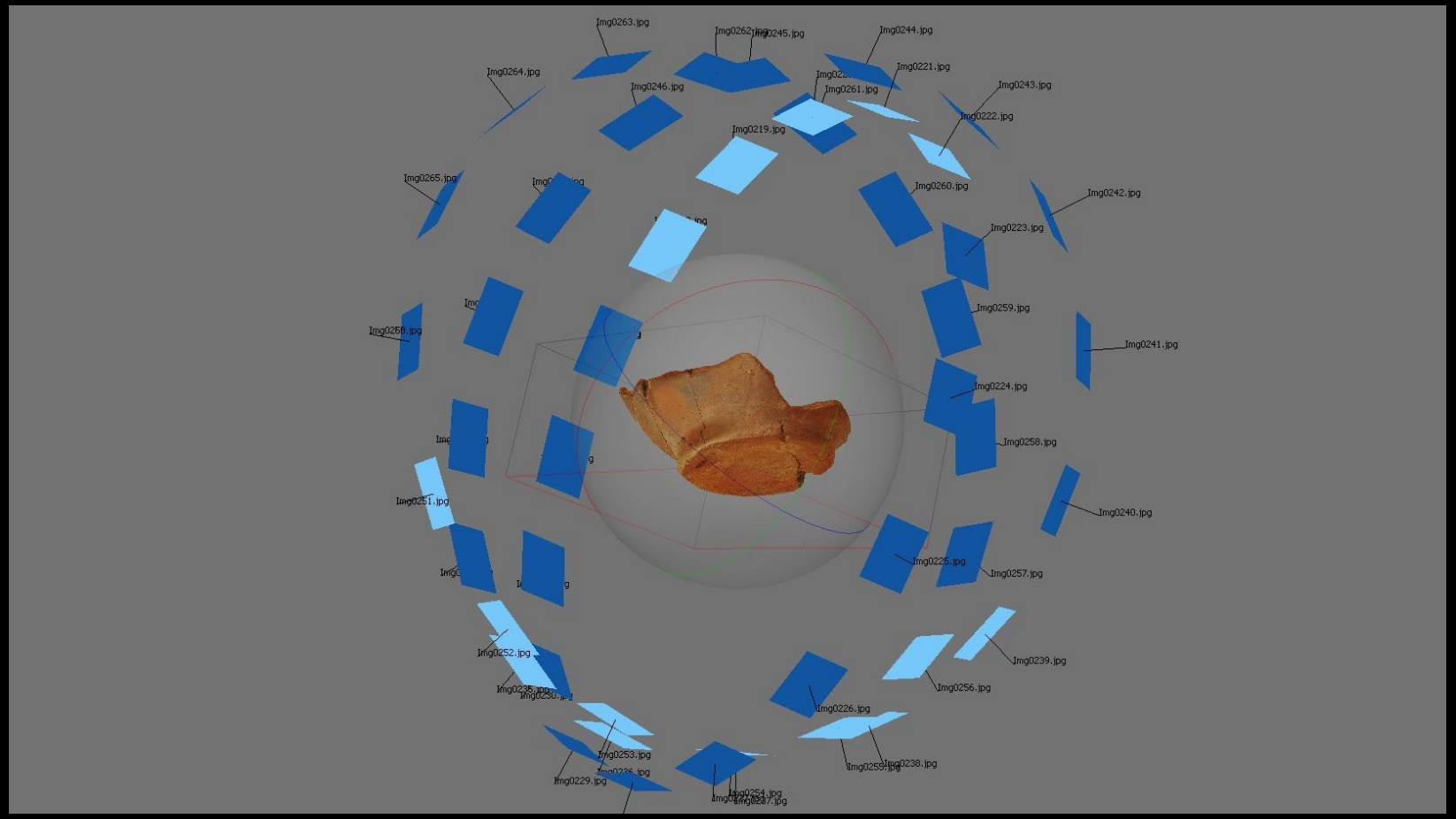
Position the object

Set the camera focus, aperture and shutter time

Photograph the object around from all sides

Reposition the camera, focus if needed, and repeat

Reposition the object



Can we control existing lighting?

If we have to use natural lighting, what time is it most suitable?

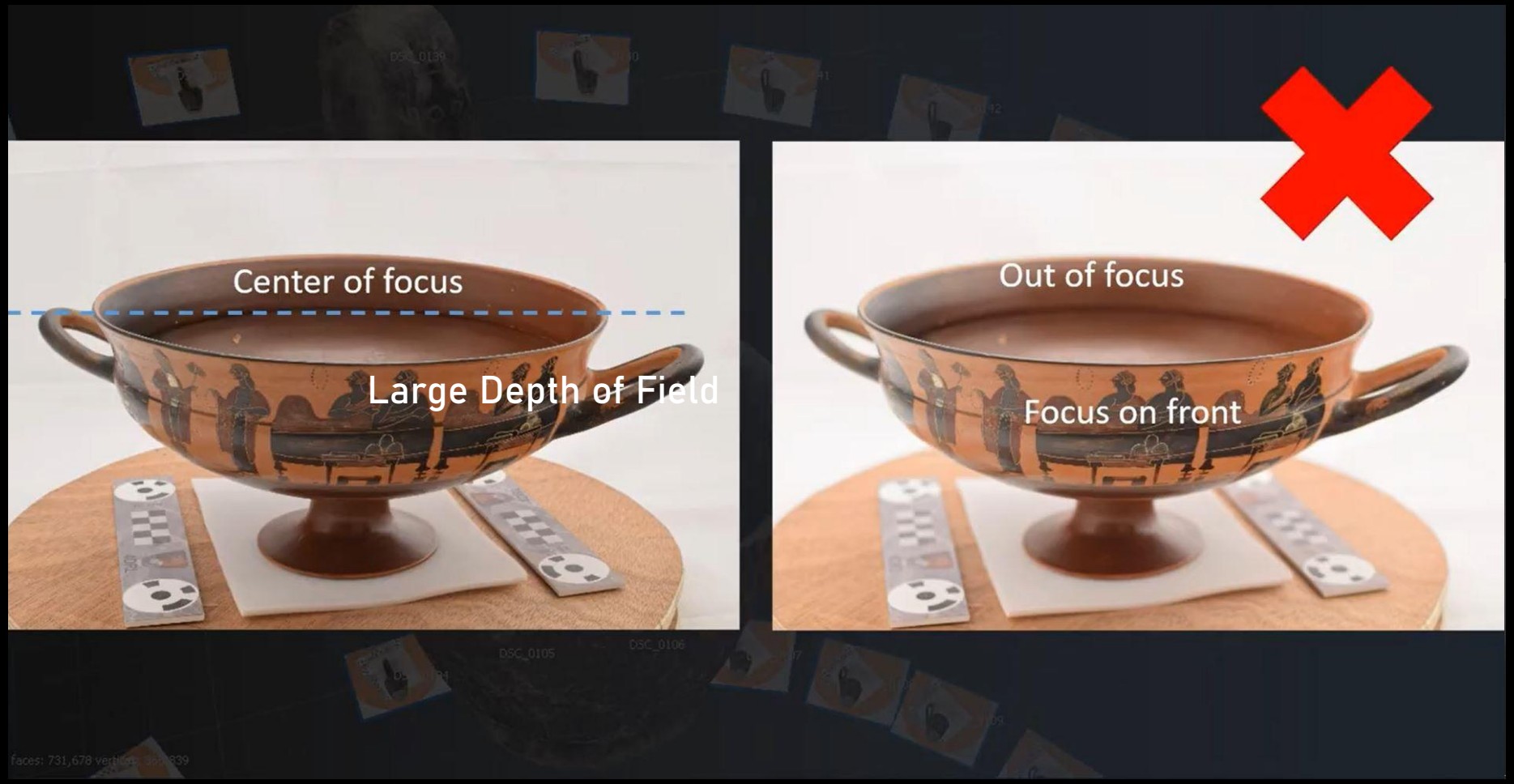
Remember that the best lighting is diffused, without strong light-shadow contrasts.

If we can't control the conditions, can we somehow mitigate them with the equipment? Can we improve the photos with later adjustments?

Available lighting is never completely neutral and can distort colors. In order to be able to correct it through image treatment software, we can embed a color checker

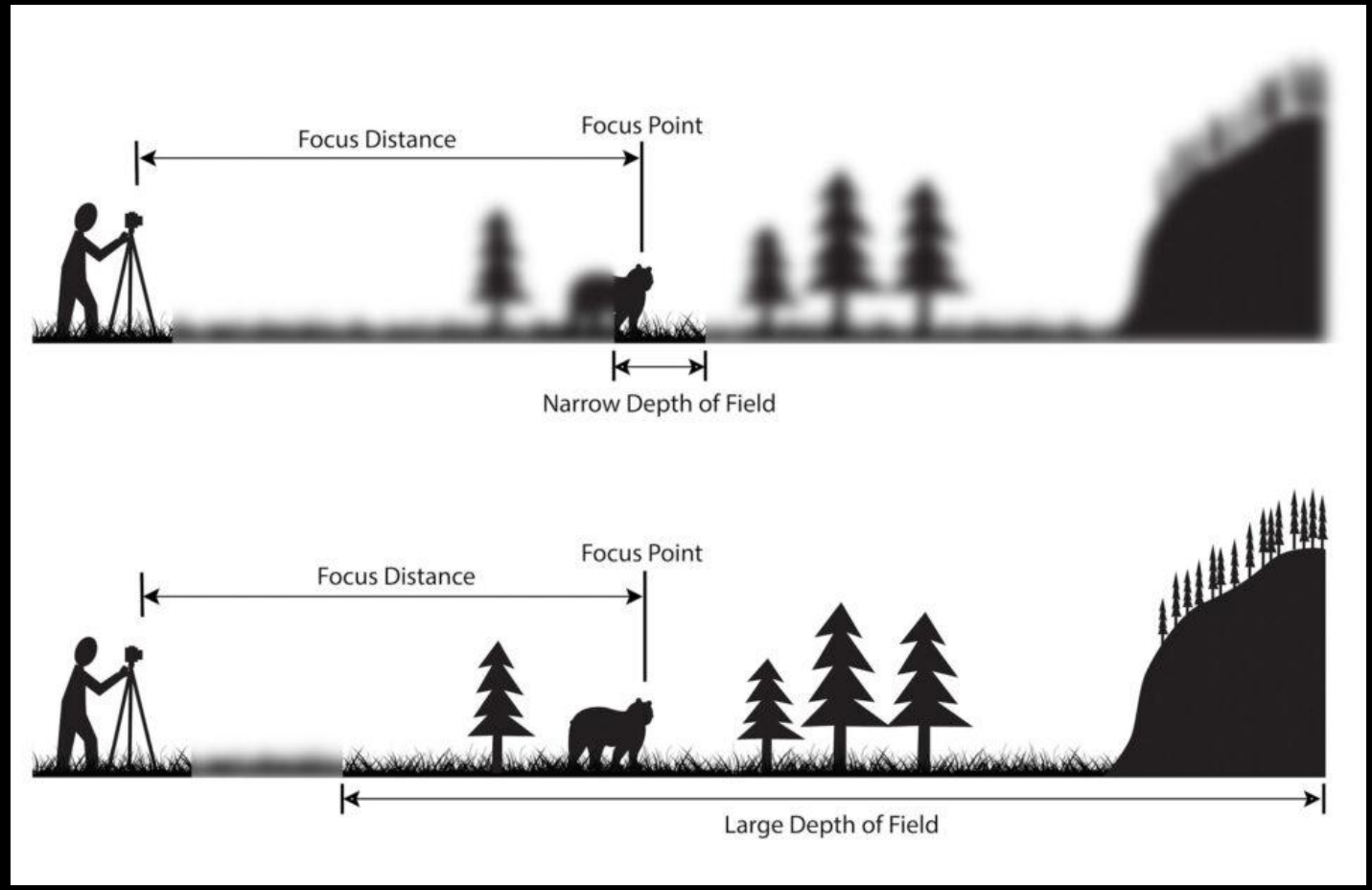
CAMERA SETUP

Manual focus



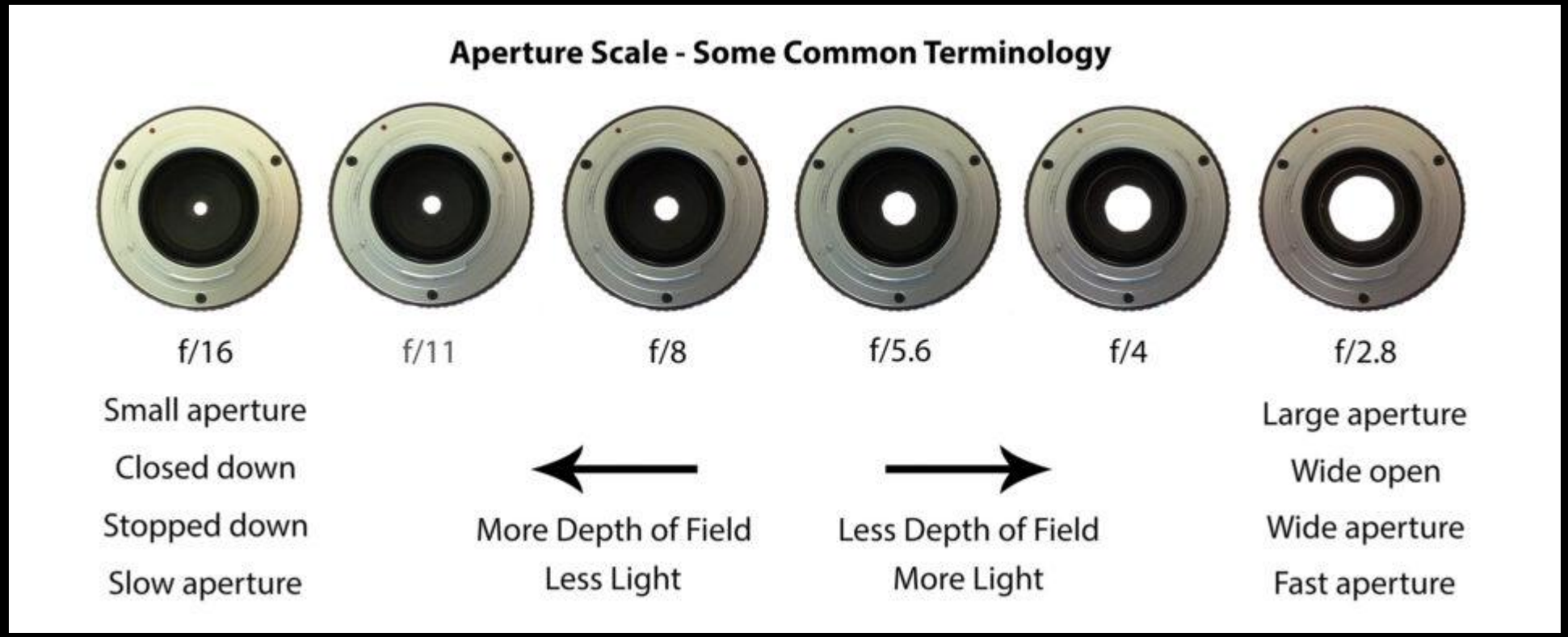
CAMERA SETUP

Large Depth of Field



CAMERA SETUP

Aperture



What's necessary

- Contiguous photos with 80% overlap
- Move camera between shots
- Minimize/eliminate moving shadows
  - Static light source
  - Diffuse light

- 5+ megapixel camera
- Wider lenses (50 mm or less)
- Maximize depth of field
  - Aperture between F8 and F16
    - This varies with lens
  - Tip: use aperture priority mode
- Include scale in a few extra photos or precisely measure and record a few features
- Color checker

2.7 OTHER MEDIA AND ACCESSORIES: POLES, TRIPODS AND DRONES

2.7 OTHER MEDIA AND ACCESSORIES: POLES, TRIPODS AND DRONES

Softlight Boxes

Background

Flash Diffuser

2.7 OTHER MEDIA AND ACCESSORIES: POLES, TRIPODS AND DRONES

Turntable

Ruler

Markers

2.7 OTHER MEDIA AND ACCESSORIES: POLES, TRIPODS AND DRONES

Tripod

Camera remote trigger

Markers

2.7 OTHER MEDIA AND ACCESSORIES: POLES, TRIPODS AND DRONES

Pole

Lifting Platforms

Drones

3 - Processing workflow and 3D model editing

3.1 Download, installation and activation

3.2 User interface and menus

3.3 Workflow

3.3.1 Photo Quality

3.3.2 Aligning meshes

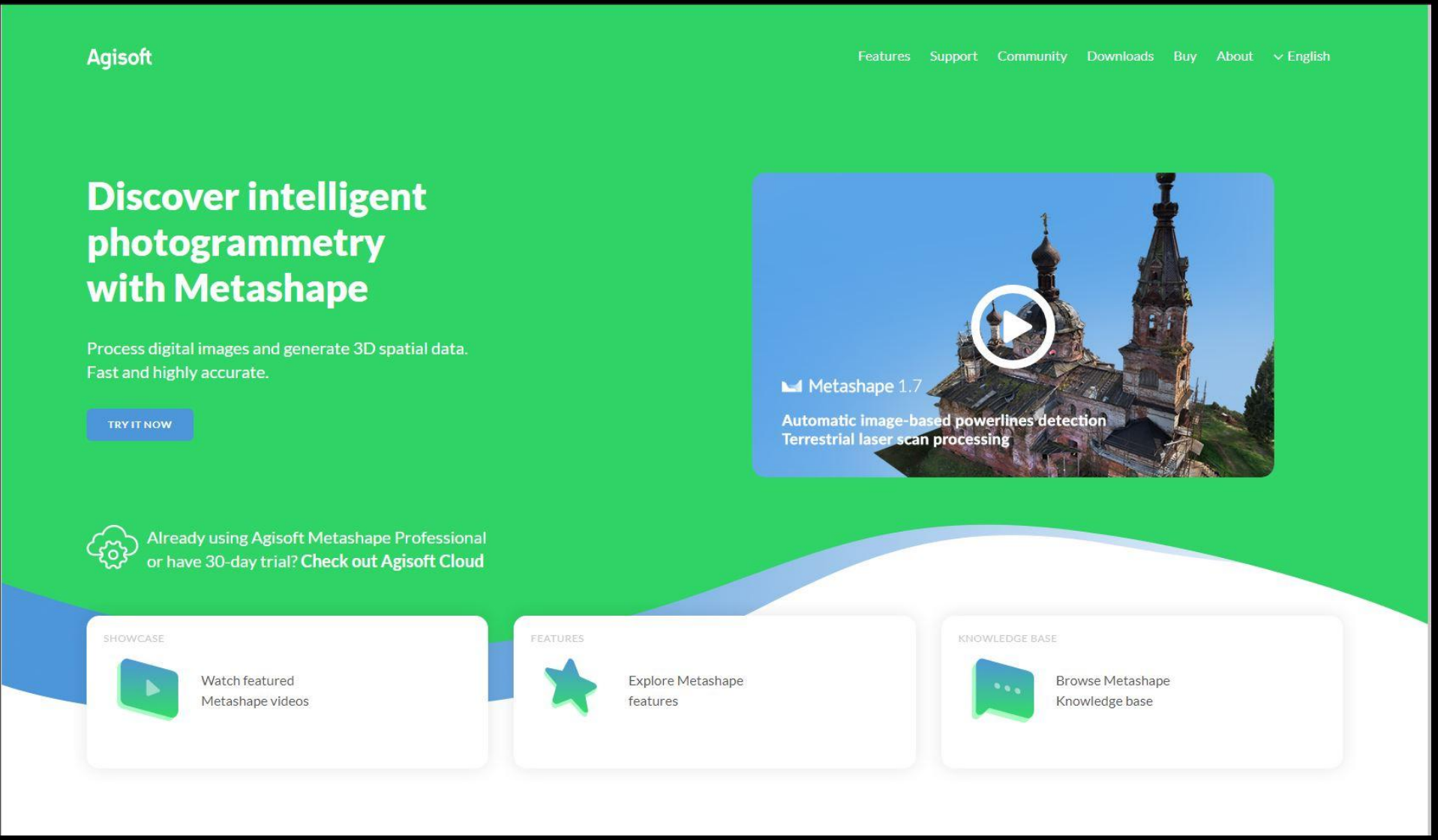
3.3.3 Positioning of the model

3.3.4 Creating and Cleaning the Dense Cloud

3.3.5 Creating Meshes and Textures

3.3.6 Scaling of photogrammetric models in Metashape

3.3.7 Exporting models


Agisoft
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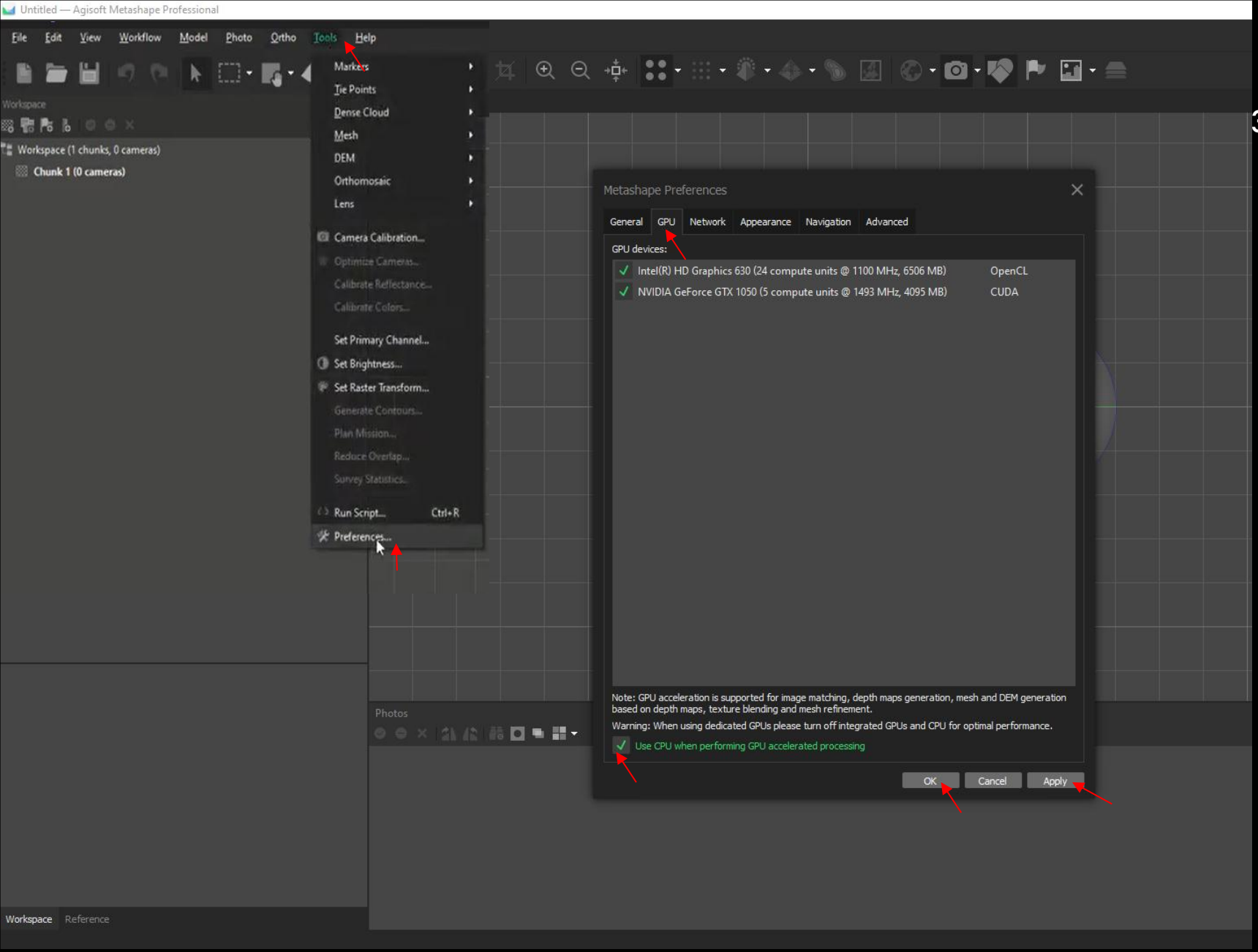
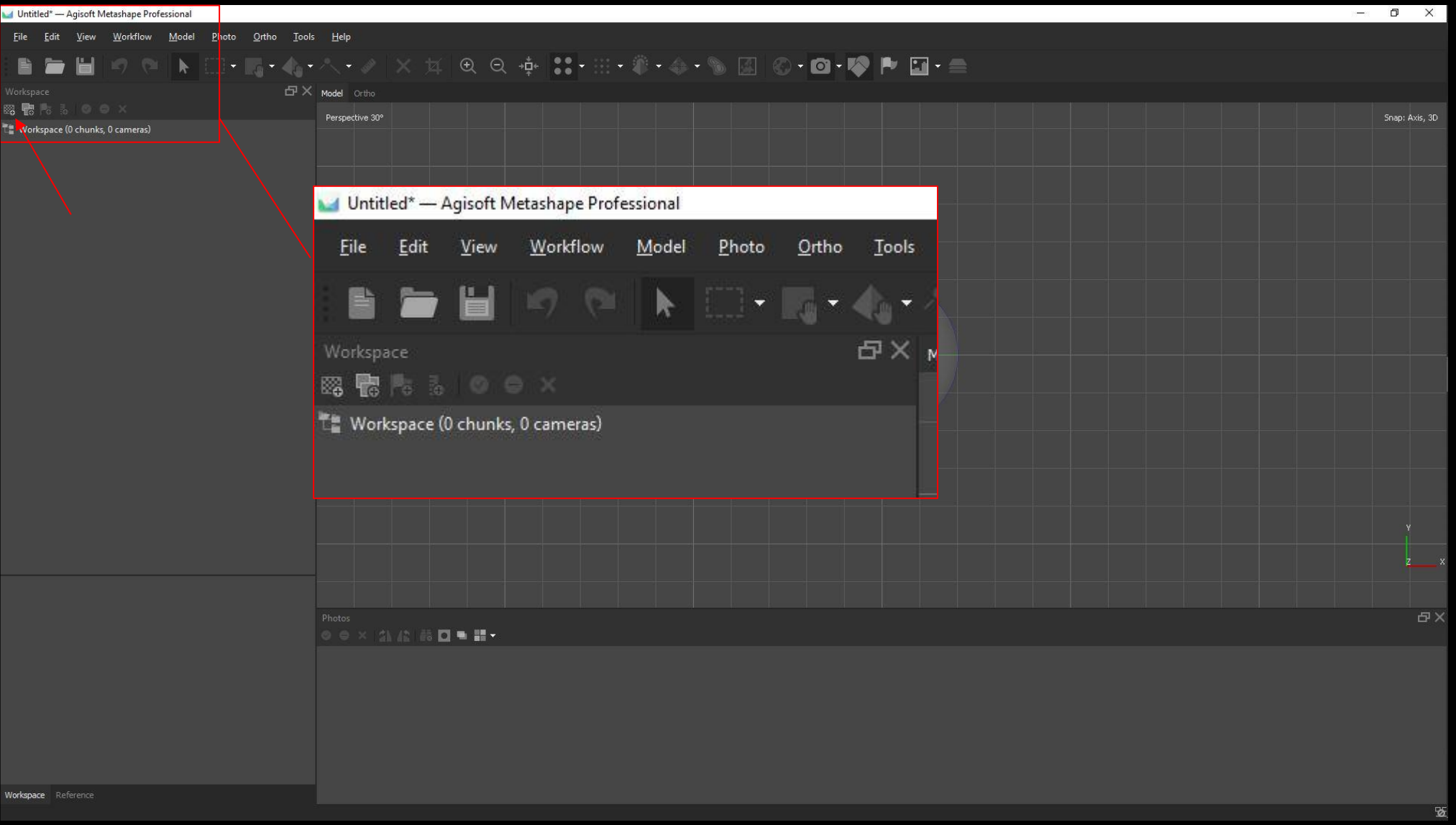
Community
Downloads
Buy
About
English
Discover intelligent photogrammetry with Metashape
Process digital images and generate 3D spatial data.
Fast and highly accurate.
TRY IT NOW
Metashape 1.7
Automatic image-based powerlines detection
Terrestrial laser scan processing
Already using Agisoft Metashape Professional or have 30-day trial? Check out Agisoft Cloud
SHOWCASE
Watch featured Metashape videos
FEATURES
Explore Metashape features
KNOWLEDGE BASE
Browse Metashape Knowledge base

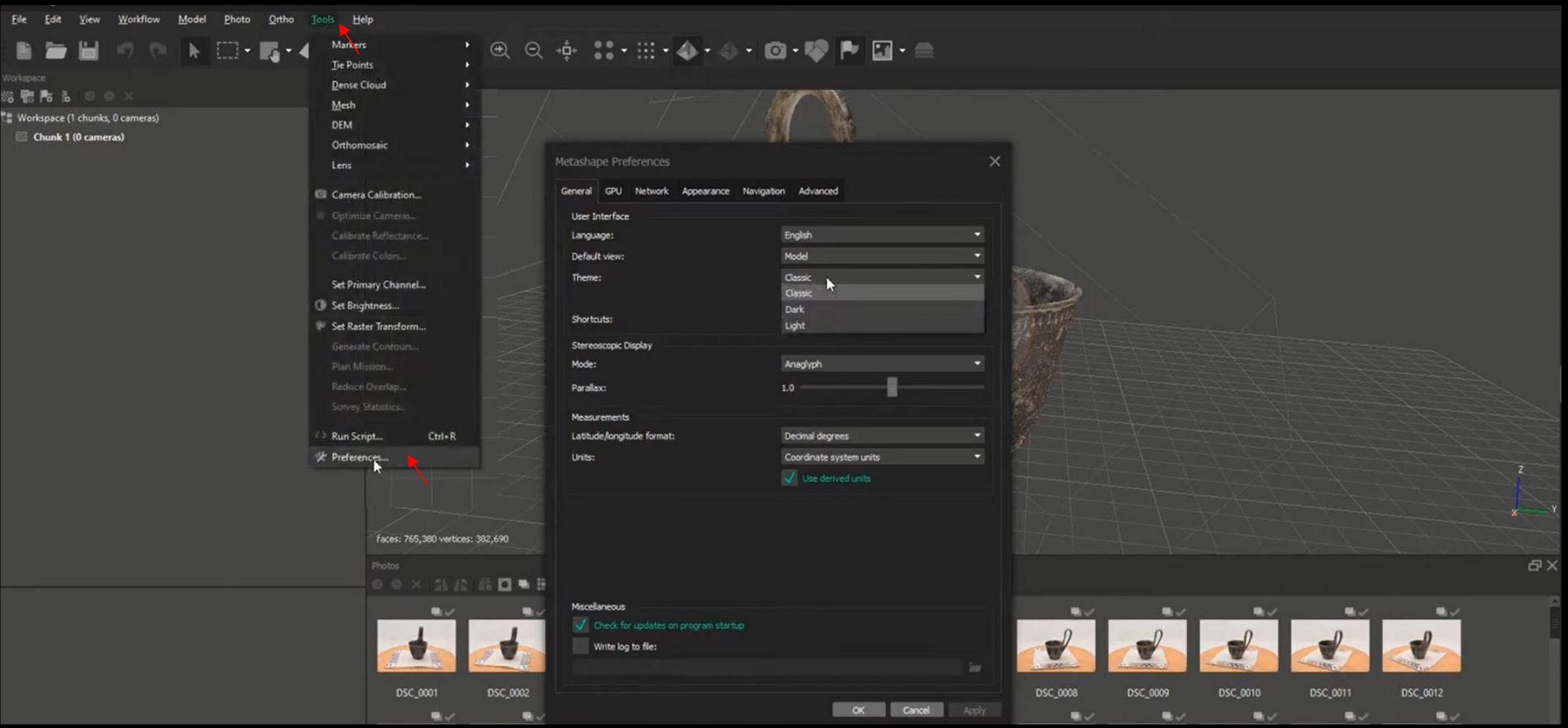


3.2 USER INTERFACE AND MENUS

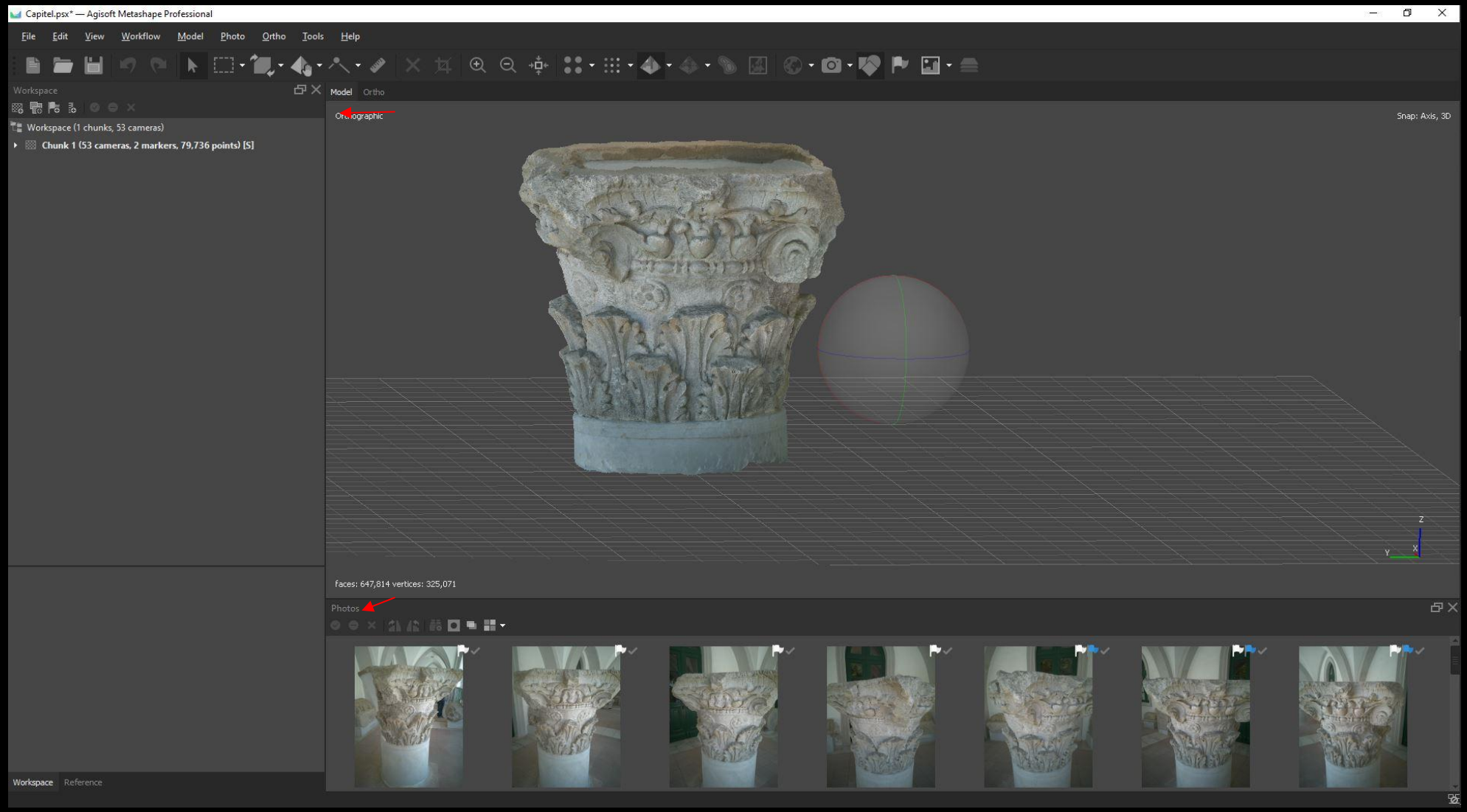
GPU Activation - Go Tools and then Preferences



New work - Chunk

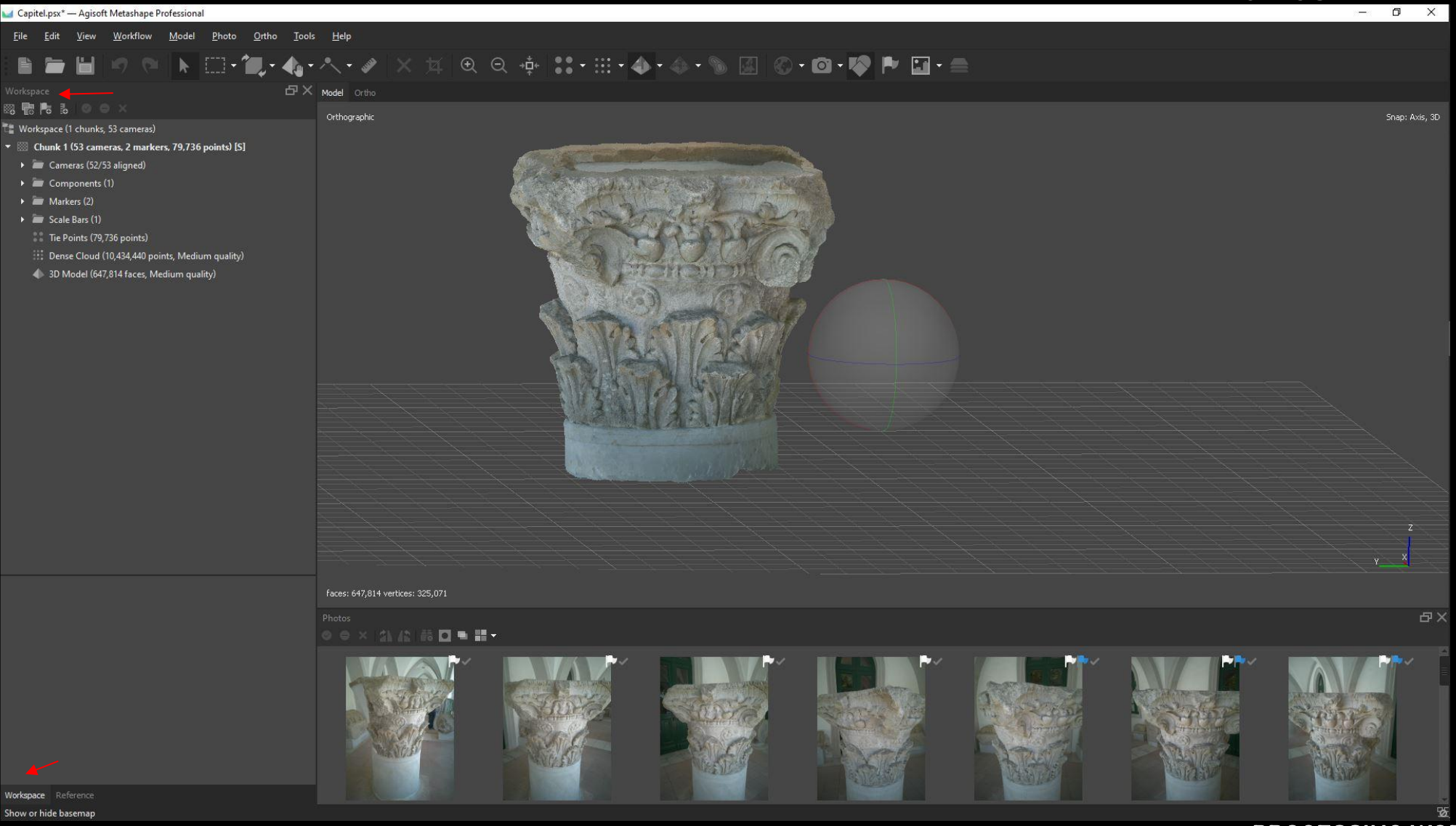

File Edit View Workflow Model Photo Ortho Tools Help
Markers
Tie Points
Dense Cloud
Mesh
DEM
Orthomosaic
Lens
Camera Calibration...
Optimize Cameras...
Calibrate Reflectance...
Calibrate Colors...
Set Primary Channel...
Set Brightness...
Set Raster Transform...
Generate Contours...
Plan Mission...
Reduce Overlap...
Survey Statistics...
Run Script... Ctrl+R
Preferences...
Workspace (1 chunks, 0 cameras)
Chunk 1 (0 cameras)
Metashape Preferences
General GPU Network Appearance Navigation Advanced
User Interface
Language: English
Default view: Model
Theme: Classic
Classic
Dark
Light
Shortcuts:
Stereoscopic Display
Mode: Anaglyph
Parallax: 1.0
Measurements
Latitude/longitude format: Decimal degrees
Units: Coordinate system units
Use derived units
Miscellaneous
Check for updates on program startup
Write log to file:
OK Cancel Apply
faces: 765,380 vertices: 382,690
Photos
DSC_0001 DSC_0002 DSC_0008 DSC_0009 DSC_0010 DSC_0011 DSC_0012

Dark Theme

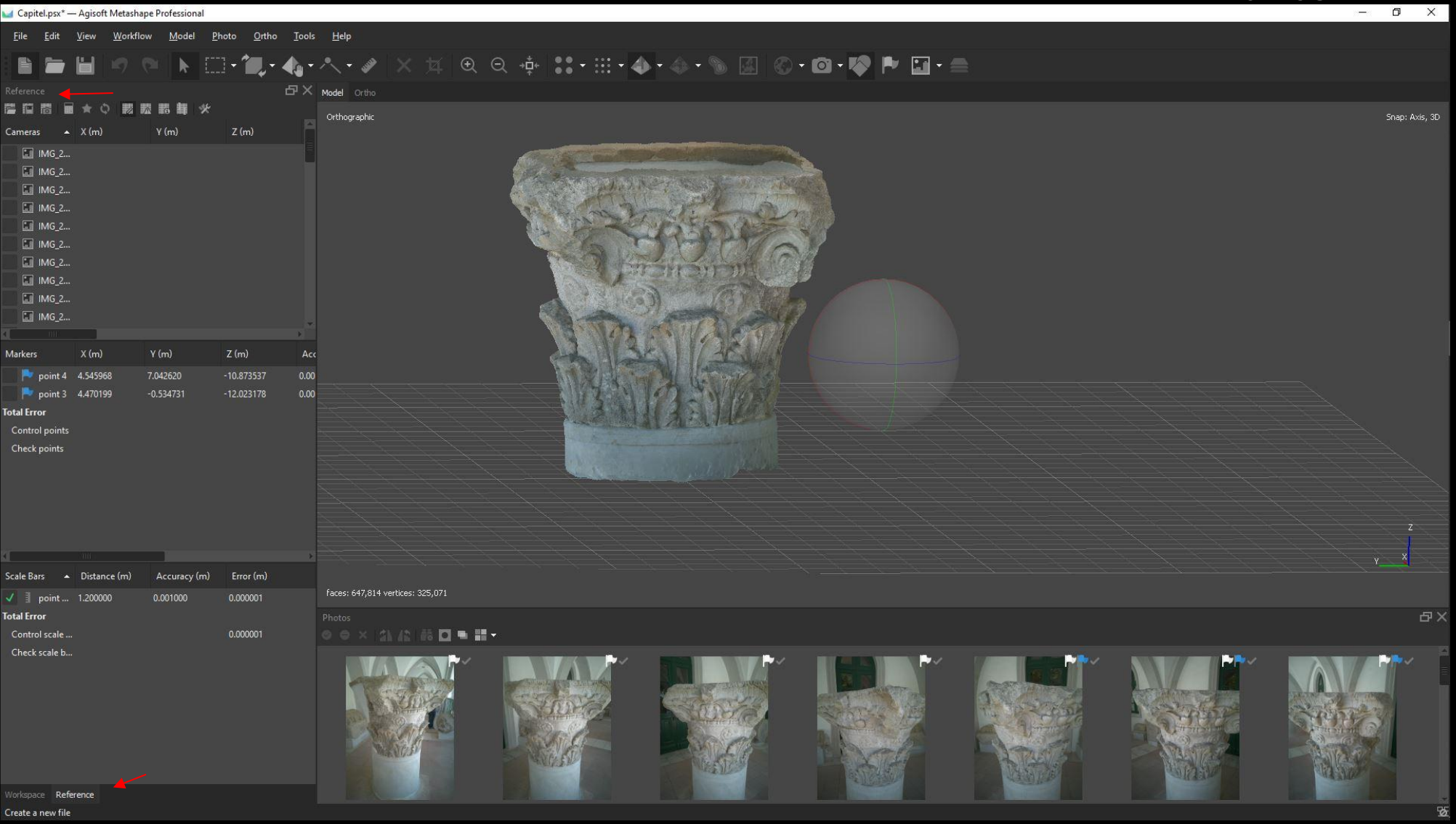


Model Viewer

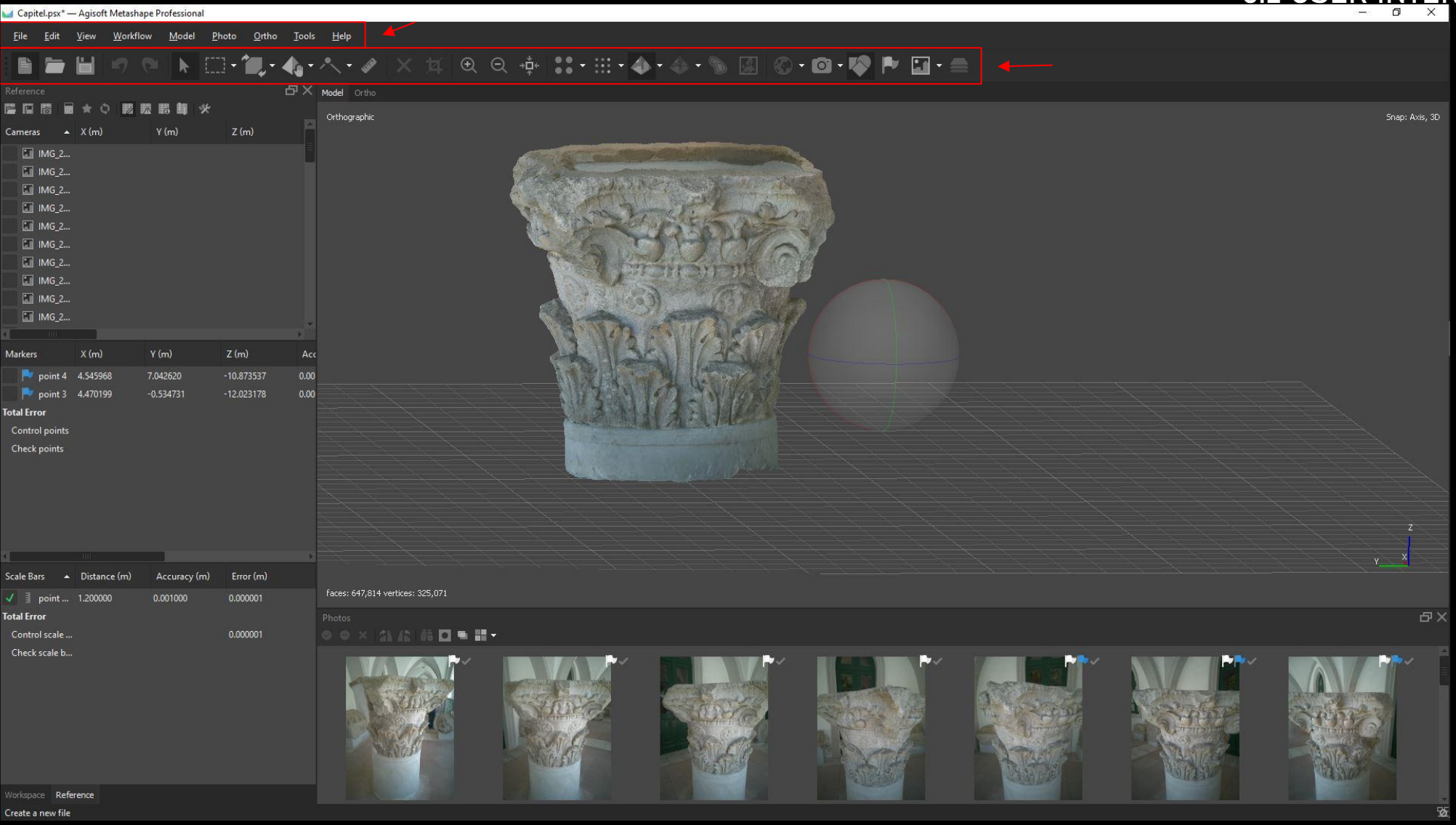
Camera View


Capitel.psx* — Agisoft Metashape Professional
File Edit View Workflow Model Photo Ortho Tools Help
Workspace
Workspace (1 chunks, 53 cameras)
Chunk 1 (53 cameras, 2 markers, 79,736 points) [S]
Cameras (52/53 aligned)
Components (1)
Markers (2)
Scale Bars (1)
Tie Points (79,736 points)
Dense Cloud (10,434,440 points, Medium quality)
3D Model (647,814 faces, Medium quality)
Model Ortho
Orthographic
Snap: Axis, 3D
faces: 647,814 vertices: 325,071
Photos
Workspace Reference
Show or hide basemap

Workspace



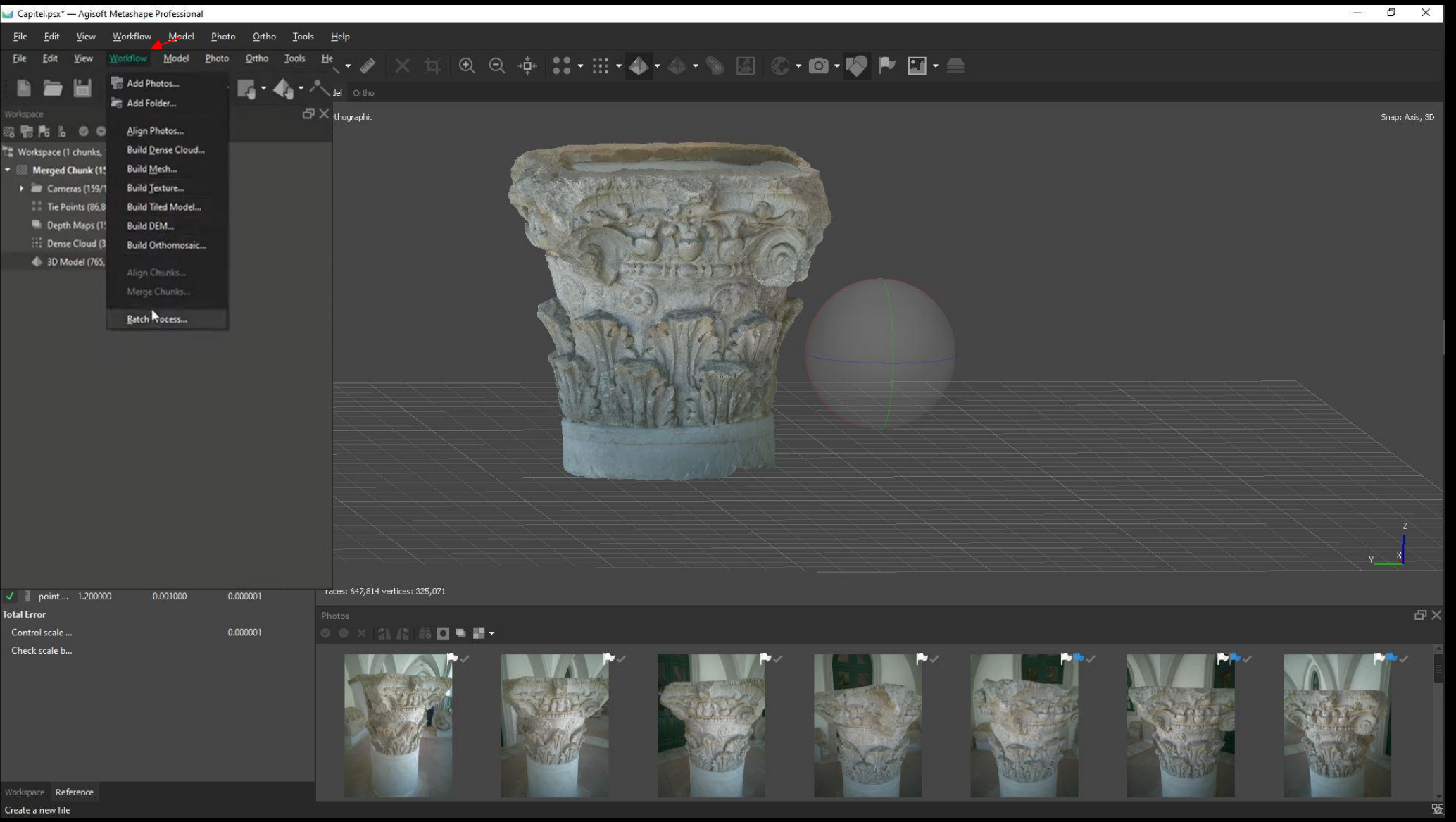
Reference Panel



Menu

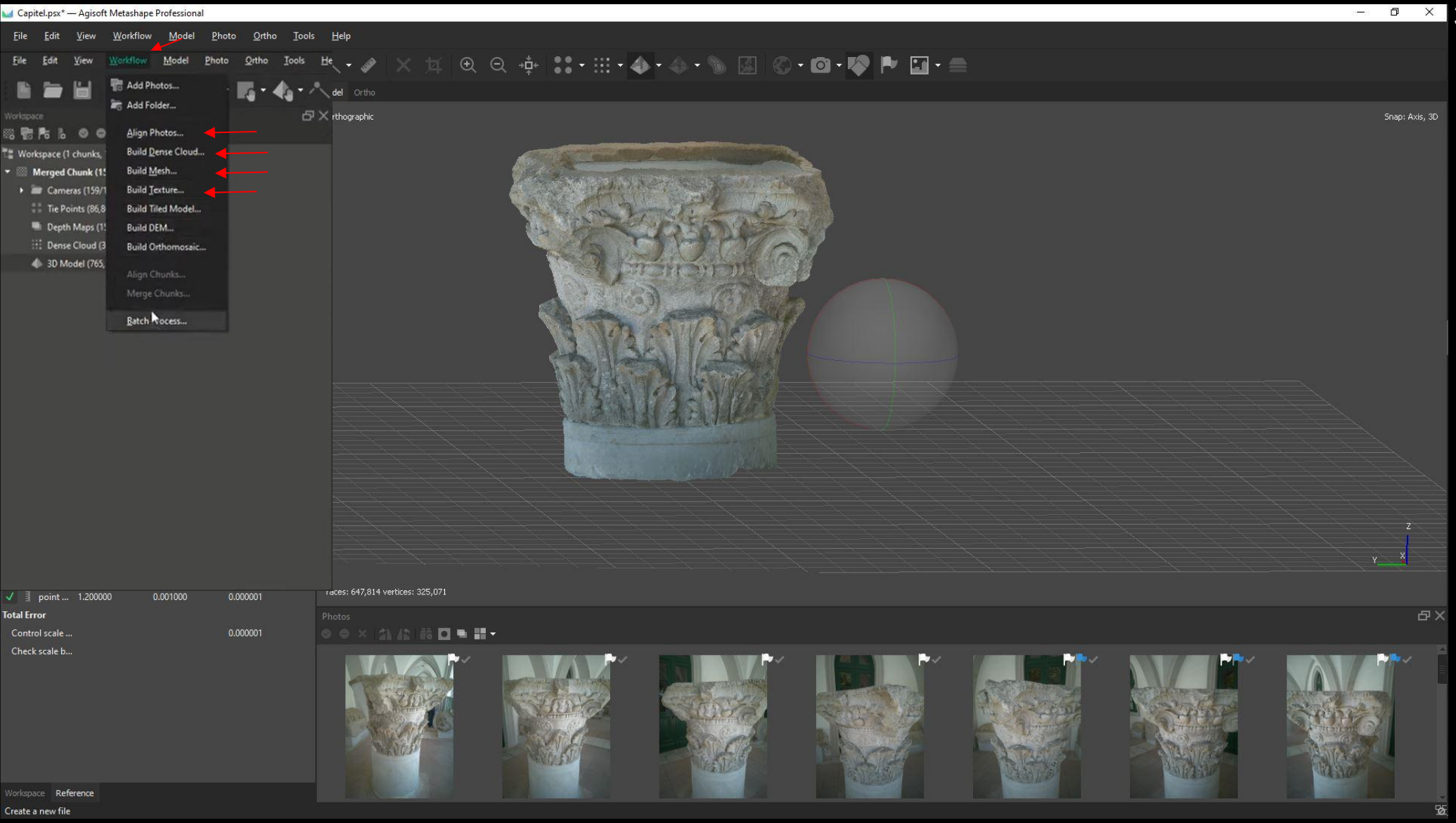
Toolbar

3.3 WORKFLOW



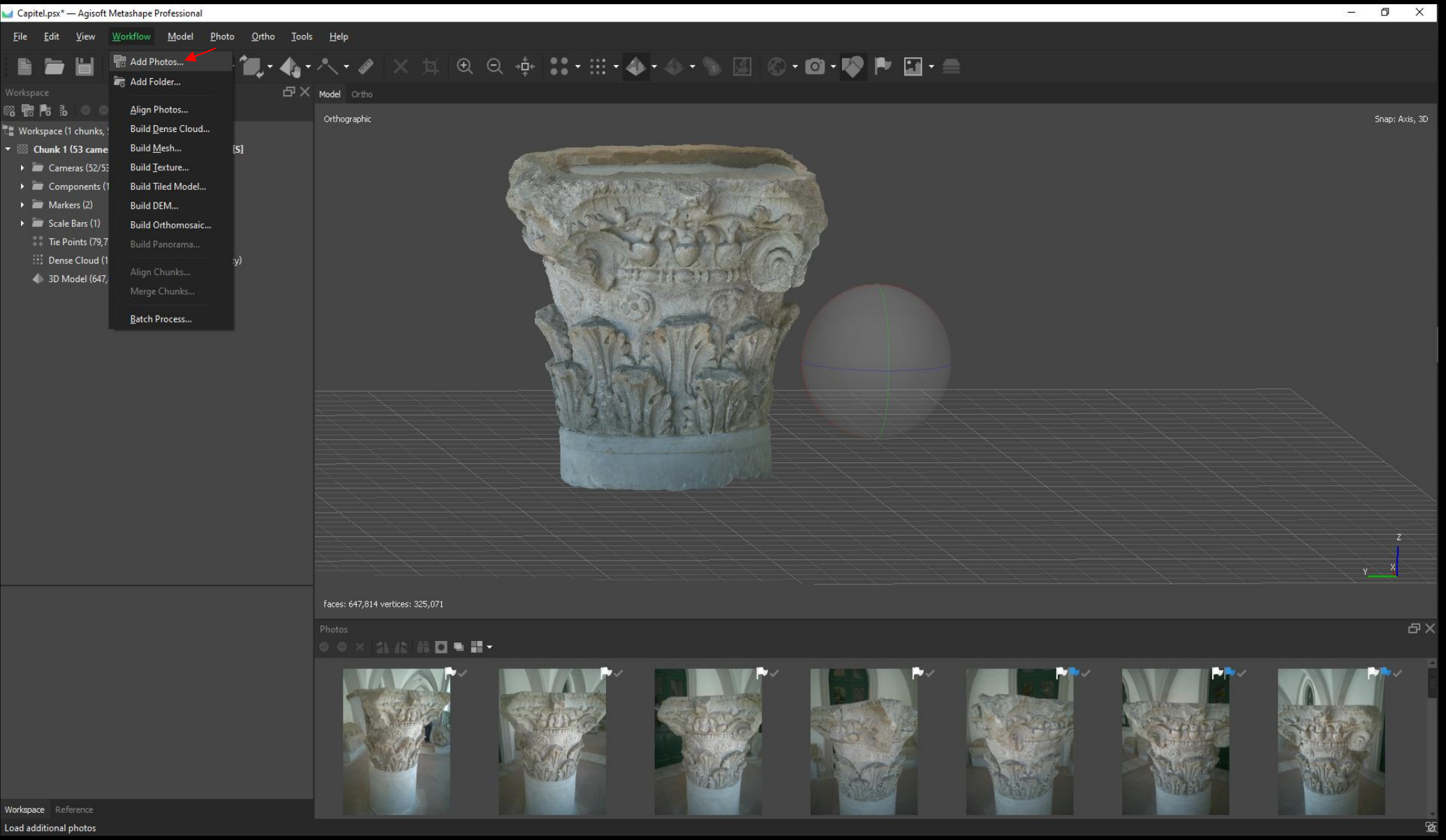
Menu

Workflow



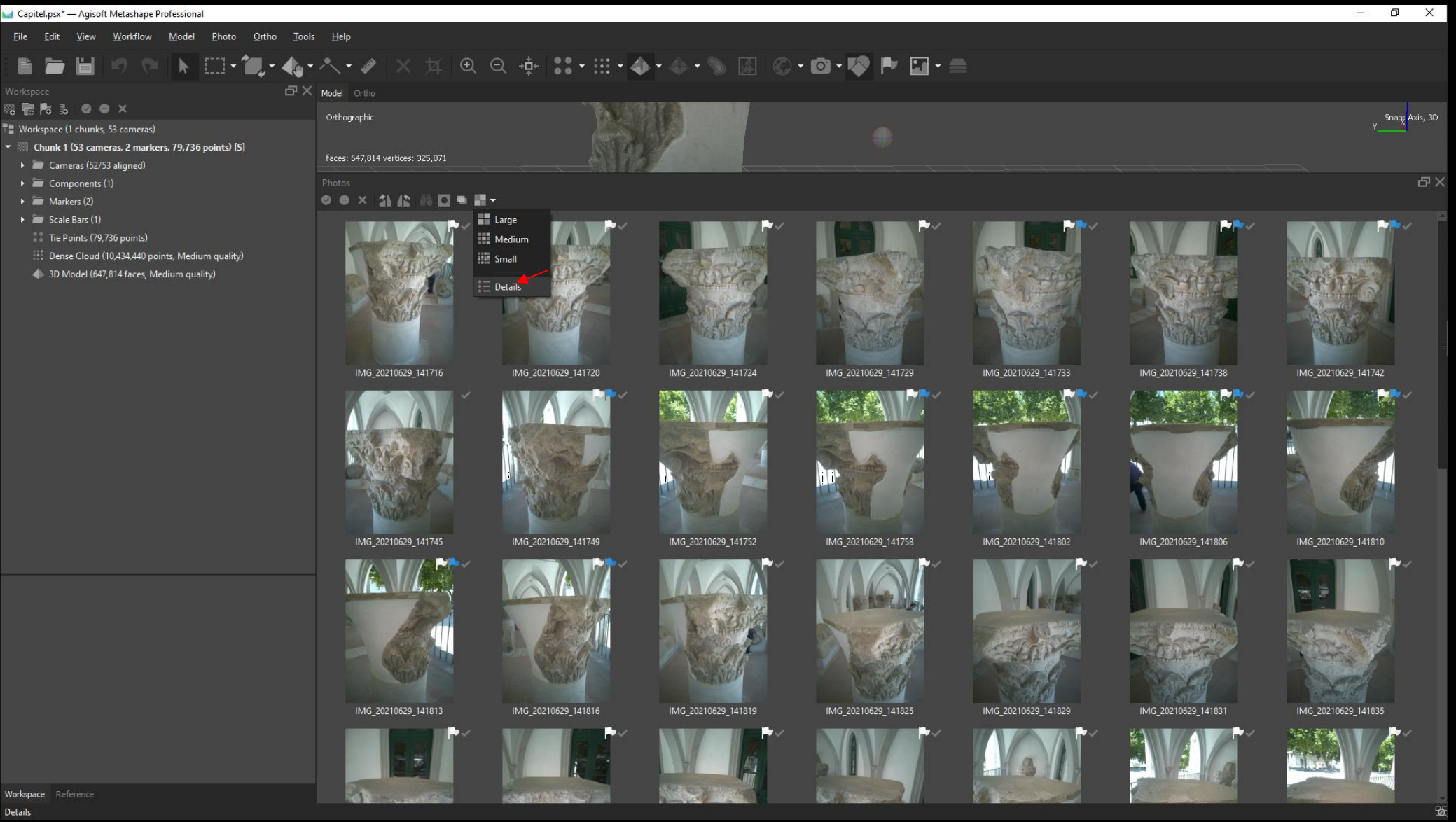
3.3 WORKFLOW

Workflow



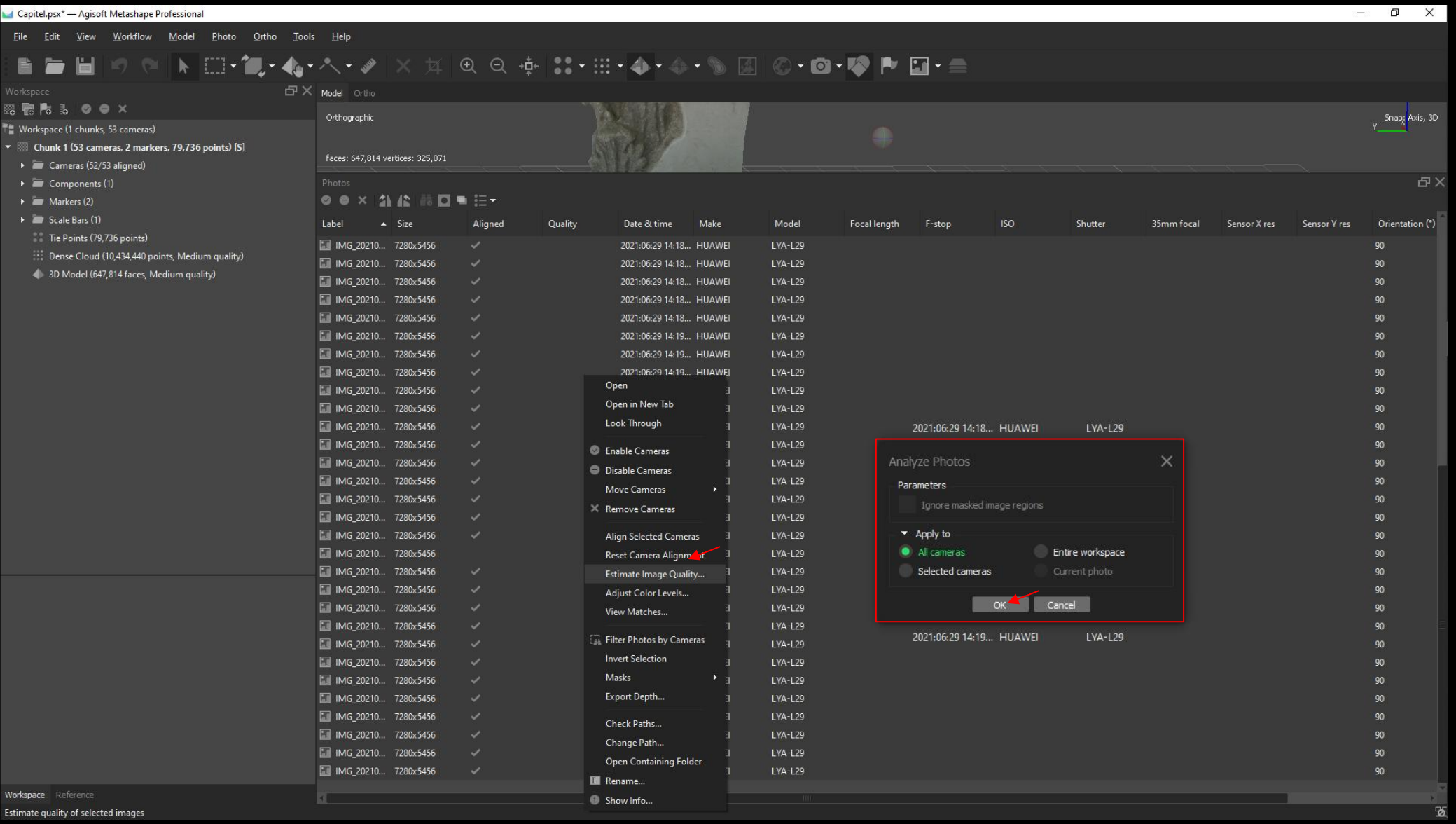
3.3.1 PHOTO QUALITY

Add Photos



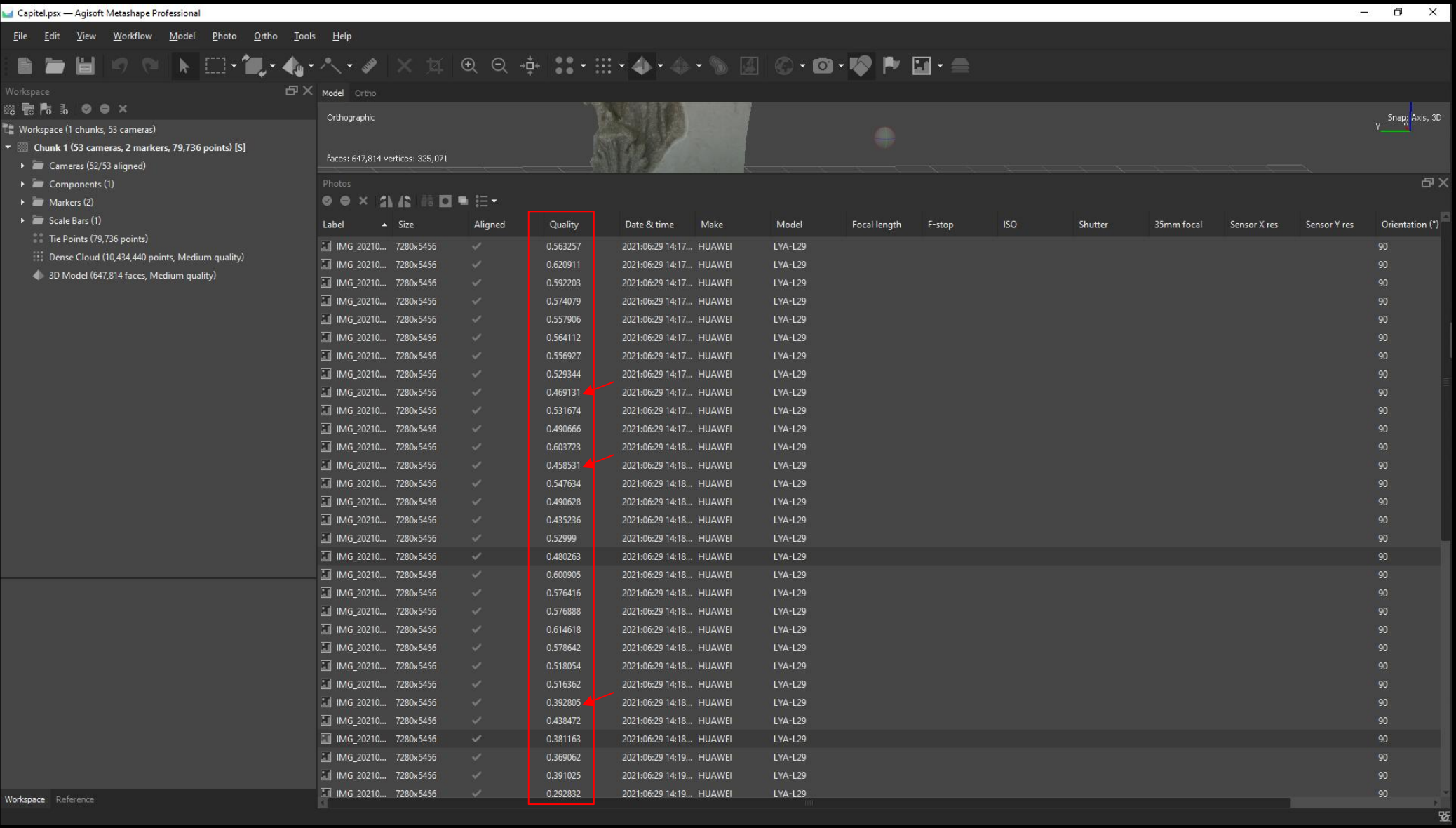
3.3.1 PHOTO QUALITY

Photo Quality



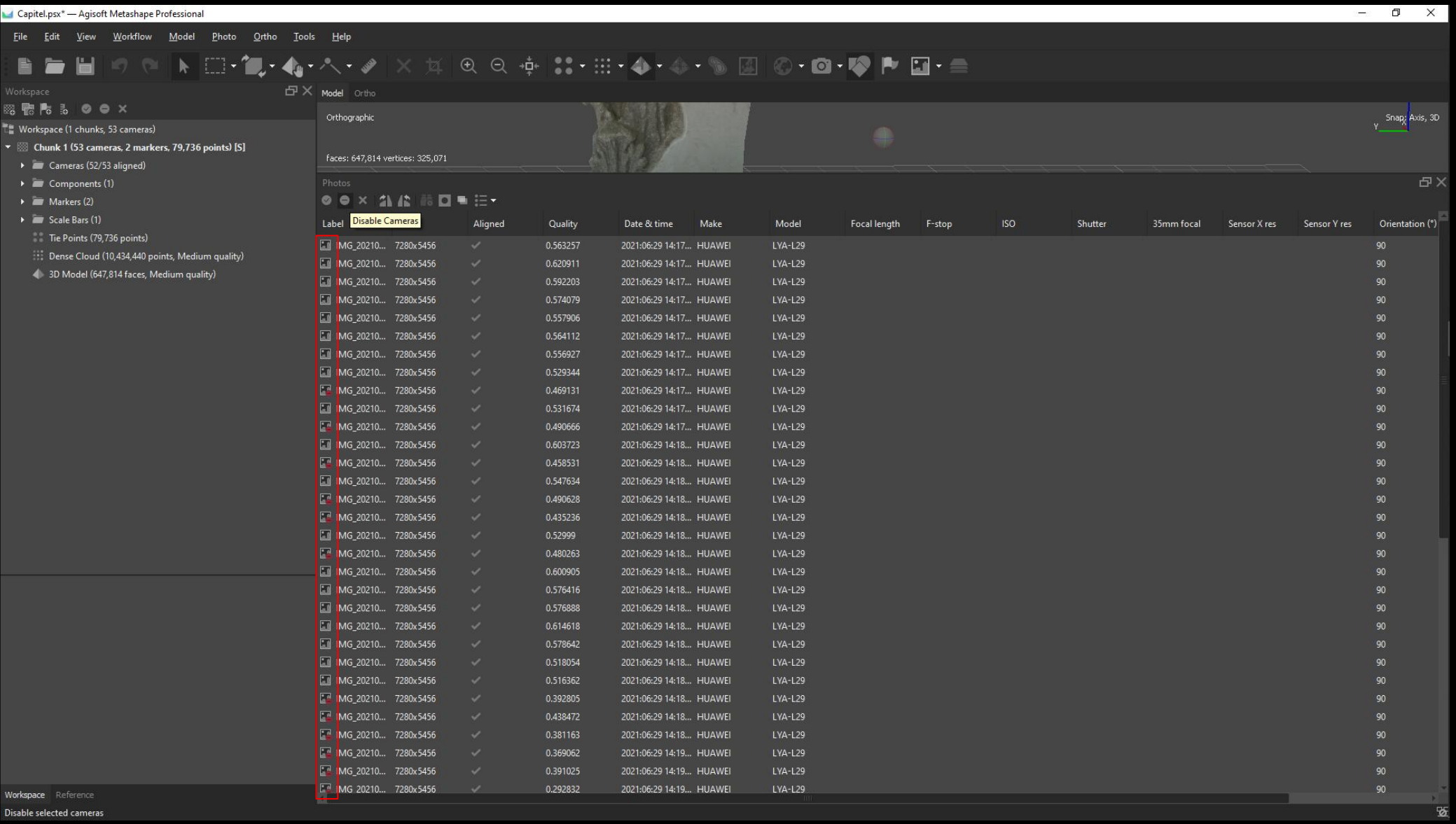
3.3.1 PHOTO QUALITY

Photo Quality



3.3.1 PHOTO QUALITY

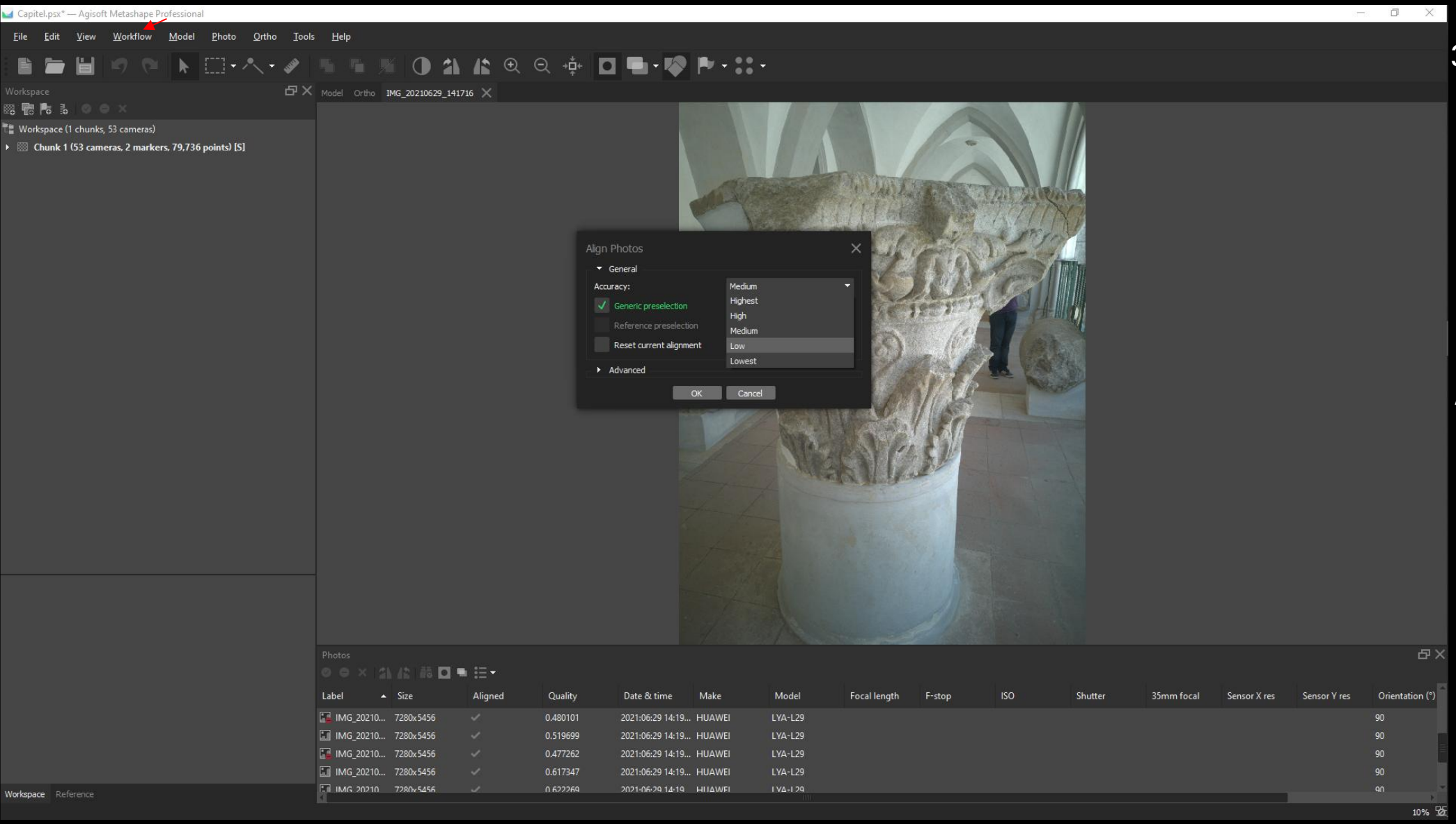
Photo Quality
0-1 Scale



3.3.1 PHOTO QUALITY

Photo Quality

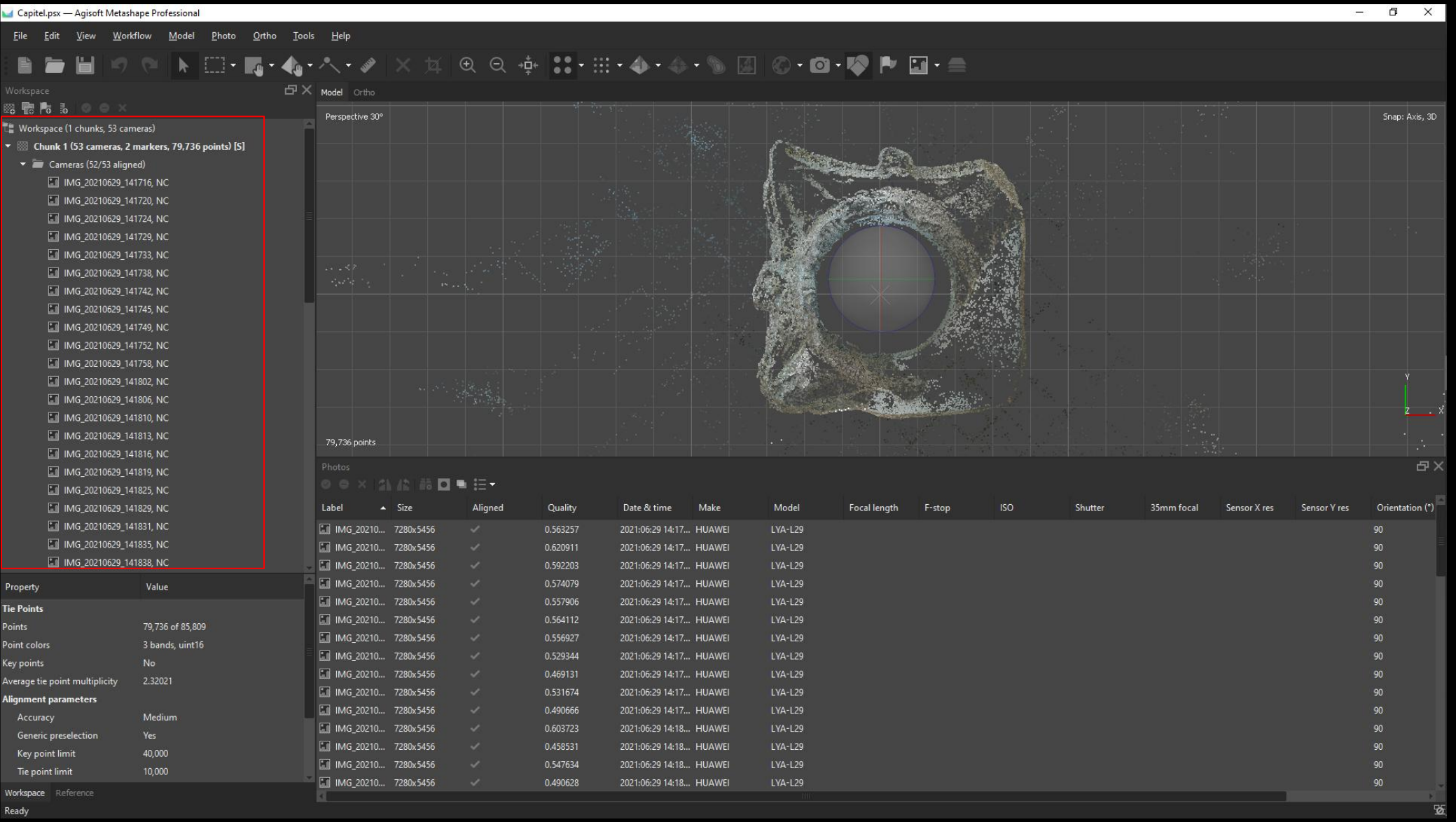
Disable Cameras



3.3.2 ALIGNING MESHES

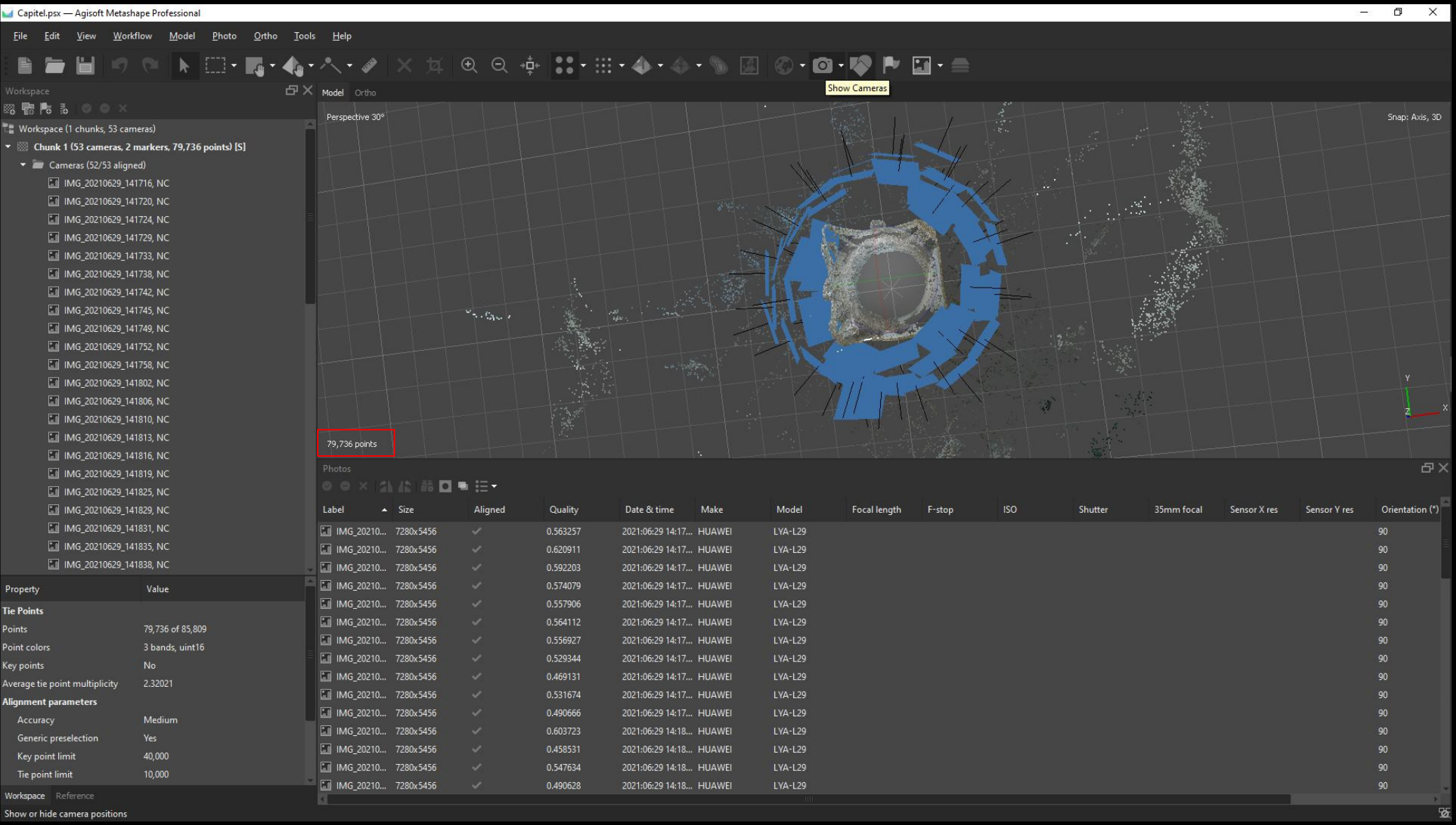
Align Photos

Generic Preselection



3.3.2 ALIGNING MESHES

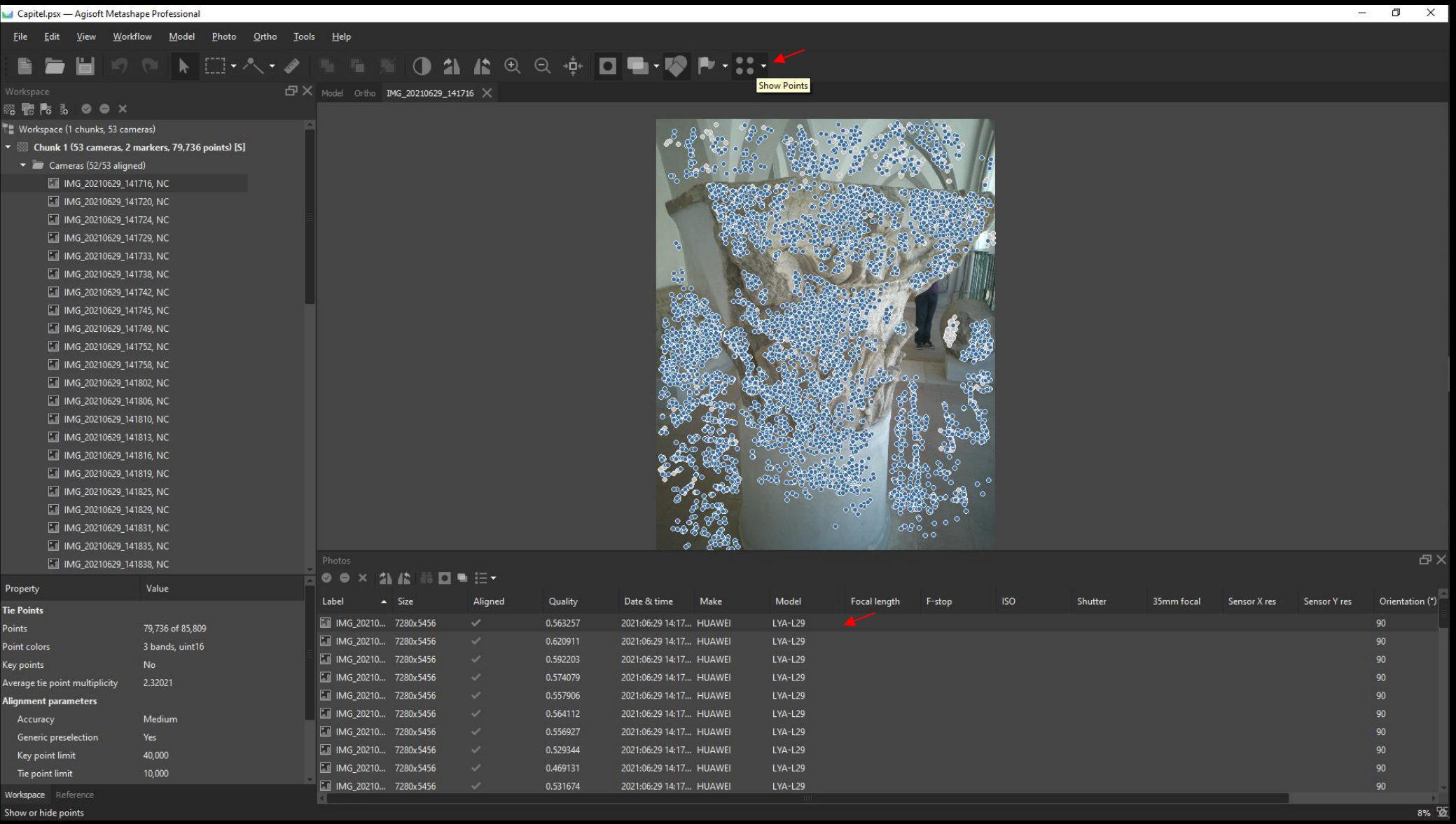
Align Photos



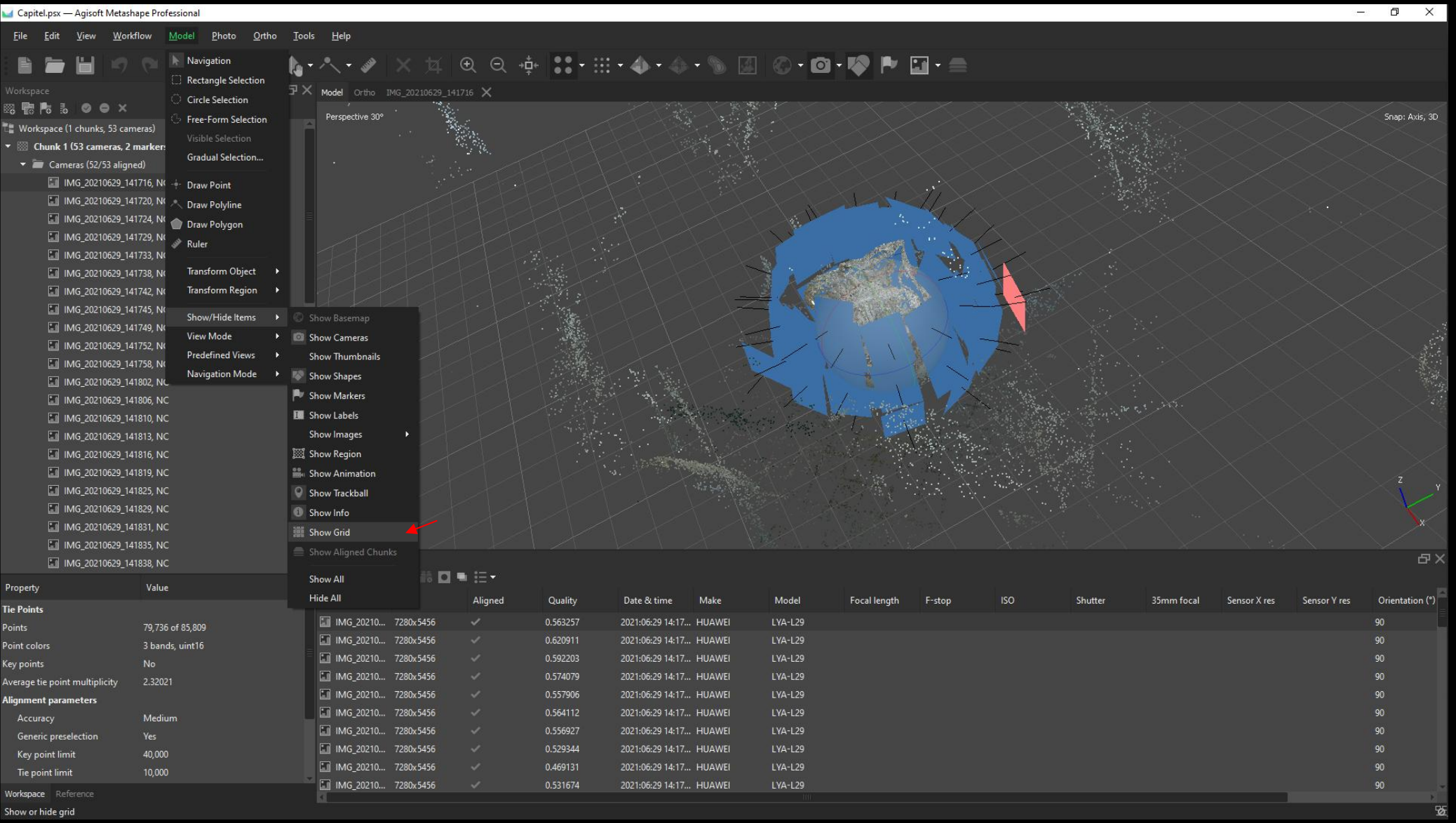
3.3.2 ALIGNING MESHES

Align Photos

3.3.2 ALIGNING MESHES

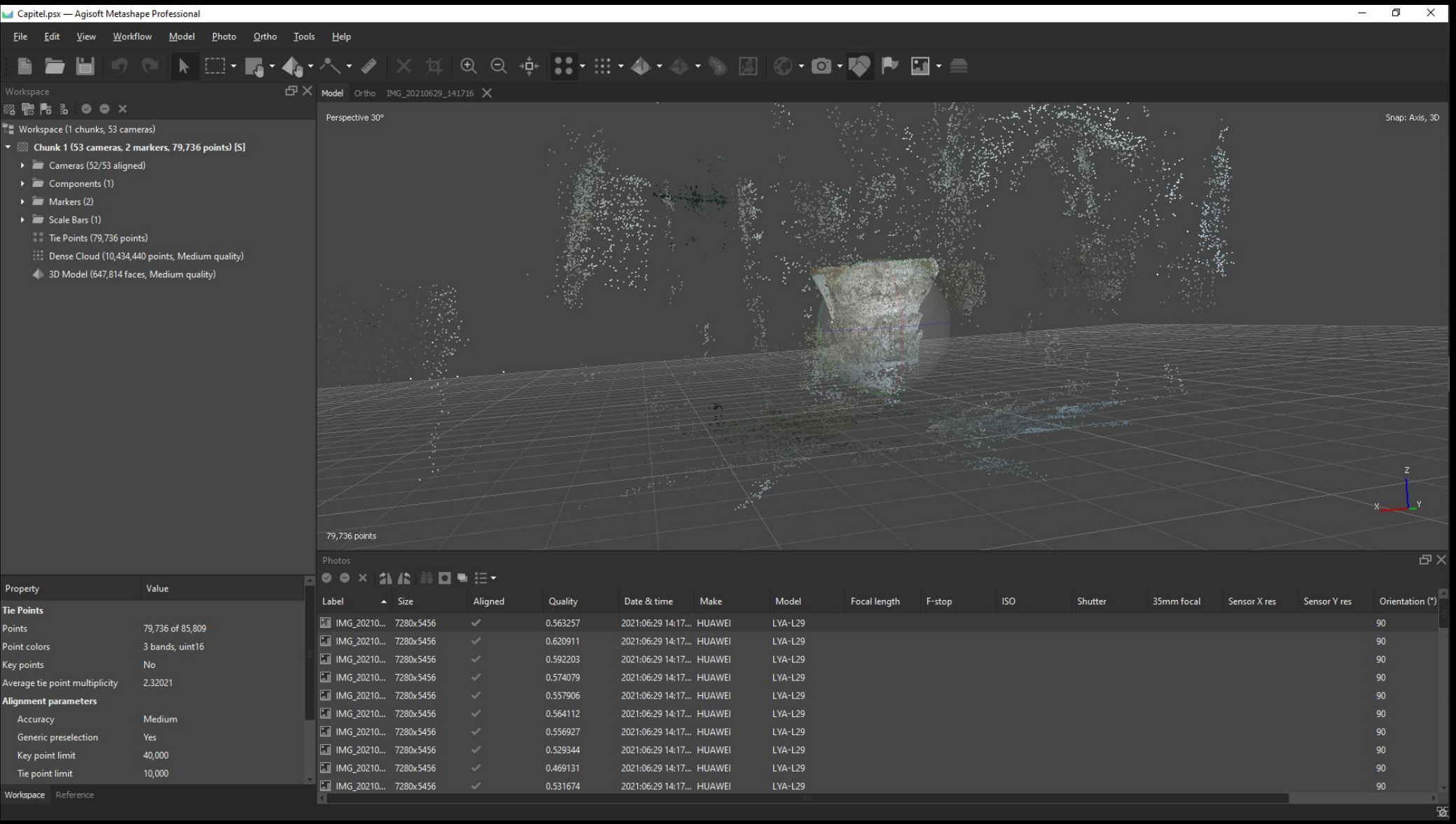


Align Photos



3.3.2 ALIGNING MESHES

Align Photos

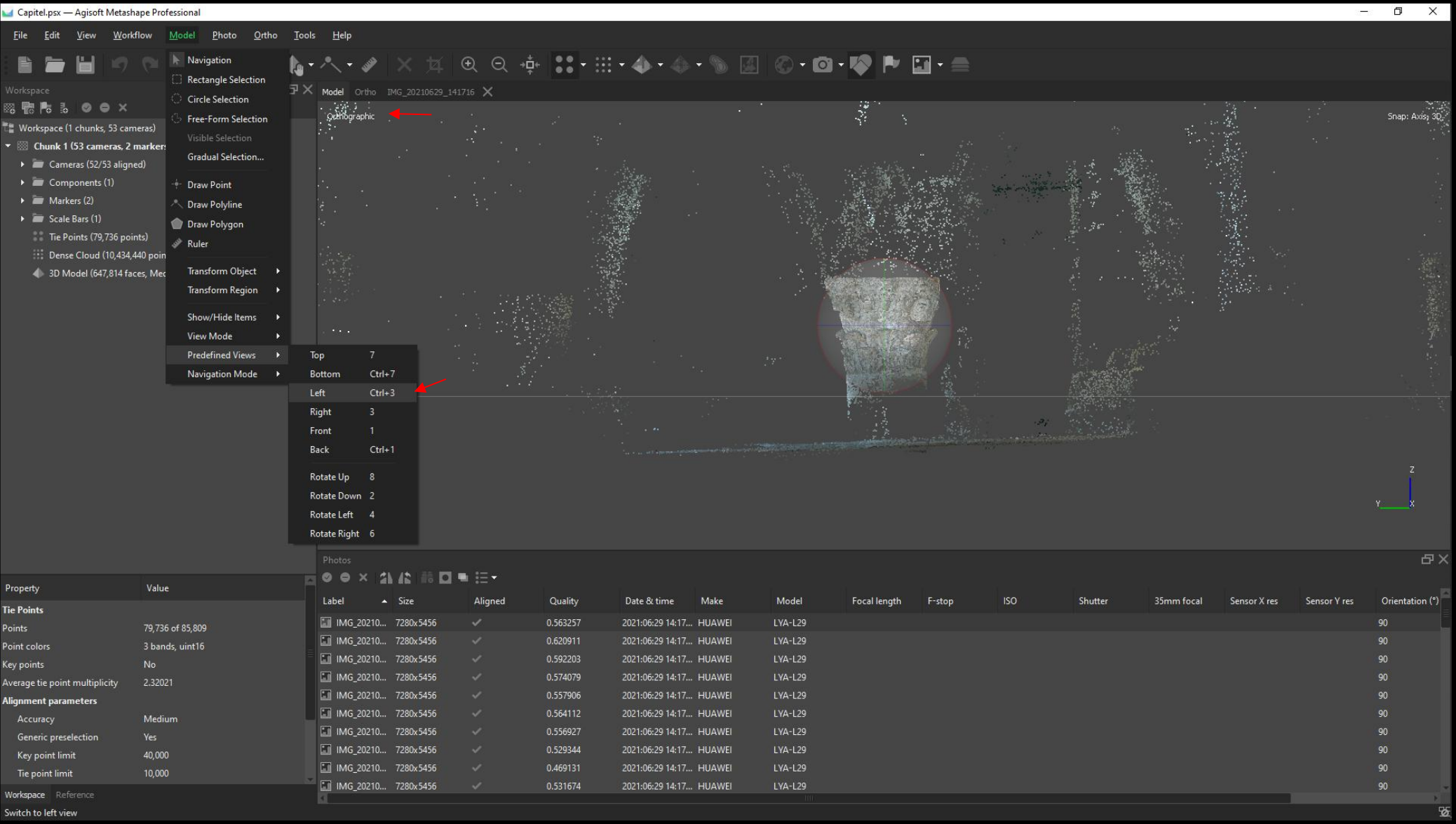


3.3.3 POSITIONING OF THE MODEL

Positioning your model

Left Click&Drag
Rotate Model

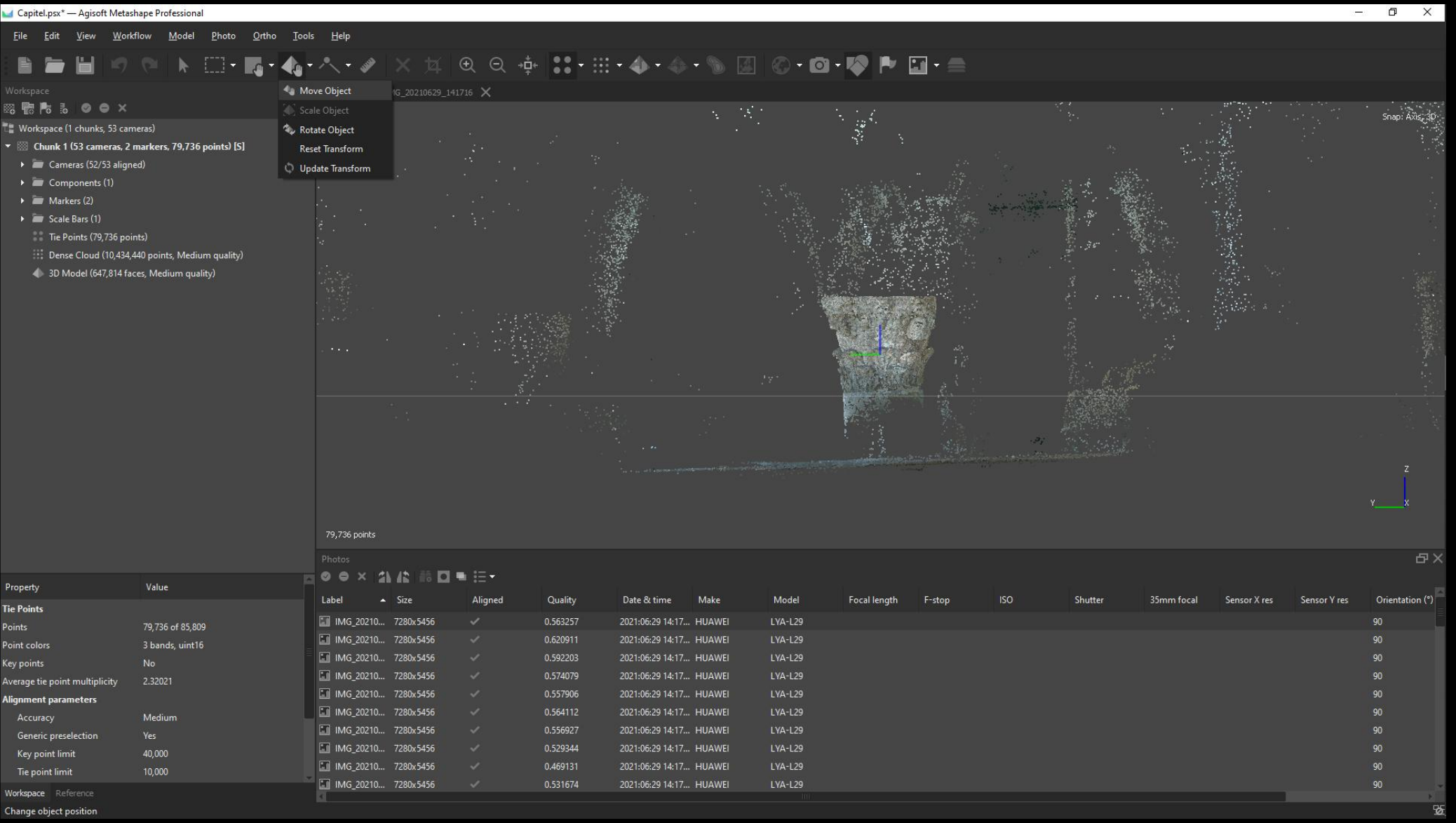
Middle Button&Drag
Move the center of the view



3.3.3 POSITIONING OF THE MODEL

Positioning your model

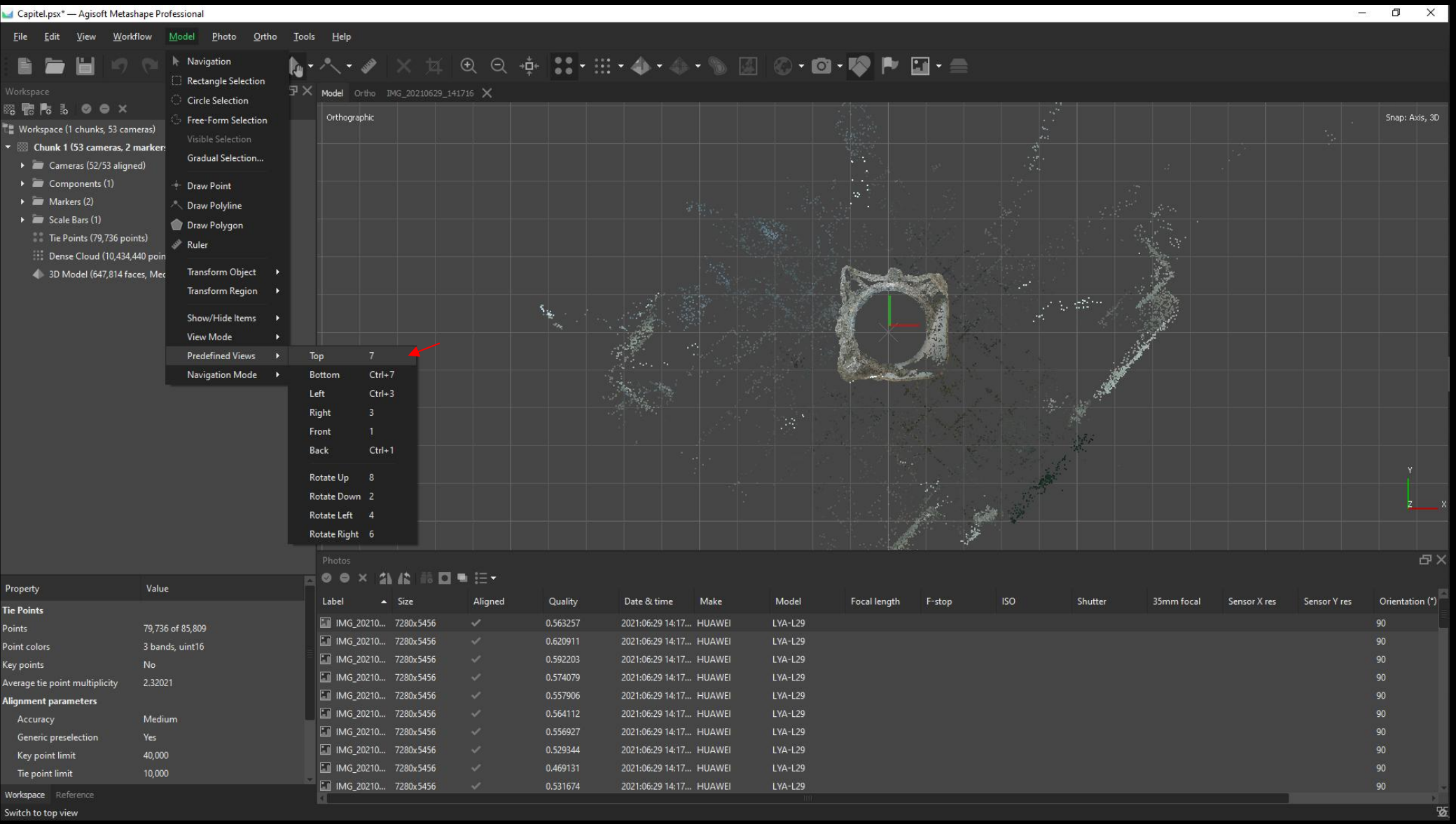
Press 5 to change the view mode to ortographic



3.3.3 POSITIONING OF THE MODEL

Positioning your model

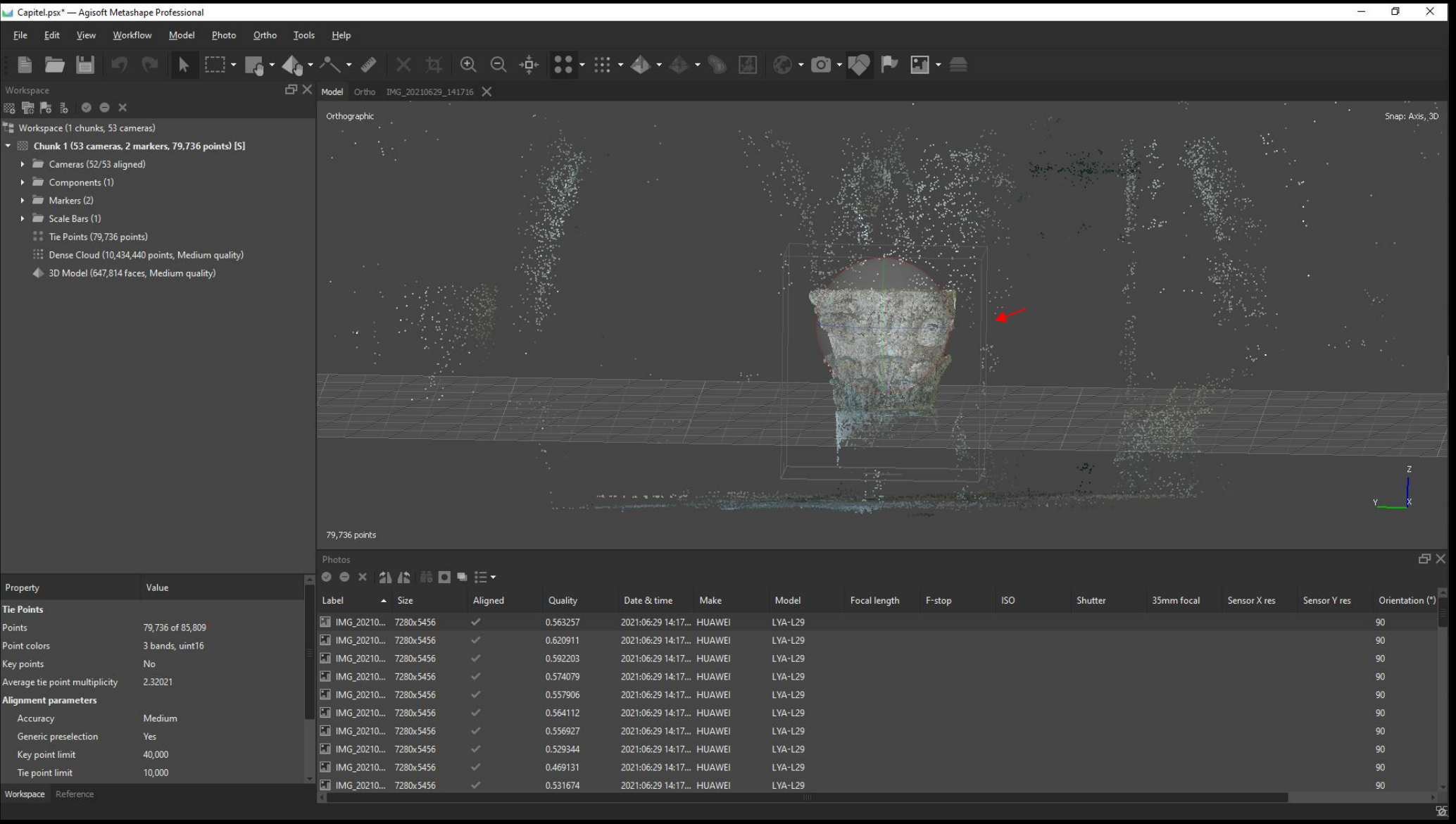
Move the model to a position above the grid



3.3.3 POSITIONING OF THE MODEL

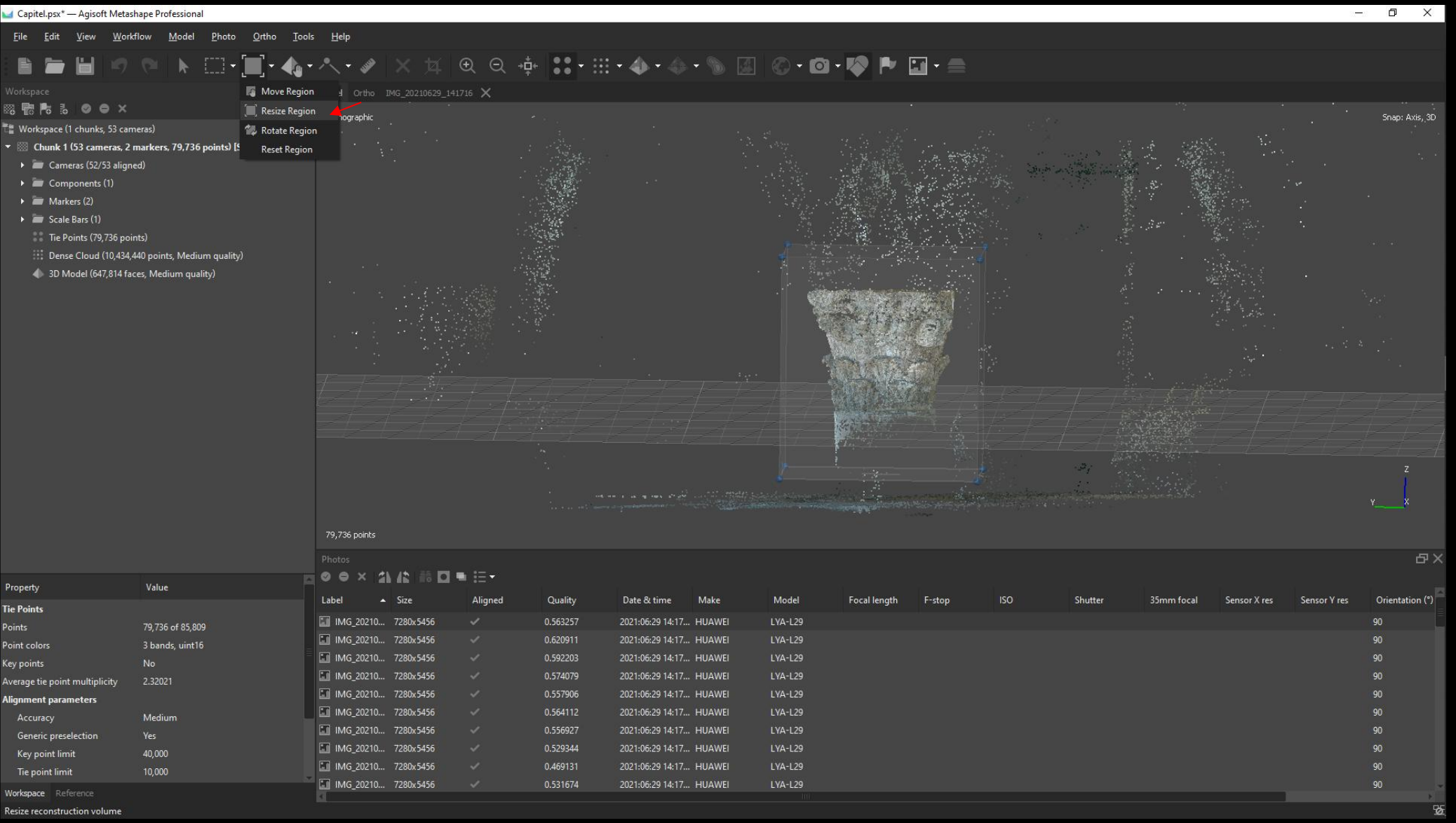
Positioning your model

Move the model to the center of the grid



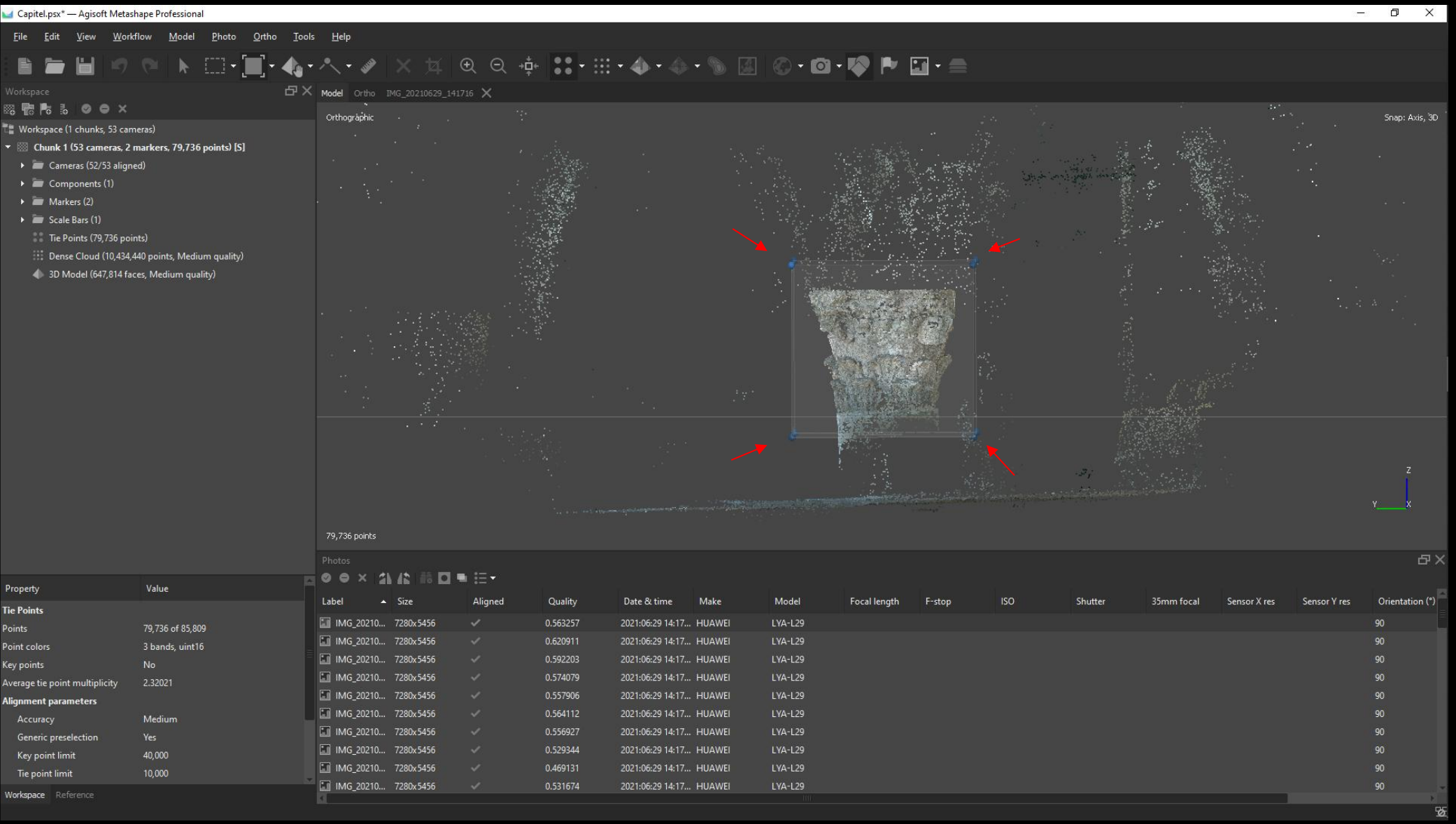
3.3.3 POSITIONING OF THE MODEL

Region

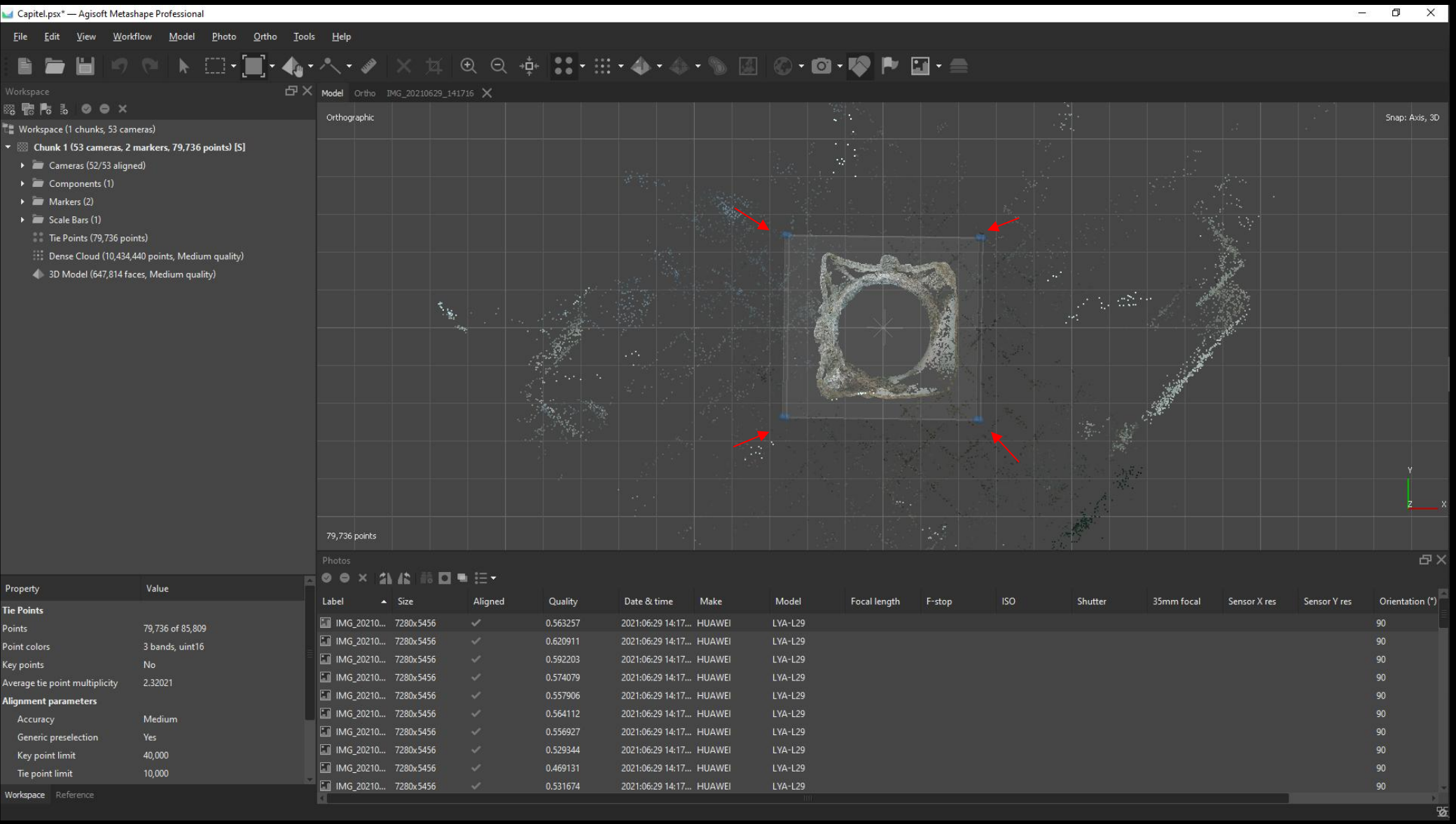

Capitel.psx* — Agisoft Metashape Professional
File Edit View Workflow Model Photo Ortho Tools Help
Move Region
Resize Region
Rotate Region
Reset Region
Workspace
Workspace (1 chunks, 53 cameras)
Chunk 1 (53 cameras, 2 markers, 79,736 points)
Cameras (52/53 aligned)
Components (1)
Markers (2)
Scale Bars (1)
Tie Points (79,736 points)
Dense Cloud (10,434,440 points, Medium quality)
3D Model (647,814 faces, Medium quality)
Ortho
IMG_20210629_141716
Snap: Axis, 3D
79,736 points
Property
Value
Tie Points
Points
79,736 of 85,809
Point colors
3 bands, uint16
Key points
No
Average tie point multiplicity
2.32021
Alignment parameters
Accuracy
Medium
Generic preselection
Yes
Key point limit
40,000
Tie point limit
10,000
Photos
Label
Size
Aligned
Quality
Date & time
Make
Model
Focal length
F-stop
ISO
Shutter
35mm focal
Sensor X res
Sensor Y res
Orientation (°)
IMG_20210... 7280x5456 0.563257 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.620911 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.592203 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.574079 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.557906 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.564112 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.556927 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.529344 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.469131 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.531674 2021:06:29 14:17... HUAWEI LYA-L29 90
Workspace
Reference
Resize reconstruction volume

Region

3.3.3 POSITIONING OF THE MODEL



Re-size Region

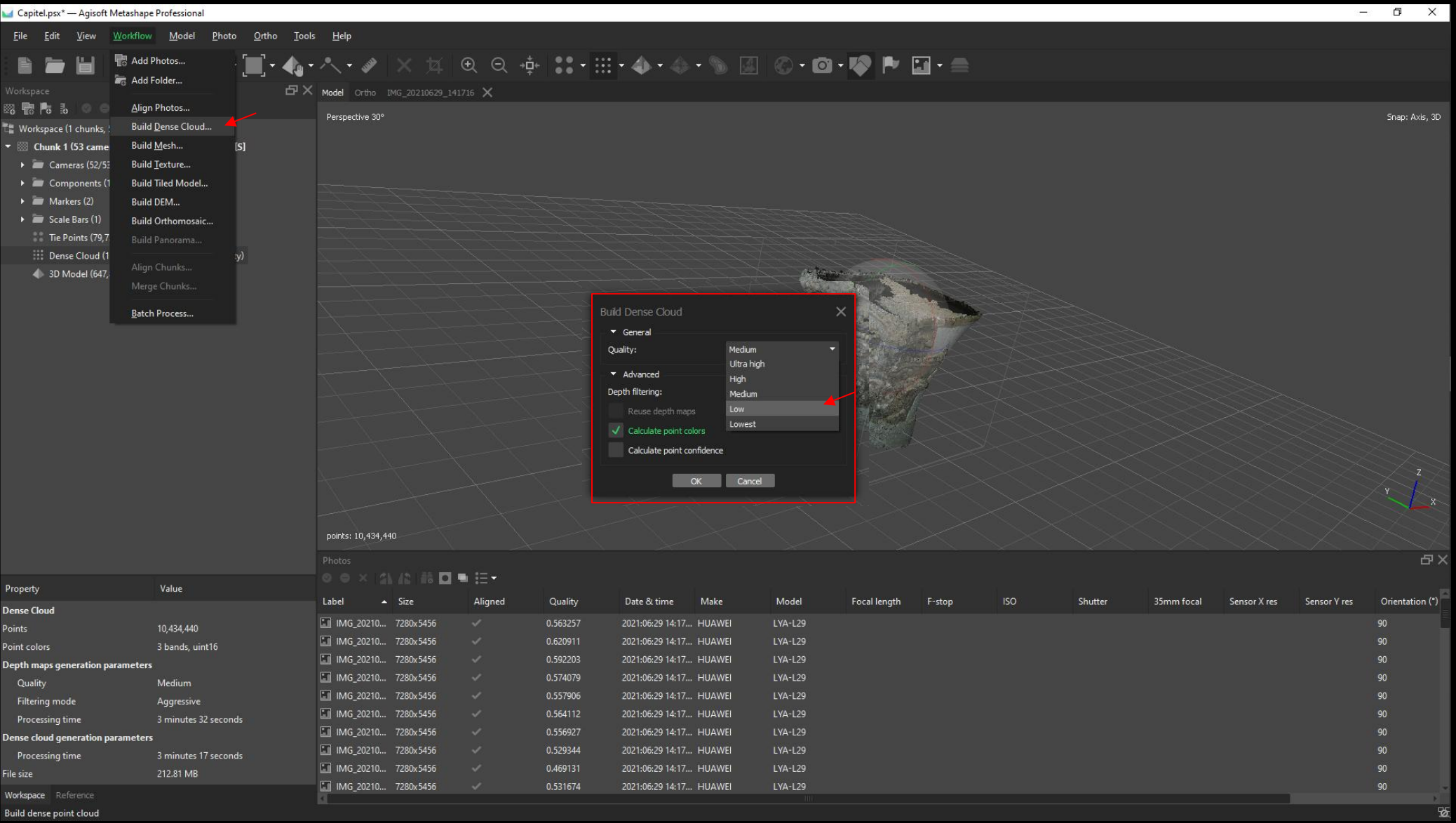


3.3.3 POSITIONING OF THE MODEL

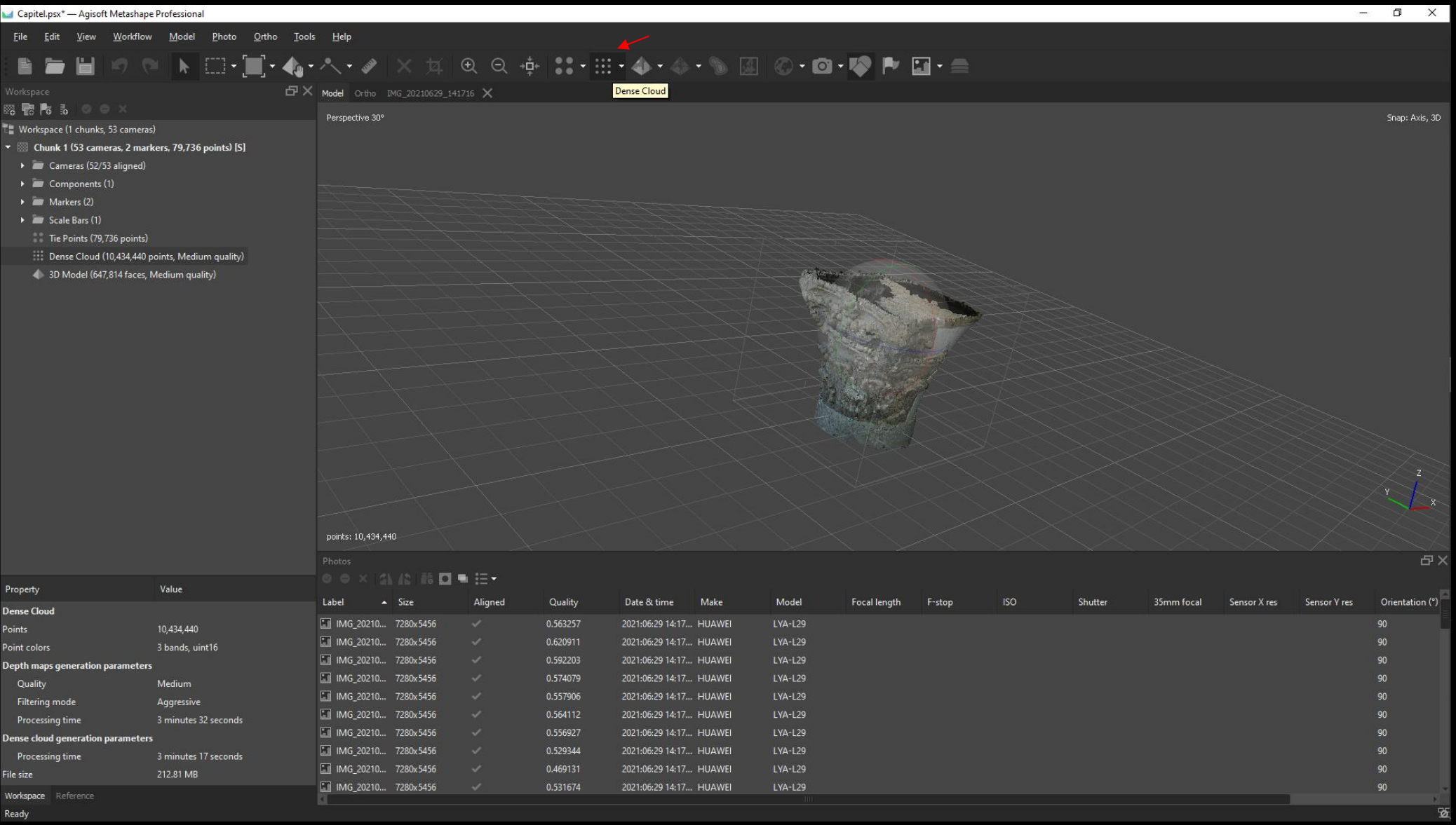
Re-size Region

Change Predefined Views in order to help

3.3.4 CREATING AND CLEANING THE DENSE CLOUD

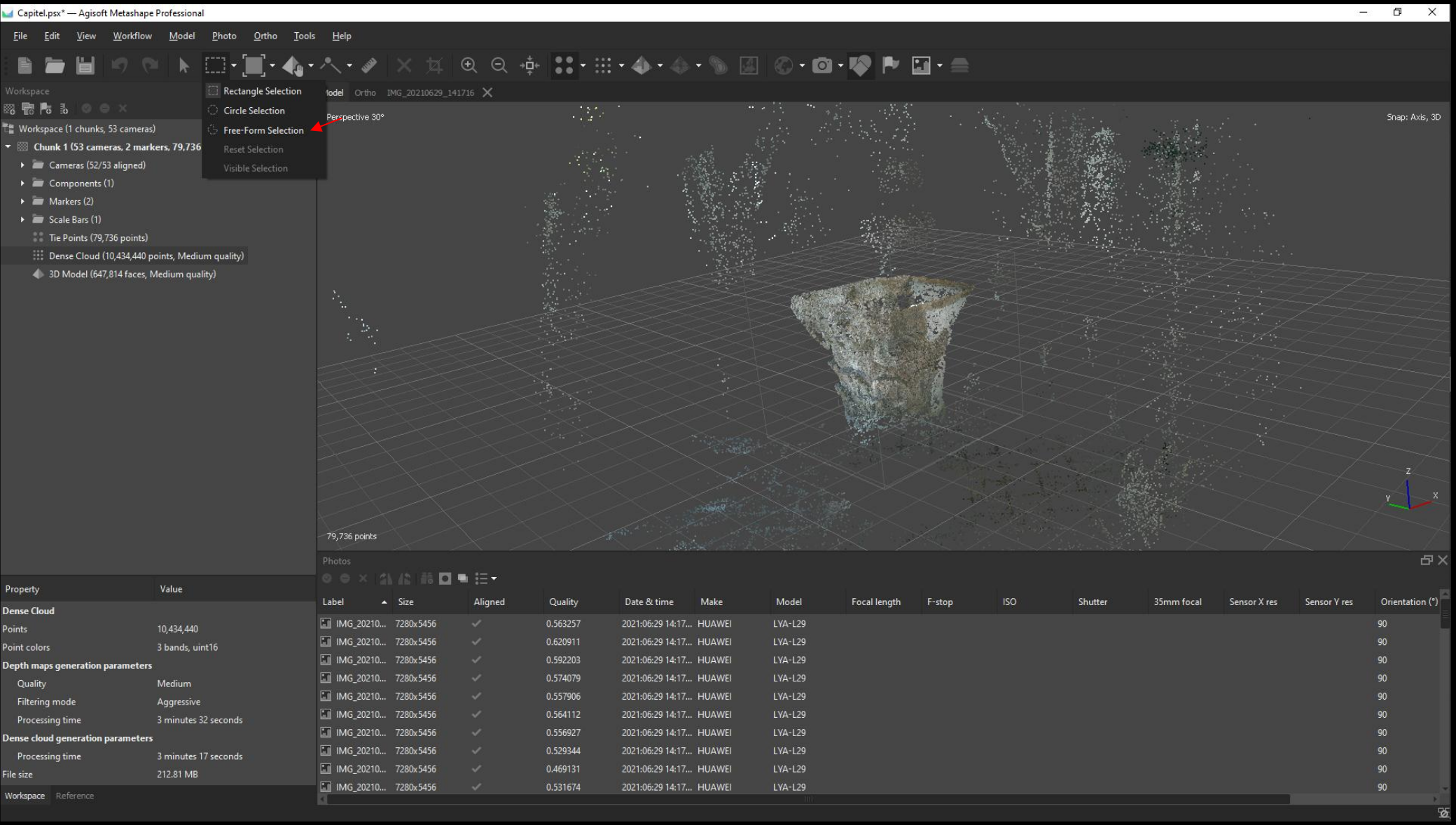


Creating Dense Cloud

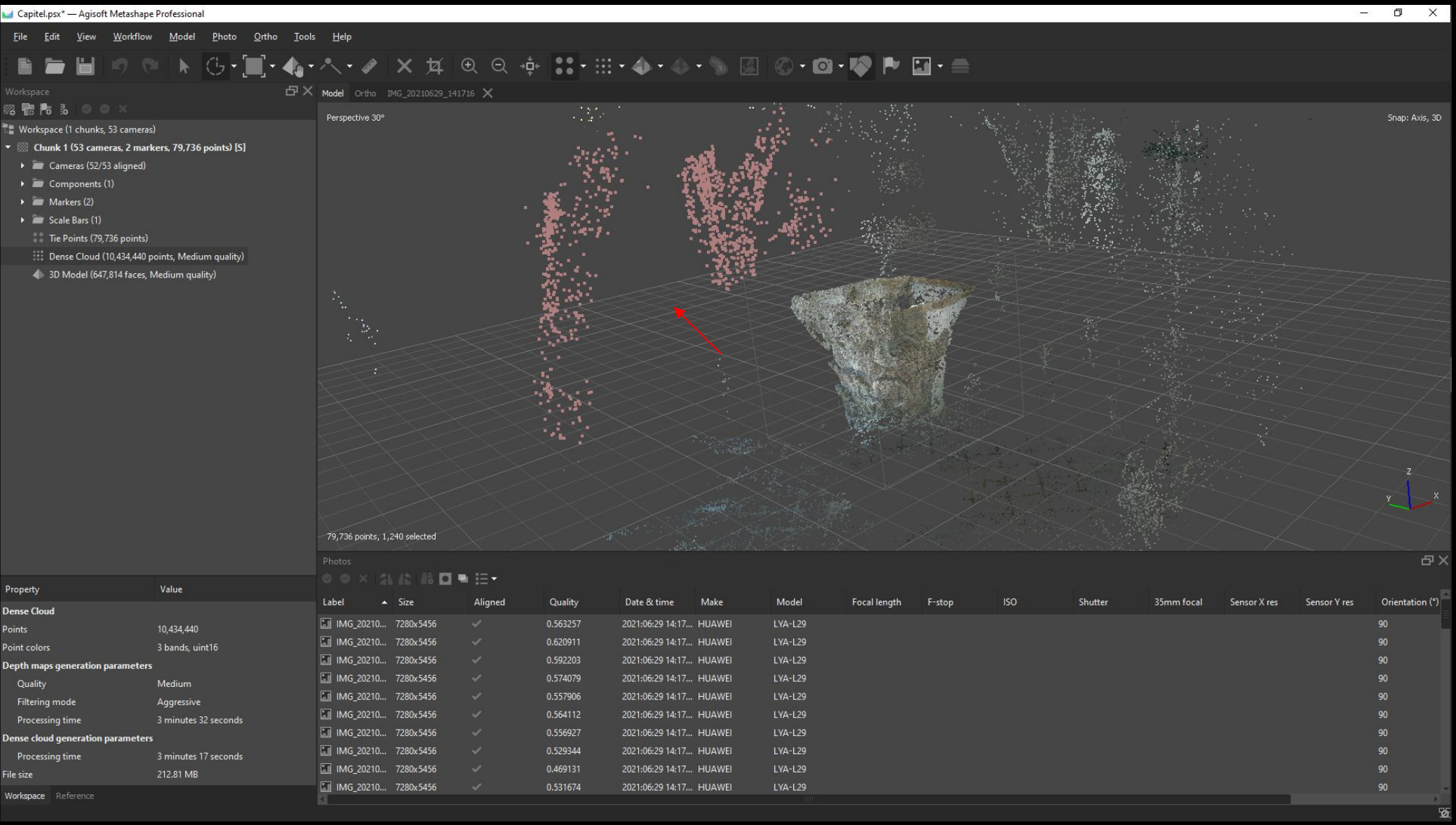


Creating Dense Cloud

3.3.4 CREATING AND CLEANING THE DENSE CLOUD



Cleaning the Dense Cloud

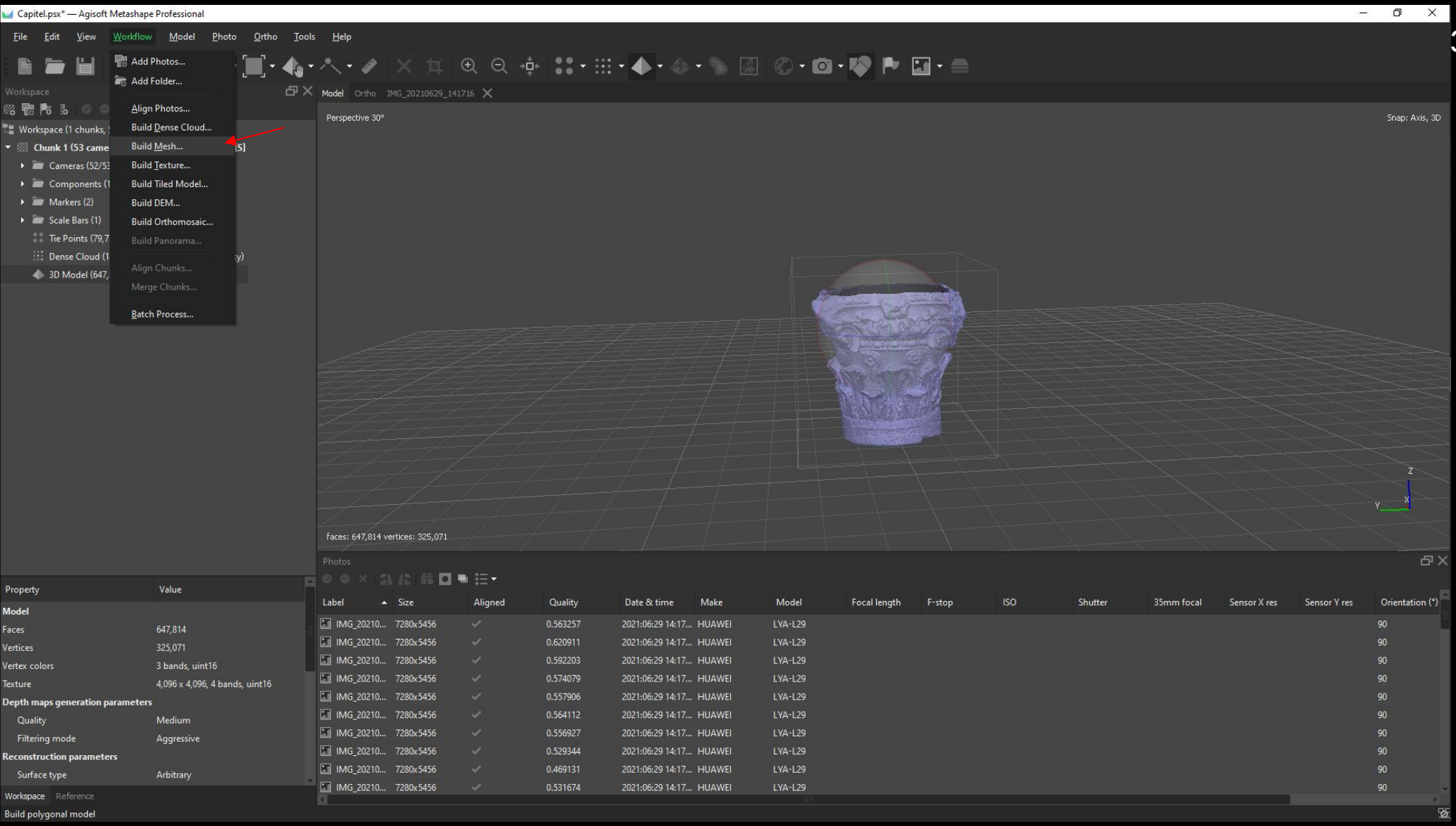


3.3.4 CREATING AND CLEANING THE DENSE CLOUD

Cleaning the Dense Cloud

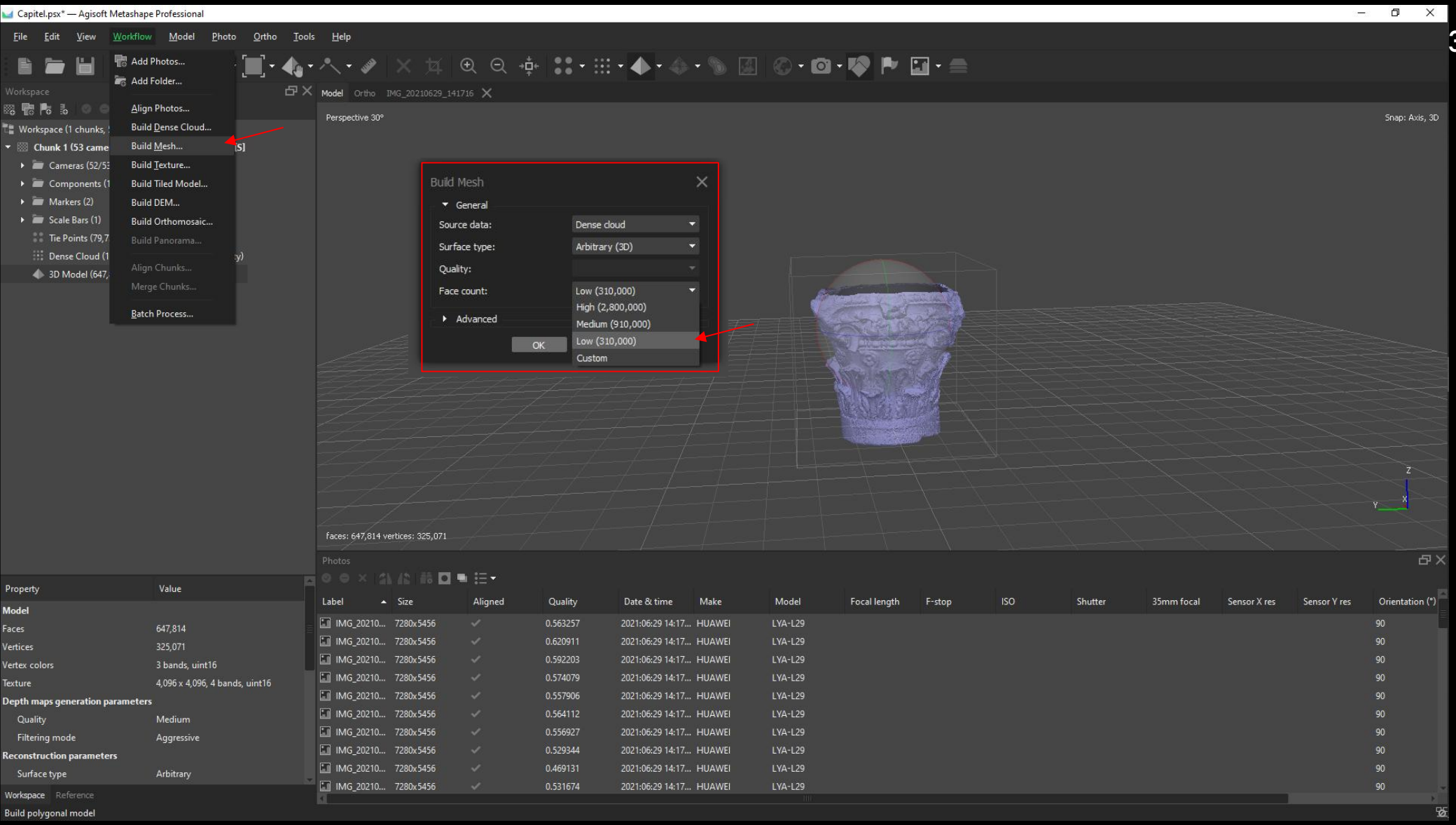
Select the points that you want and then press DELETE

3.3.5 CREATING MESHES AND TEXTURES



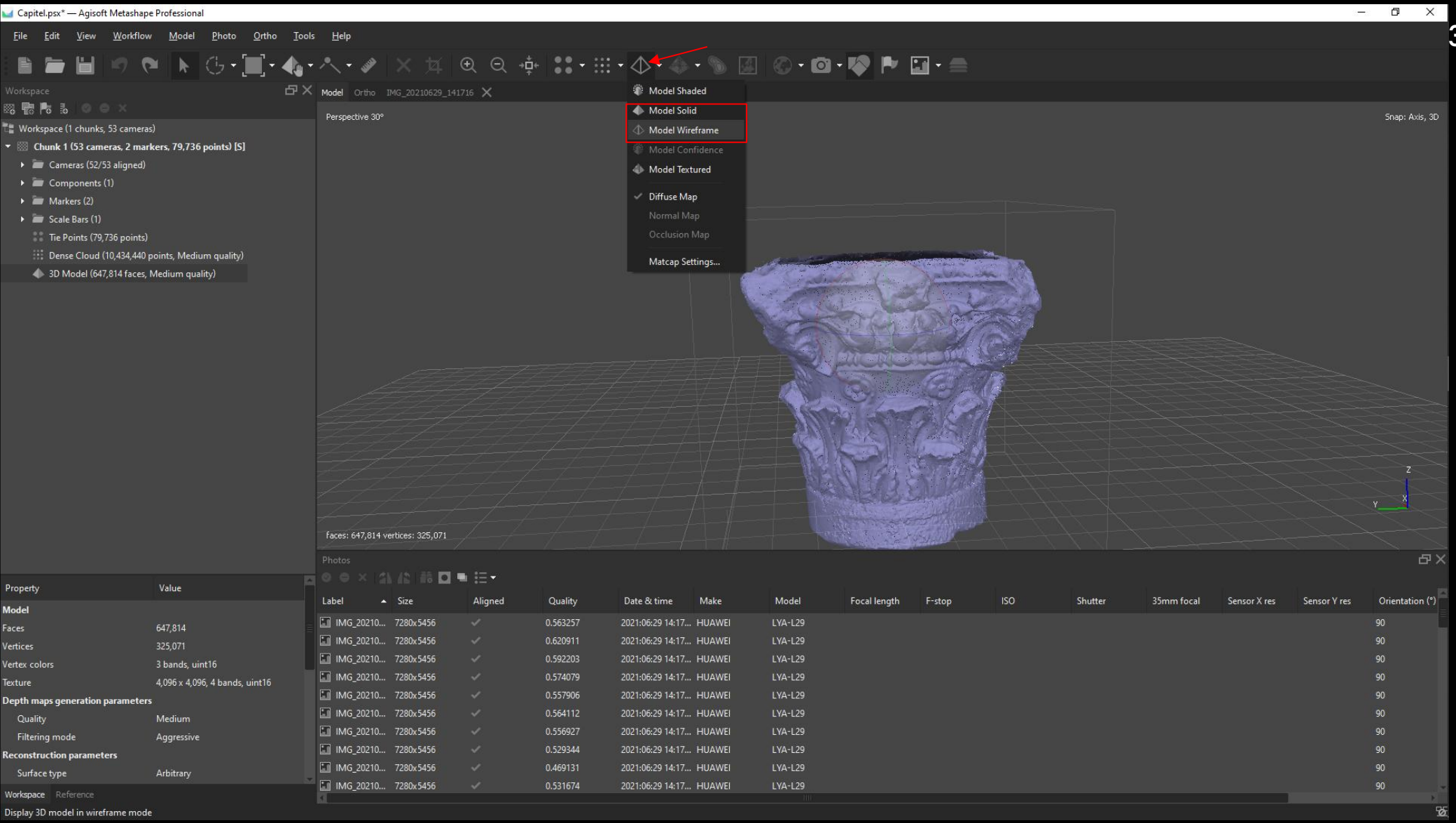
Creating Mesh

3.3.5 CREATING MESHES AND TEXTURES



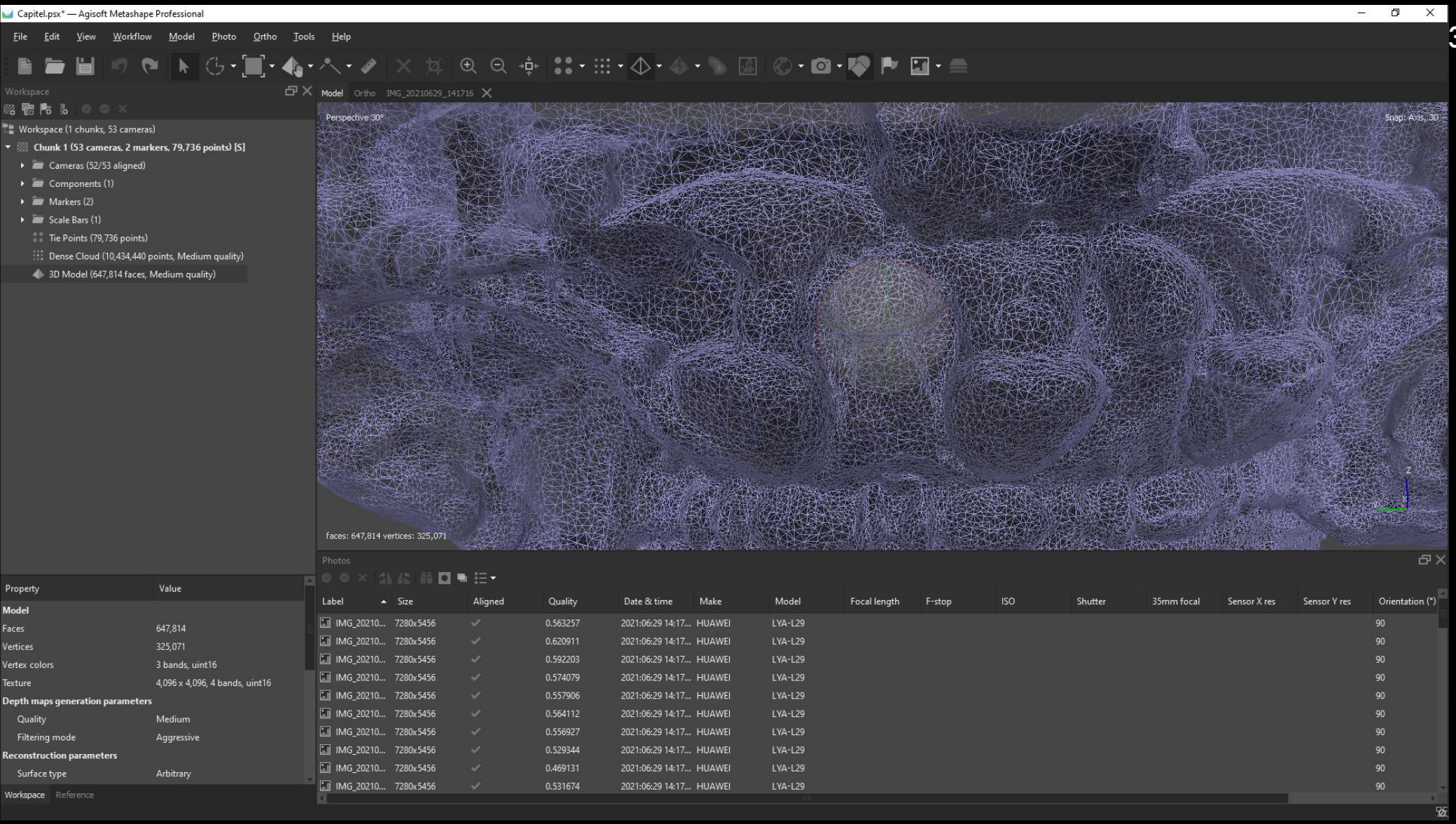
Creating Mesh

3.3.5 CREATING MESHES AND TEXTURES



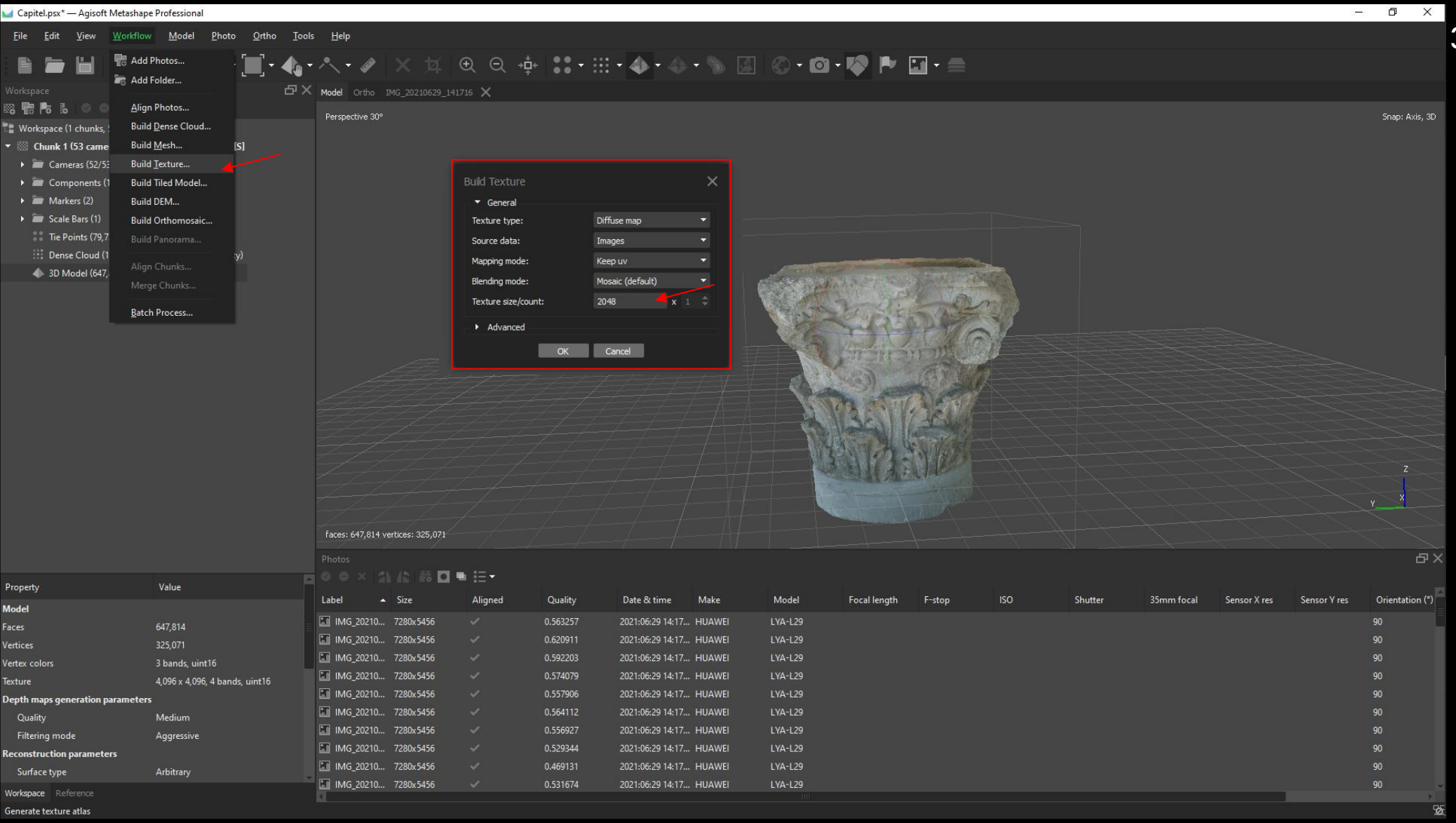
Creating Mesh

3.3.5 CREATING MESHES AND TEXTURES

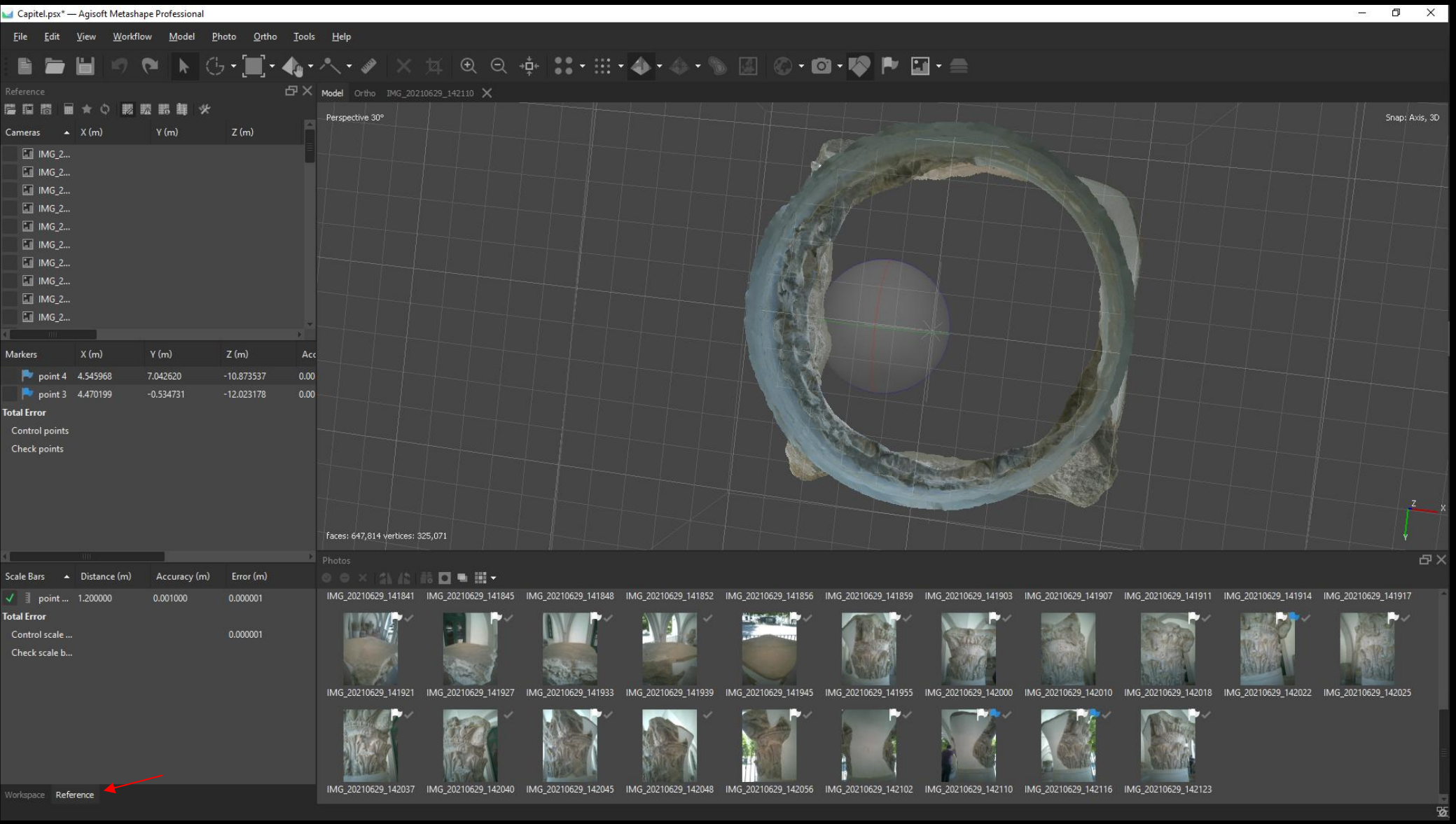


Creating Mesh
Wireframe View

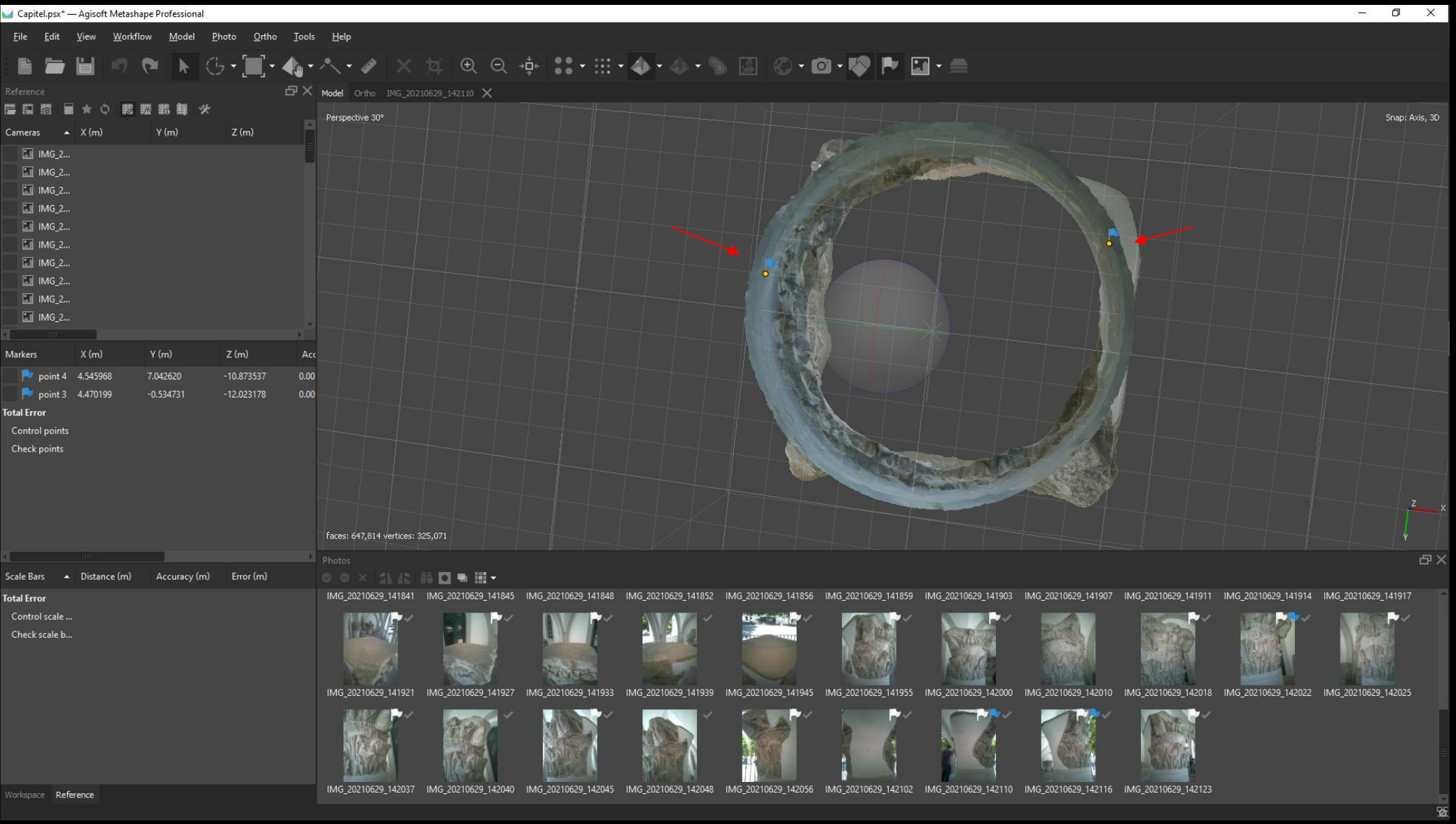
3.3.5 CREATING MESHES AND TEXTURES



Building Texture 1024/2048/4096

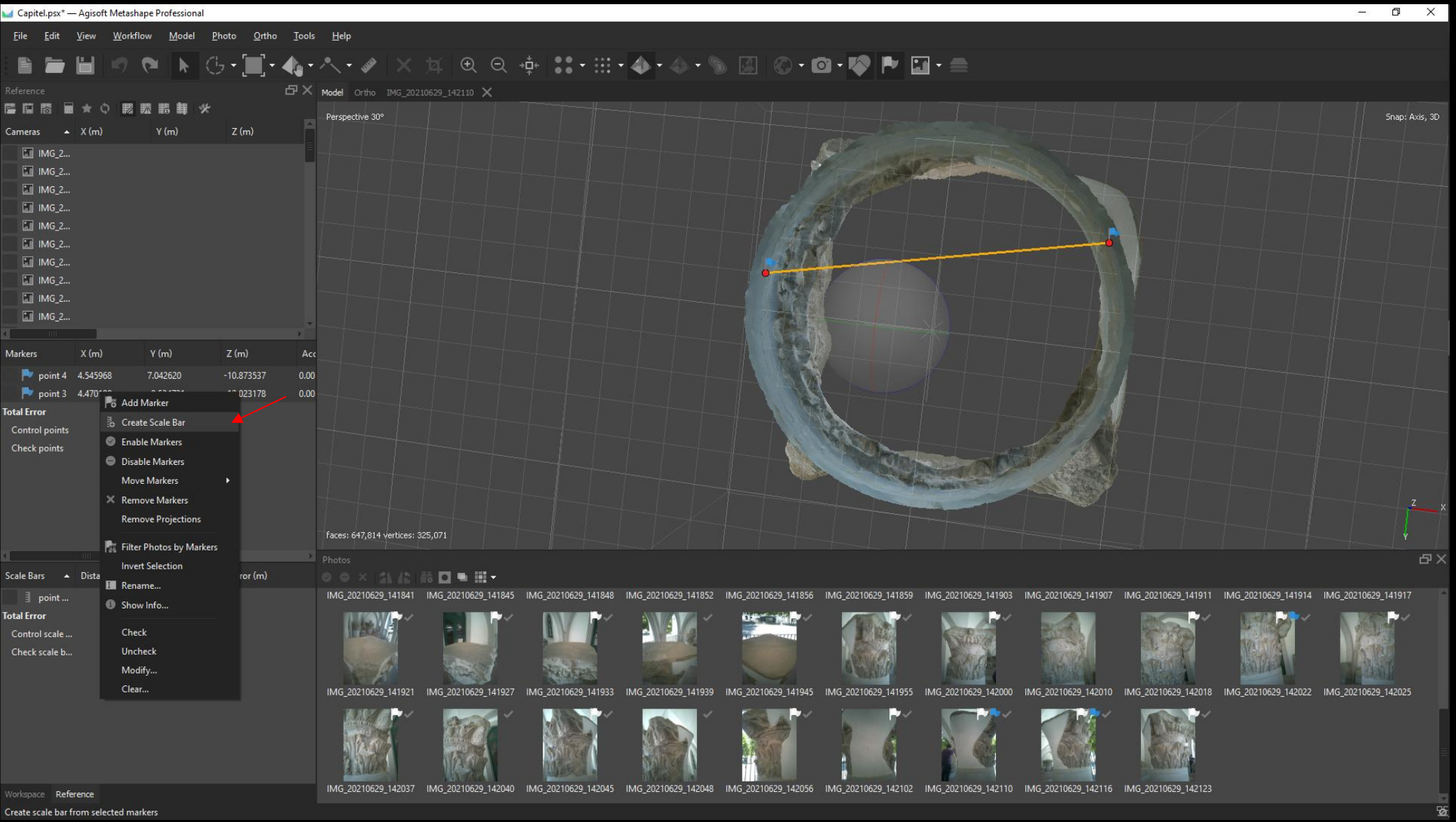


Scaling the model

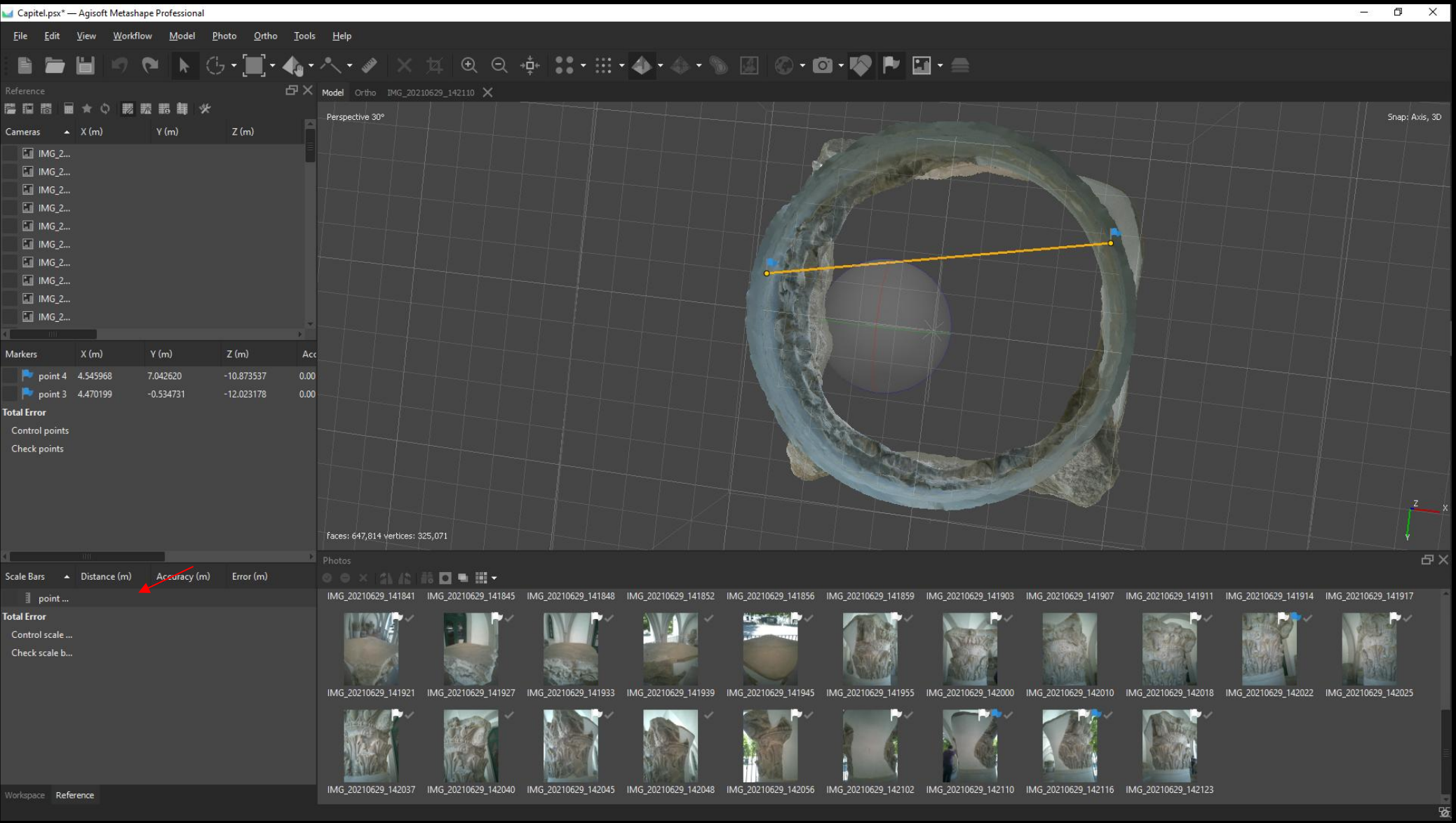


Scaling the model

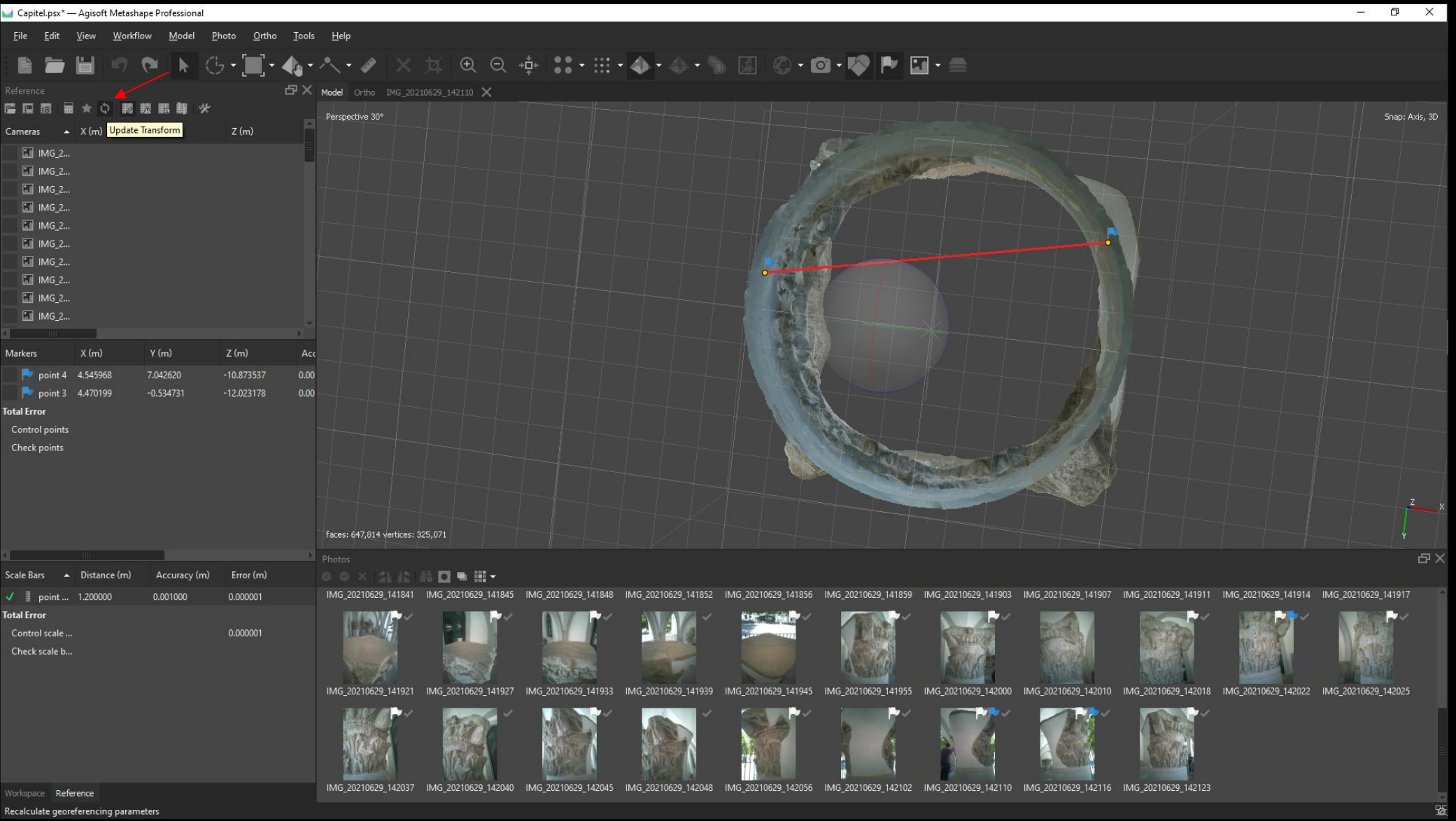
Create 2 points



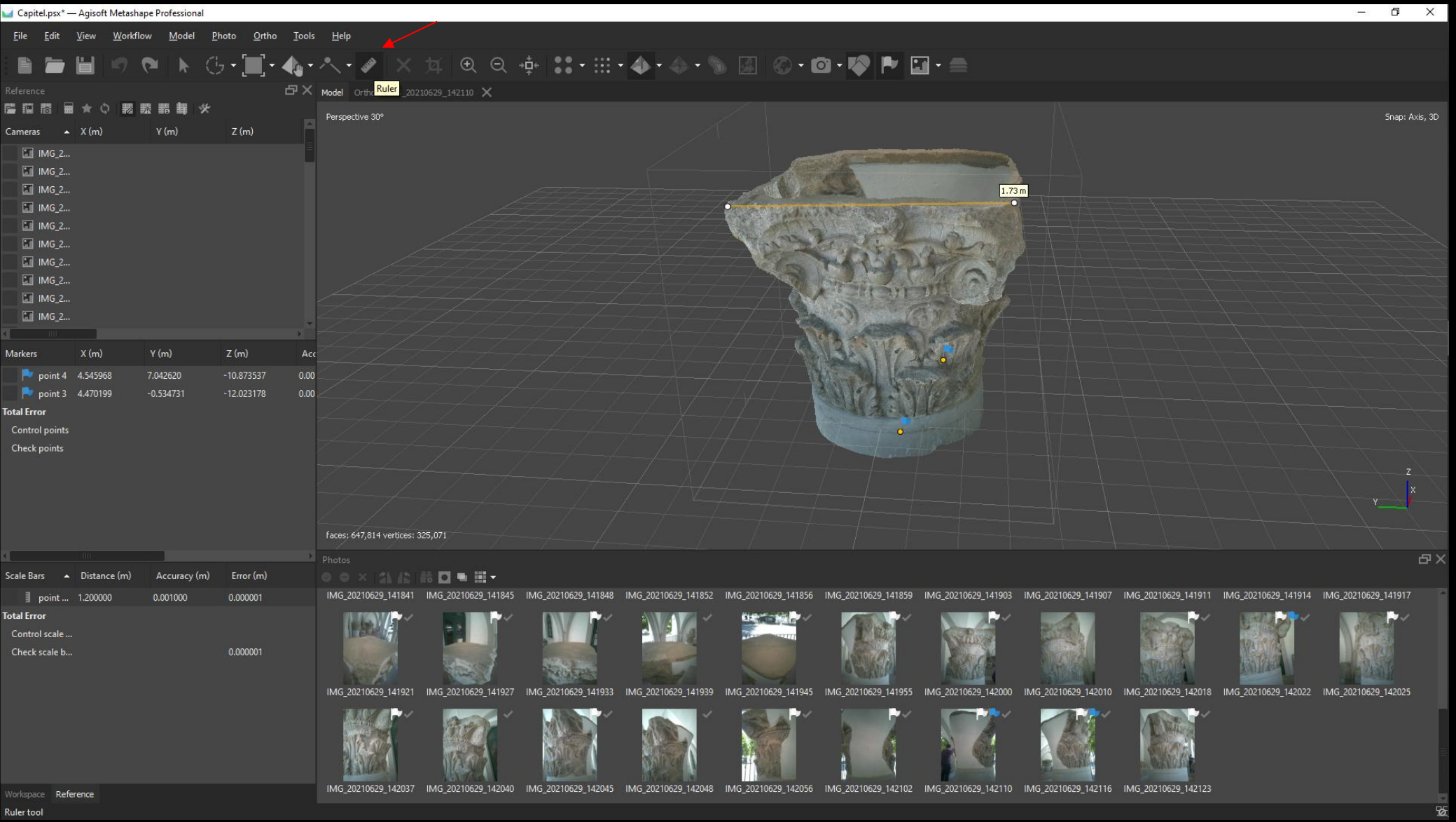
Scaling the model
Select the 2 points



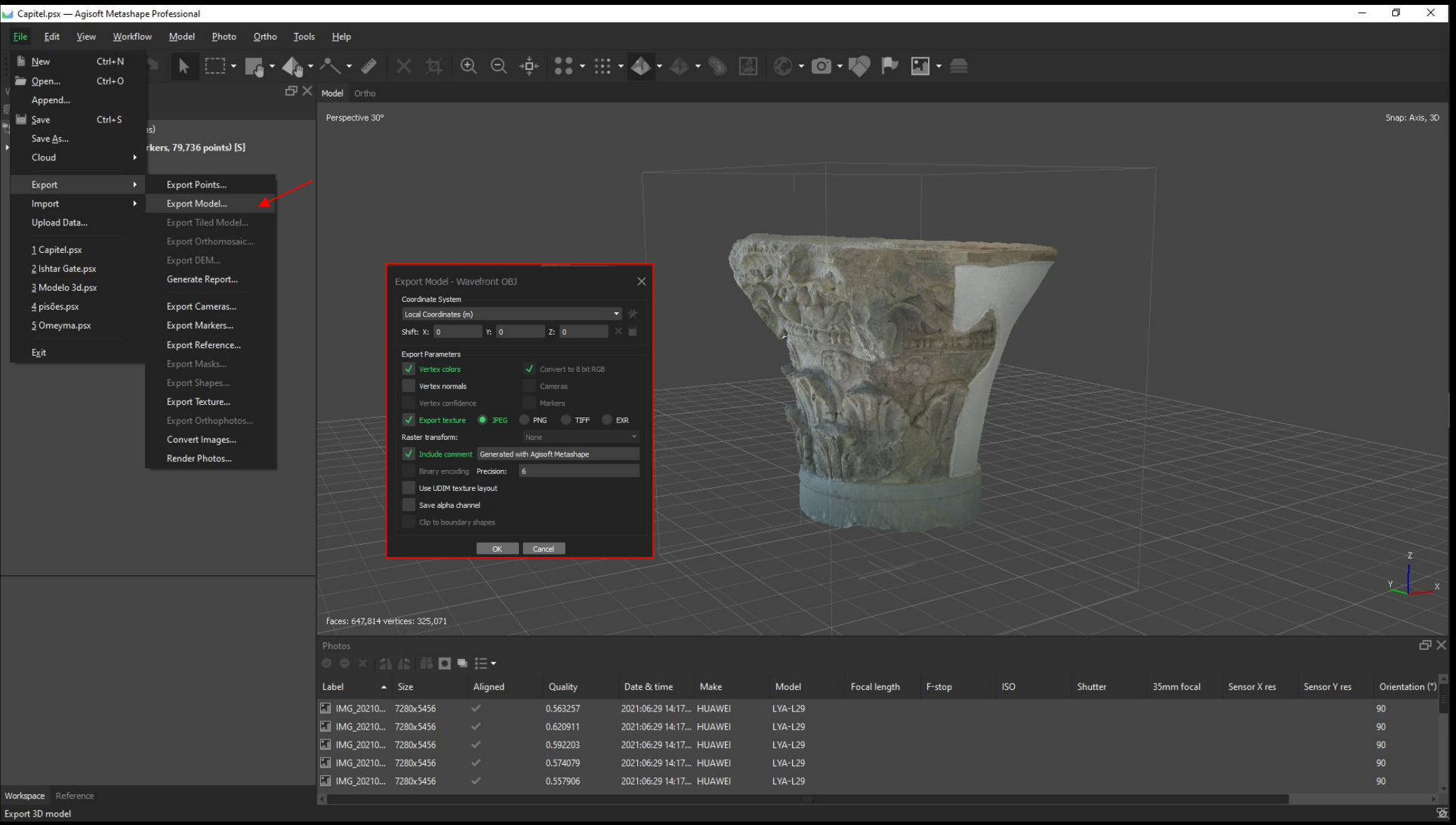
Scaling the model
Insert the Distance between 2 markers (in meters)



Scaling the model



Taking measures
Take 2 points to measure on the model


Capitel.psx — Agisoft Metashape Professional
File Edit View Workflow Model Photo Ortho Tools Help
New Ctrl+N
Open... Ctrl+O
Append...
Save Ctrl+S
Save As...
Cloud
Export
Import
Upload Data...
1 Capitel.psx
2 Ishtar Gate.psx
3 Modelo 3d.psx
4 pisões.psx
5 Omeyma.psx
Exit
Export Points...
Export Model...
Export Tiled Model...
Export Orthomosaic...
Export DEM...
Generate Report...
Export Cameras...
Export Markers...
Export Reference...
Export Masks...
Export Shapes...
Export Texture...
Export Orthophotos...
Convert Images...
Render Photos...
Model Ortho
Perspective 30°
Snap: Axis, 3D
Export Model - Wavefront OBJ
Coordinate System
Local Coordinates (m)
Shift: X: 0 Y: 0 Z: 0
Export Parameters
Vertex colors
Convert to 8 bit RGB
Vertex normals
Cameras
Vertex confidence
Markers
Export texture
JPEG PNG TIFF EXR
Raster transform:
None
Include comment
Generated with Agisoft Metashape
Binary encoding
Precision: 6
Use UDIM texture layout
Save alpha channel
Clip to boundary shapes
OK
Cancel
faces: 647,814 vertices: 325,071
Photos
Label Size Aligned Quality Date & time Make Model Focal length F-stop ISO Shutter 35mm focal Sensor X res Sensor Y res Orientation (°)
IMG_20210... 7280x5456 0.563257 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.620911 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.592203 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.574079 2021:06:29 14:17... HUAWEI LYA-L29 90
IMG_20210... 7280x5456 0.557906 2021:06:29 14:17... HUAWEI LYA-L29 90
Workspace Reference
Export 3D model

WELL DONE!

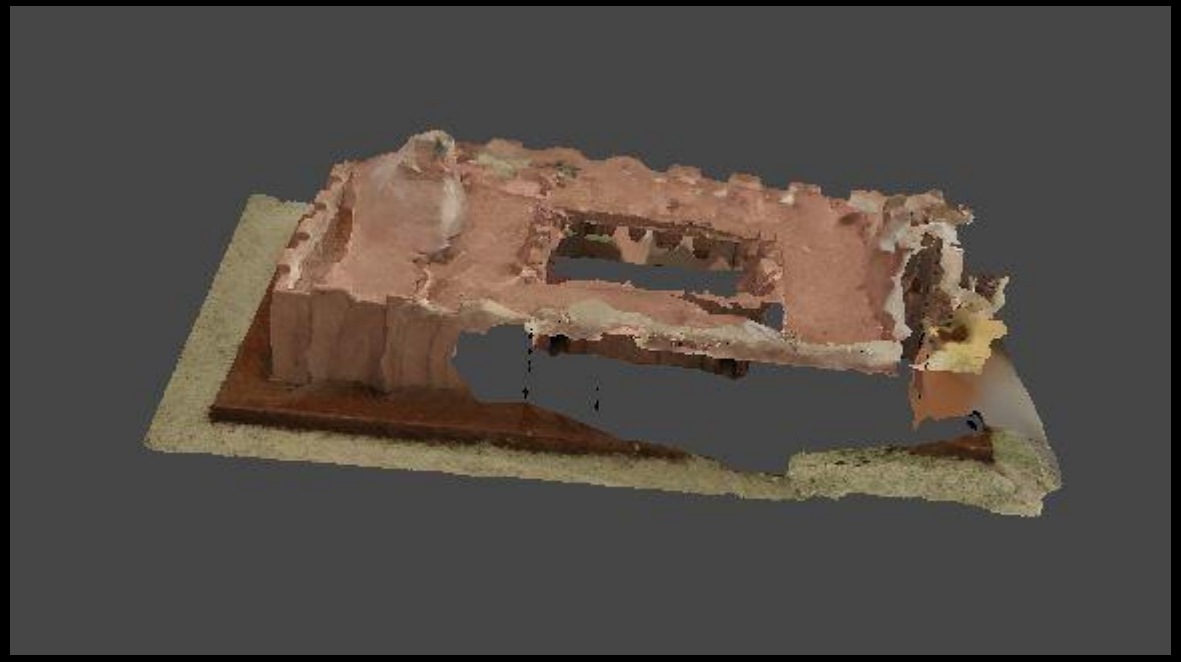
Q&A DAY

WORK EVALUATION

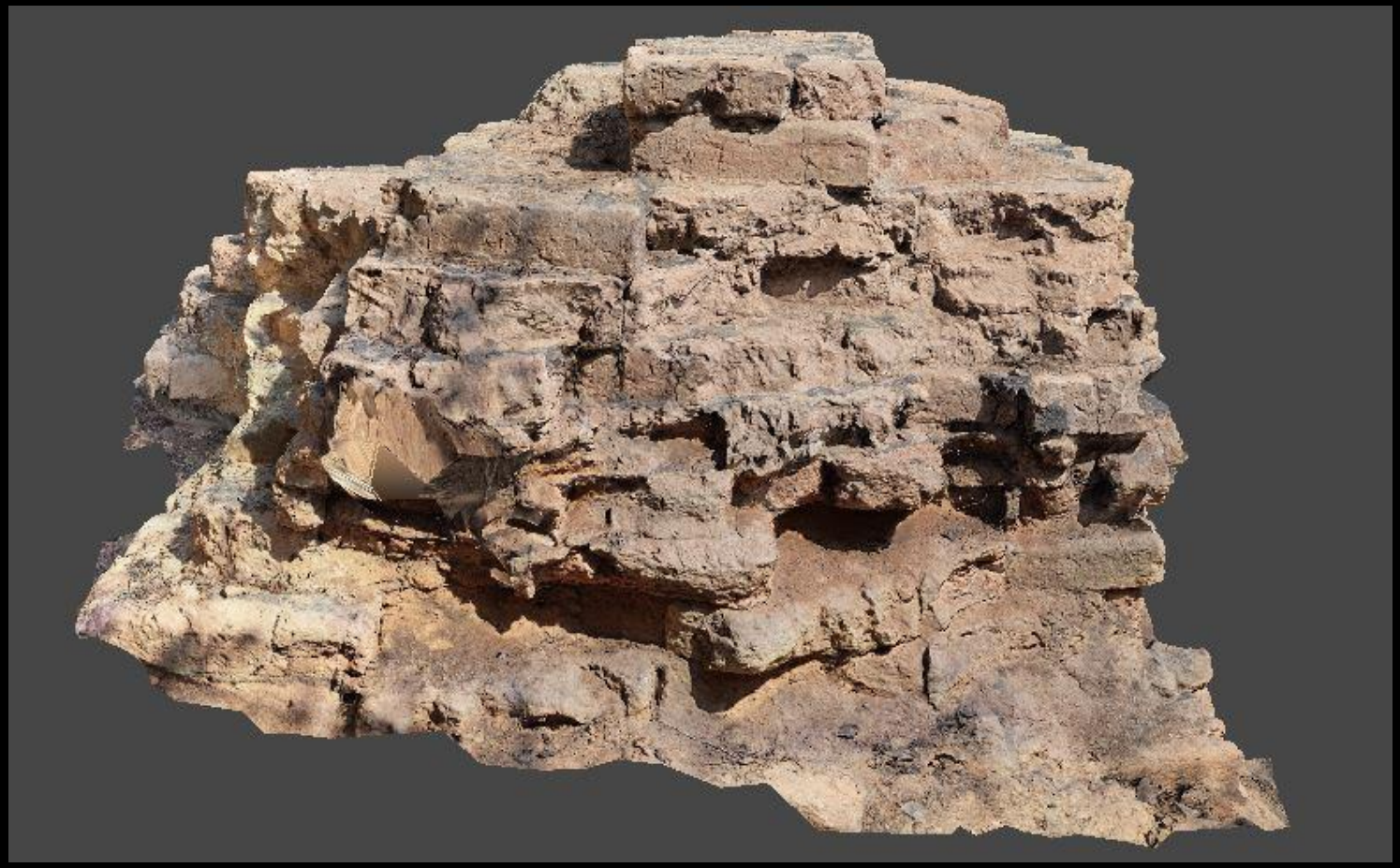
PROCESSING WORKFLOW AND 3D MODEL EDITING

PROCESSING WORKFLOW AND 3D MODEL EDITING

PROCESSING WORKFLOW AND 3D MODEL EDITING



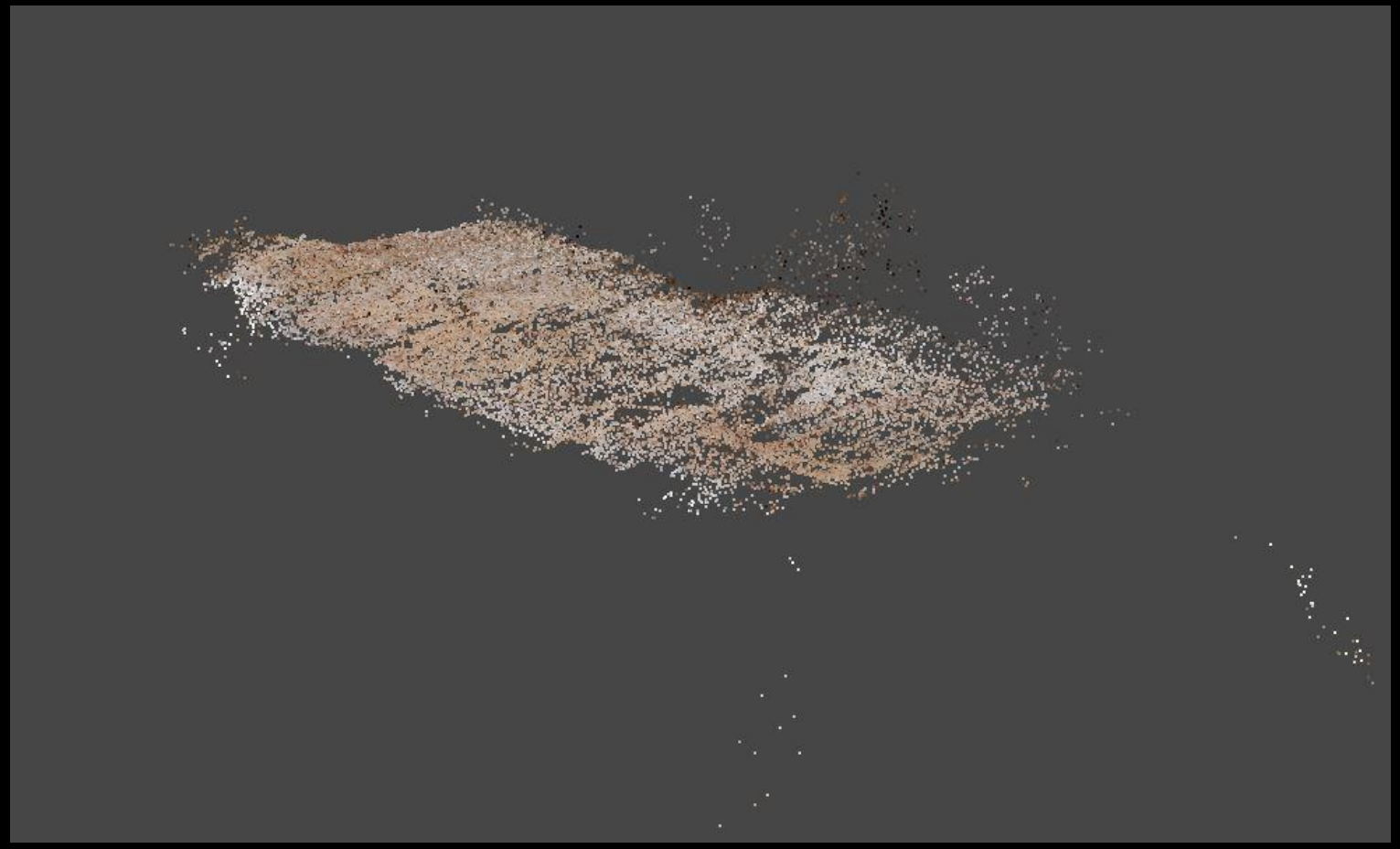
PROCESSING WORKFLOW AND 3D MODEL EDITING



PROCESSING WORKFLOW AND 3D MODEL EDITING

PROCESSING WORKFLOW AND 3D MODEL EDITING

PROCESSING WORKFLOW AND 3D MODEL EDITING



PROCESSING WORKFLOW AND 3D MODEL EDITING

PROCESSING WORKFLOW AND 3D MODEL EDITING

4- PHOTOGRAMMETRY AND DRONES

4.1 HOW TO OPERATE THE DRONE

4.2 CAPTURING PHOTOS FROM THE AIR

4.3 DRONE HARMONY APP FOR PLANNED FLIGHTS

4.4 METASHAPE WORKFLOW FOR DATA PROCESSING

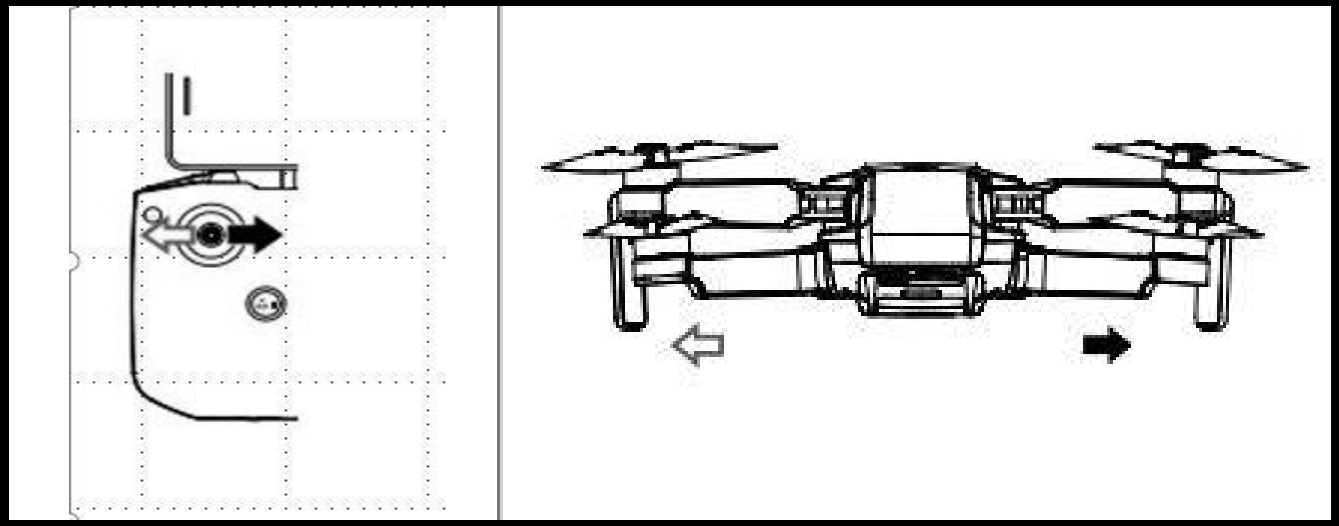
4.5 USES AND APPLICATIONS OF AERIAL PHOTOGRAMMETRY IN CULTURAL HERITAGE


MINI 2 SE

4.1 HOW TO OPERATE DRONES

There are four main drone controls:

ROLL: Done by pushing the left stick to the left or right. Literally rolls the drone, which maneuvers the drone left or right.



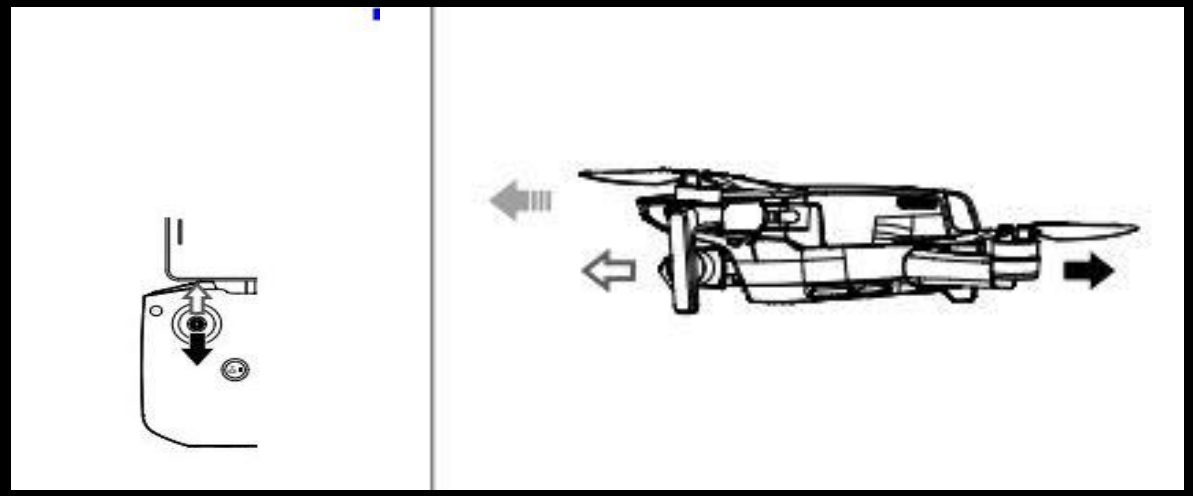
IMPORTANT NOTE:
When the drone is facing you (instead of facing away from you) the controls are all switched.

PHOTOGRAMMETRY AND DRONES

4.1 HOW TO OPERATE DRONES

There are four main drone controls:

PITCH: Done by pushing the left stick forwards or backward. Tilts the drone, which maneuvers the drone forwards or backward.



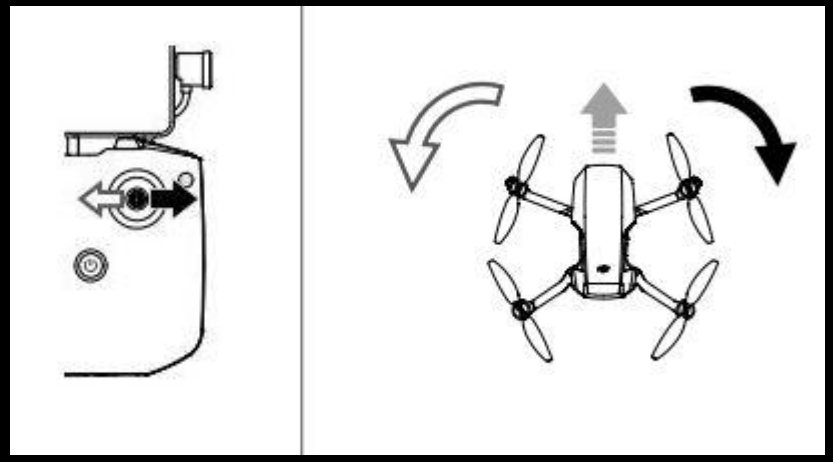
IMPORTANT NOTE:
When the drone is facing you (instead of facing away from you) the controls are all switched.

PHOTOGRAMMETRY AND DRONES

4.1 HOW TO OPERATE DRONES

There are four main drone controls:

YAW: Done by pushing the right stick to the left or to the right. Rotates the drone left or right. Points the front of the copter in different directions and helps with changing directions while flying.

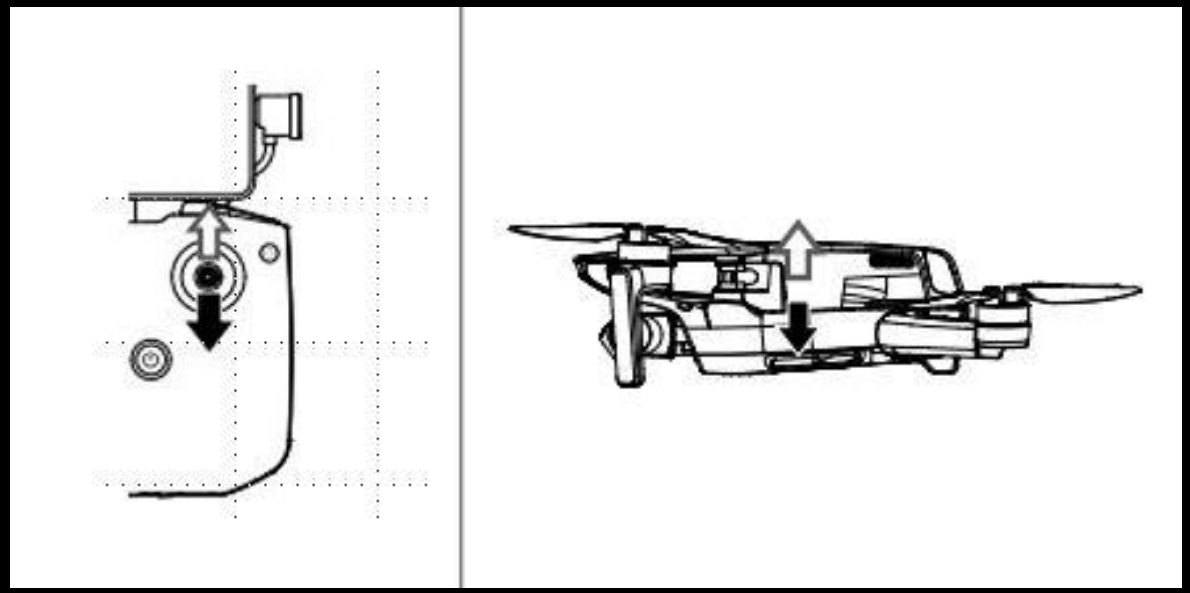


IMPORTANT NOTE:
When the drone is facing you (instead of facing away from you) the controls are all switched.

PHOTOGRAMMETRY AND DRONES

There are four main drone controls:

THROTTLE: To increase, push the right stick forwards. To decrease, pull the right stick backward. This adjusts the altitude, or height, of the drone.



IMPORTANT NOTE:
When the drone is facing you (instead of facing away from you) the controls are all switched.

Here’s a checklist you can use before each flight:

WEATHER & SITE SAFETY CHECK

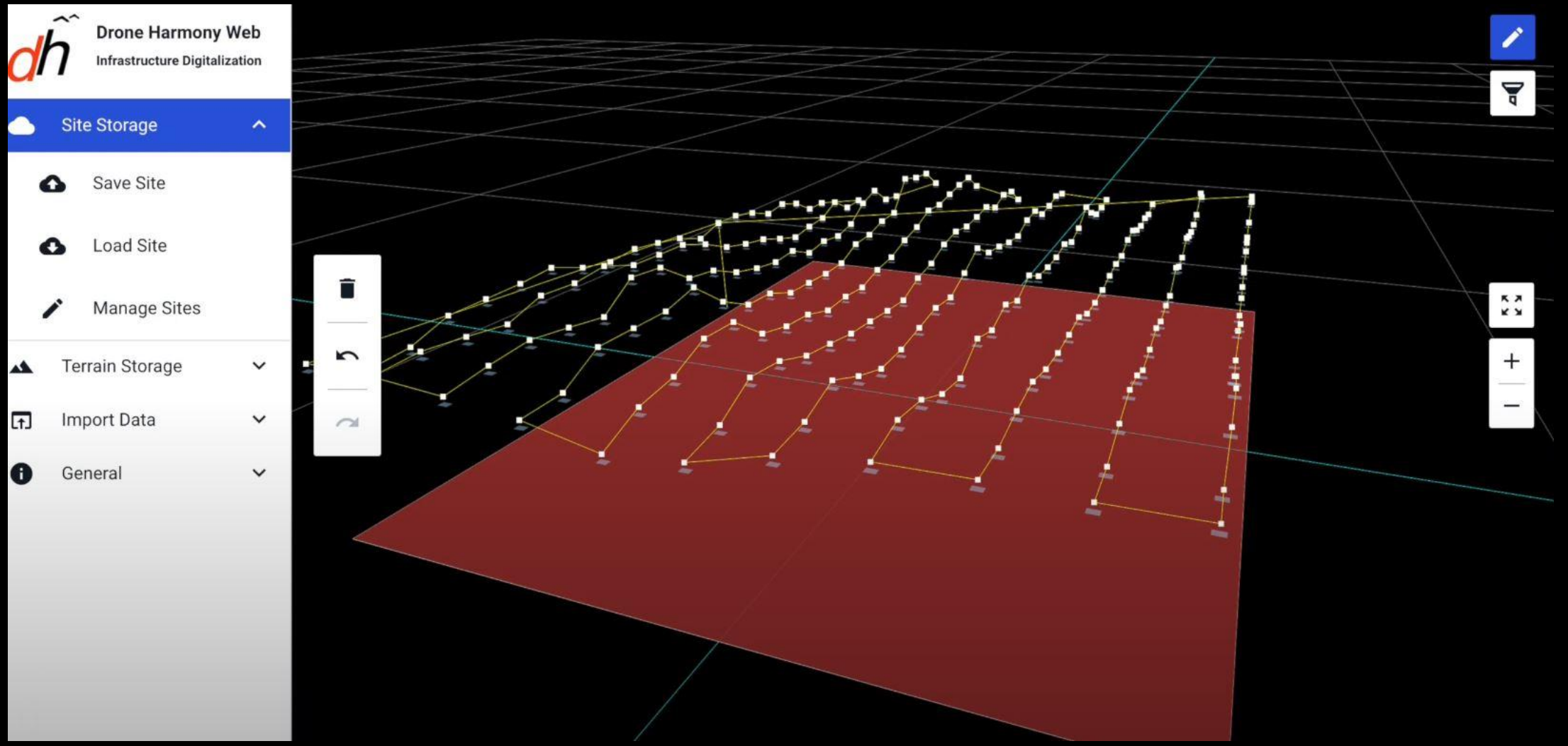
VISUAL AIRCRAFT / SYSTEM INSPECTION

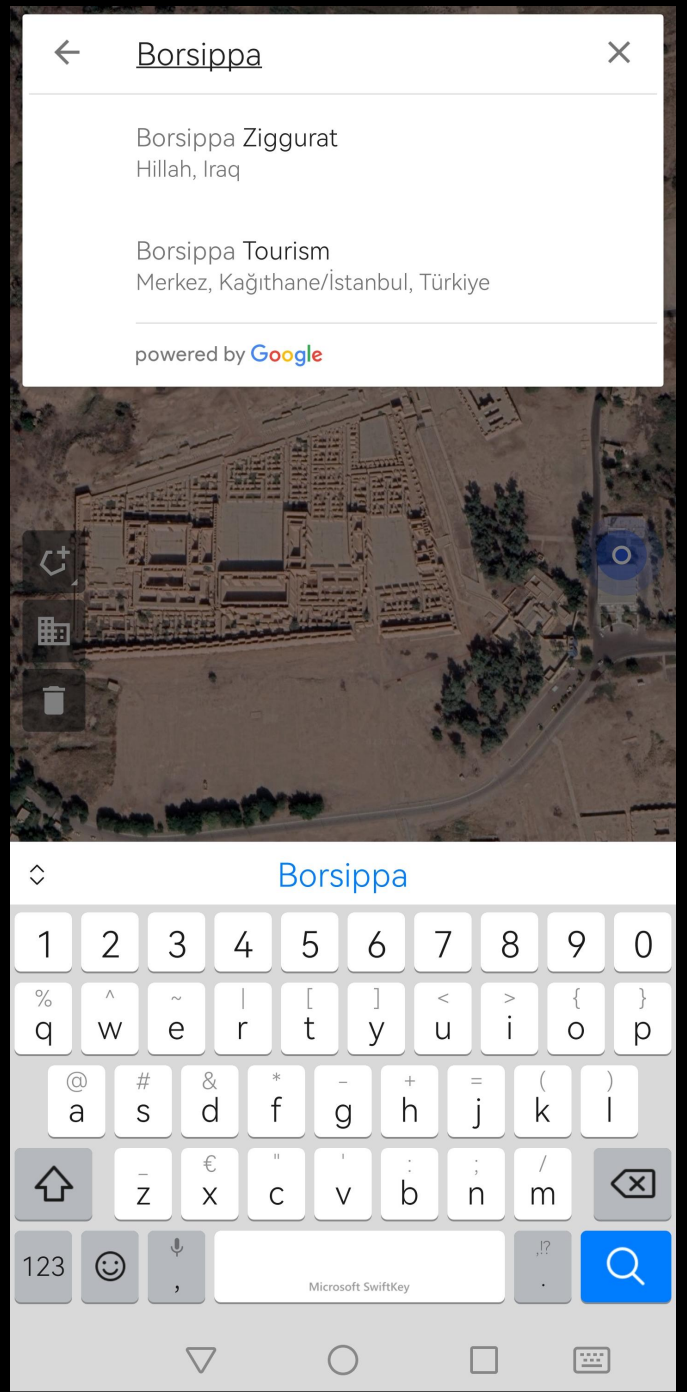
POWERING UP

TAKING OFF

MANUALLY

AUTOMATED


Drone Harmony Web
Infrastructure Digitalization
Site Storage
Save Site
Load Site
Manage Sites
Terrain Storage
Import Data
General

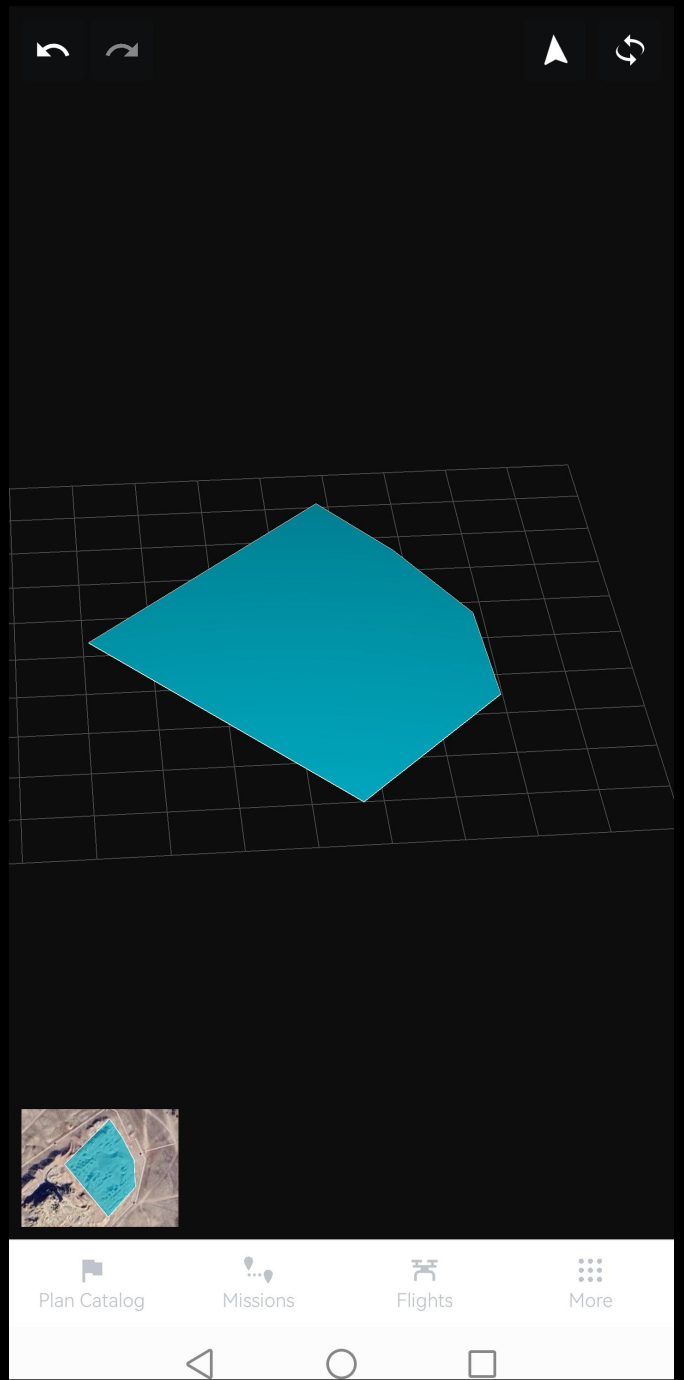


4.3 DH APP FOR PLANNED FLIGHTS

Planning from your position to another site

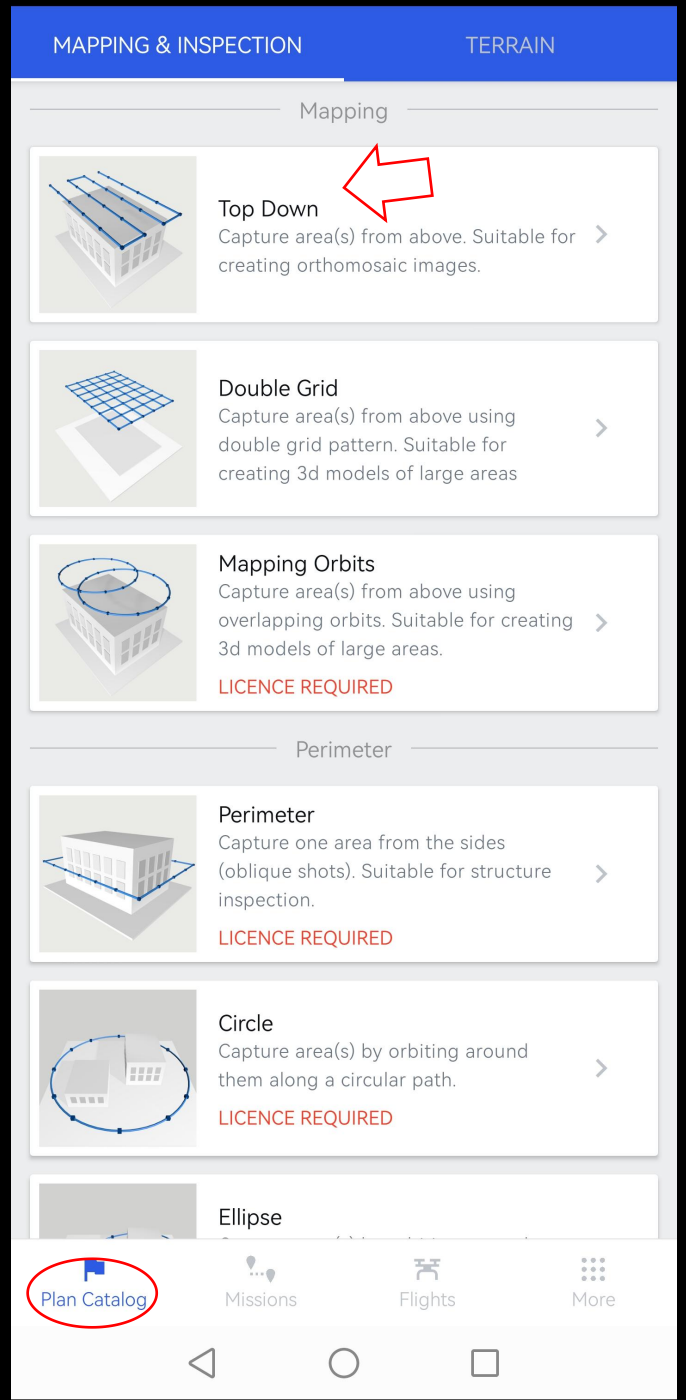
4.3 DH APP FOR PLANNED FLIGHTS

Create your workspace on the map



4.3 DH APP FOR PLANNED FLIGHTS

Creating your polygon



4.3 DH APP FOR PLANNED FLIGHTS

Choose the type of Capture

4.3 DH APP FOR PLANNED FLIGHTS

Choose the position on the map where you will Liftoff and Landing

Top Down mission

Distance: 758.8 m Waypoints: 24

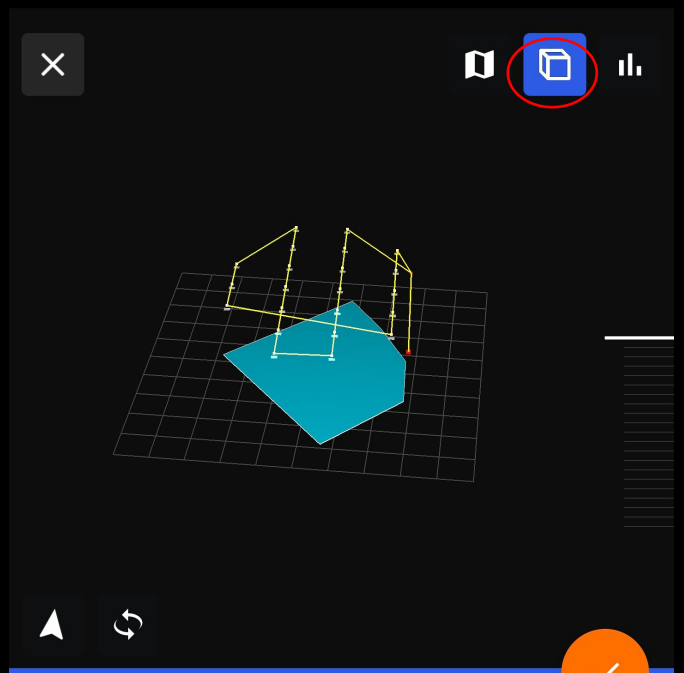
Top-Down

Flight altitude:
[5 - 1500] m
60

Compute optimal flight direction

Flight Direction: 0.0°
0

Simplify



Top Down mission

Distance: 758.8 m Waypoints: 24

Top-Down

Flight altitude:
[5 - 1500] m
60

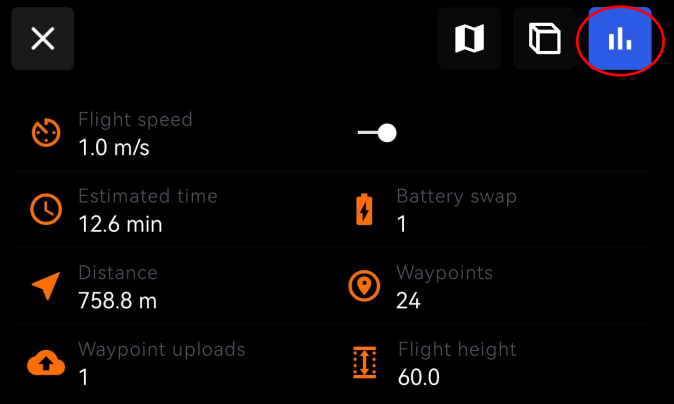
Compute optimal flight direction

Flight Direction: 0.0°
0

Simplify

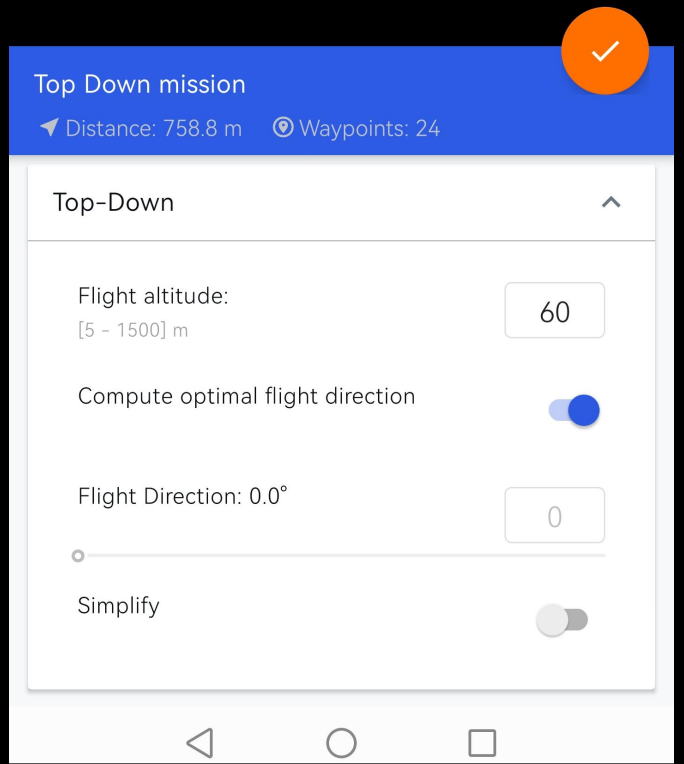
4.3 DH APP FOR PLANNED FLIGHTS

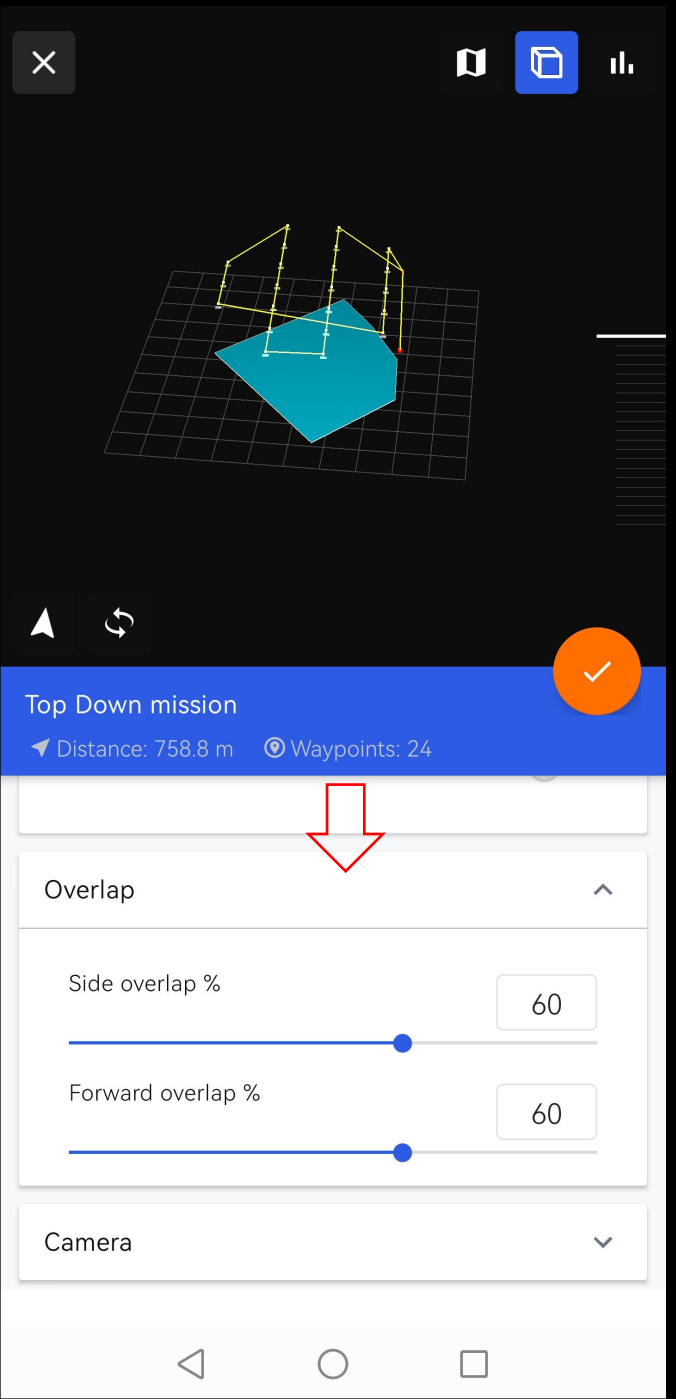
Top Down mission Planning Route

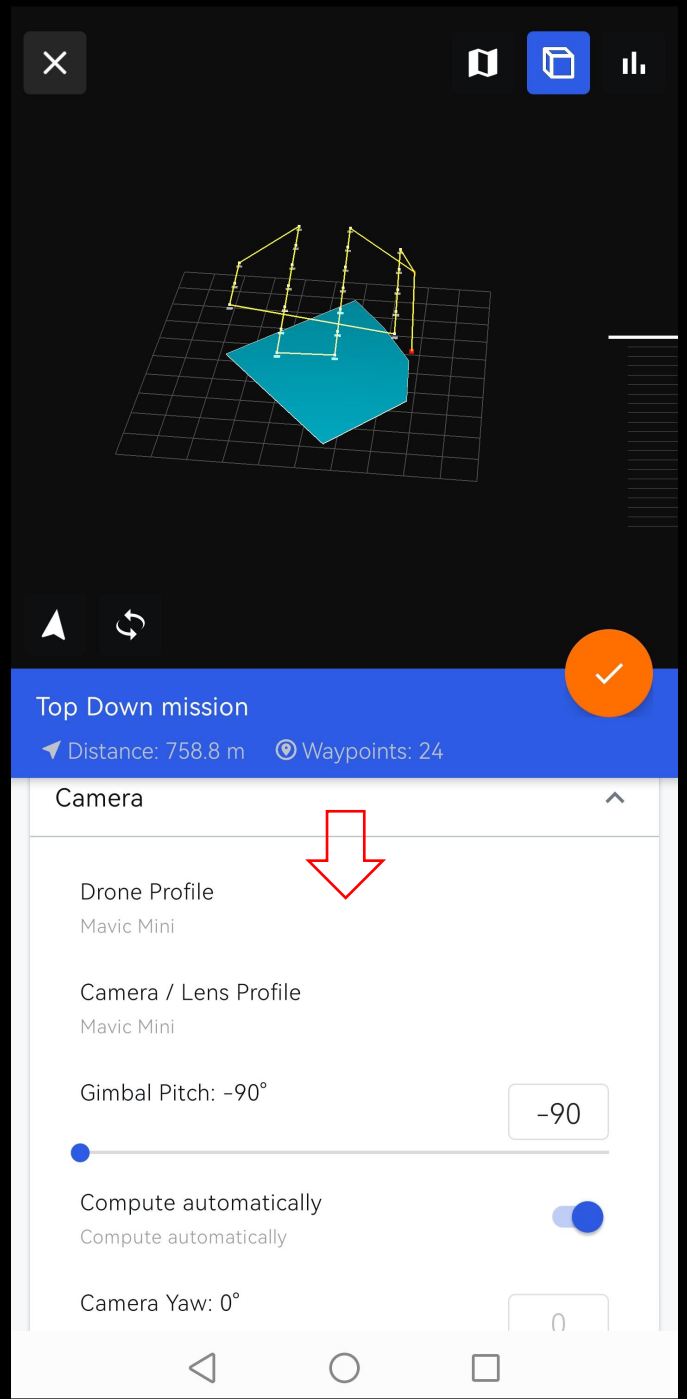


4.3 DH APP FOR PLANNED FLIGHTS

Informations about the flight

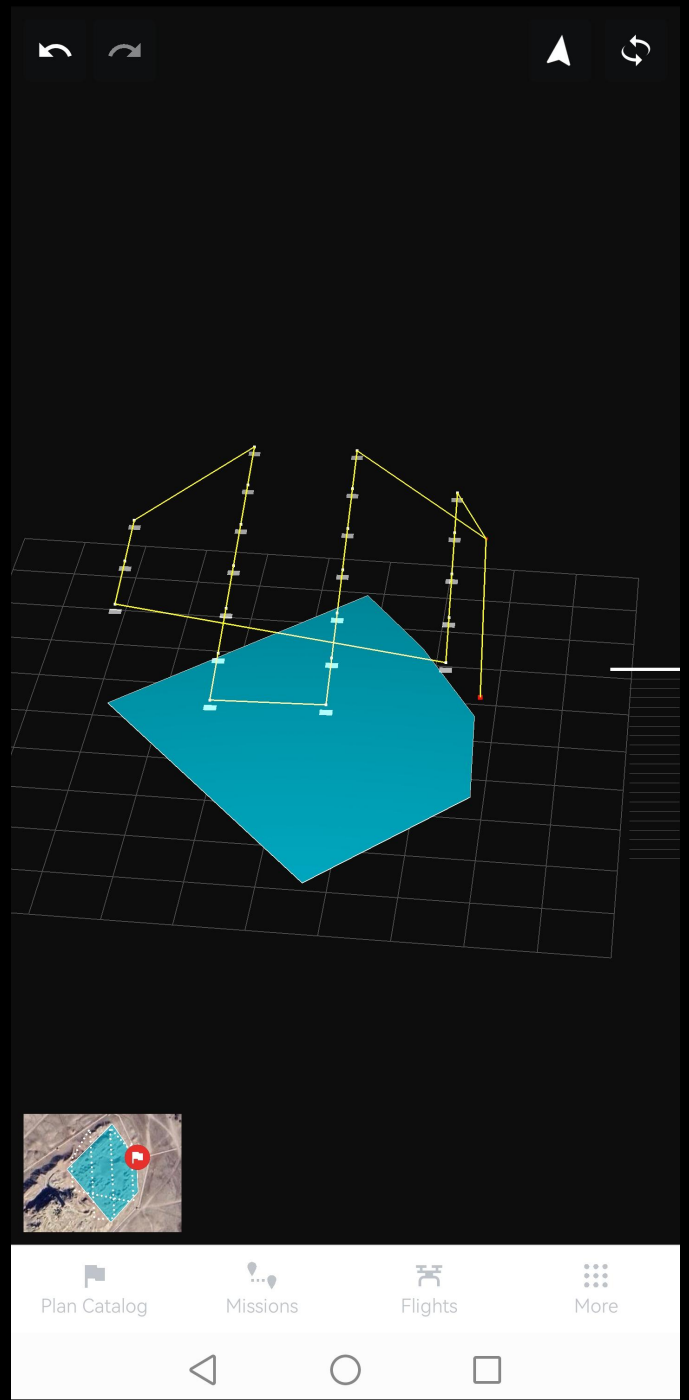






4.3 DH APP FOR PLANNED FLIGHTS

Swipe down for customize of the flight

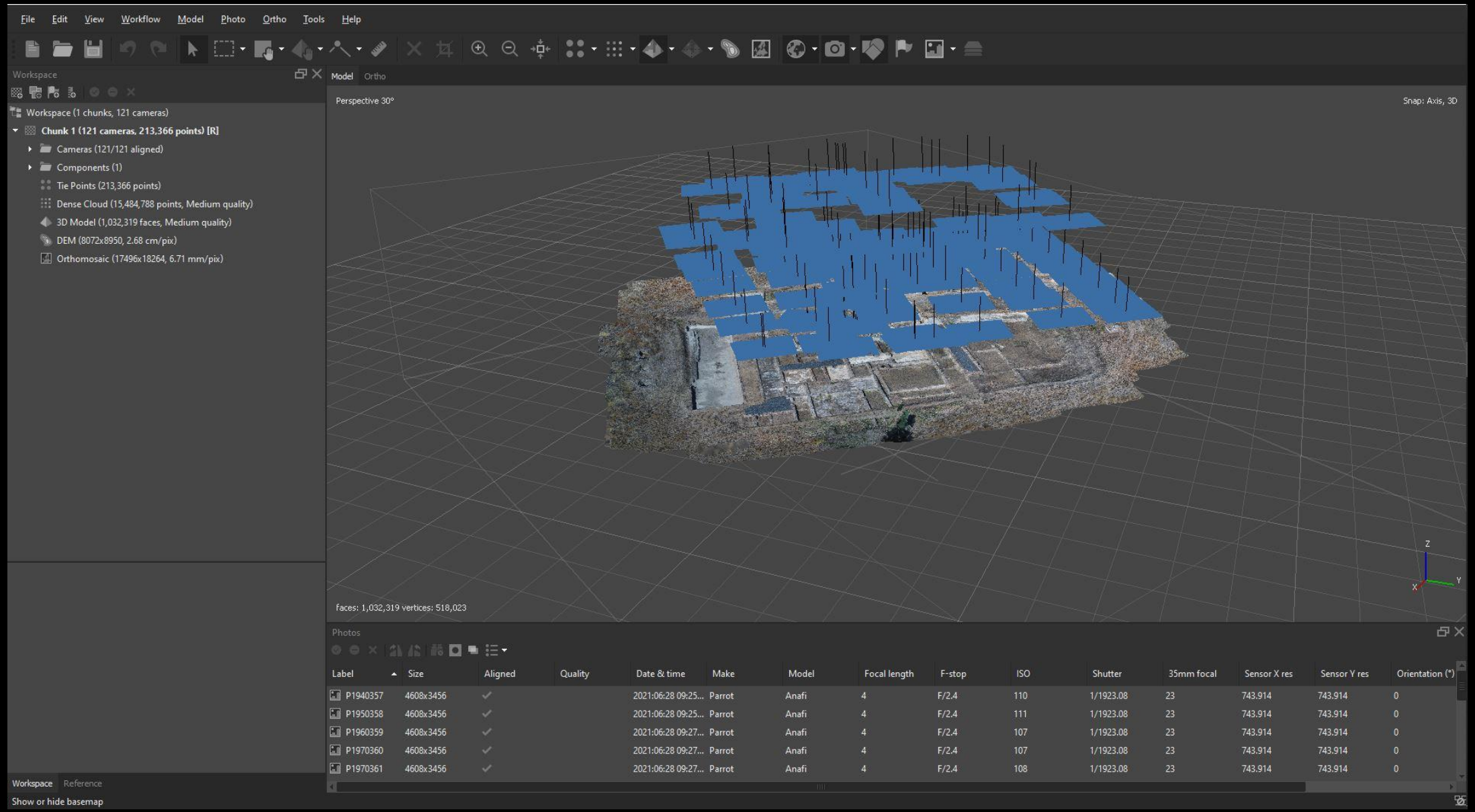


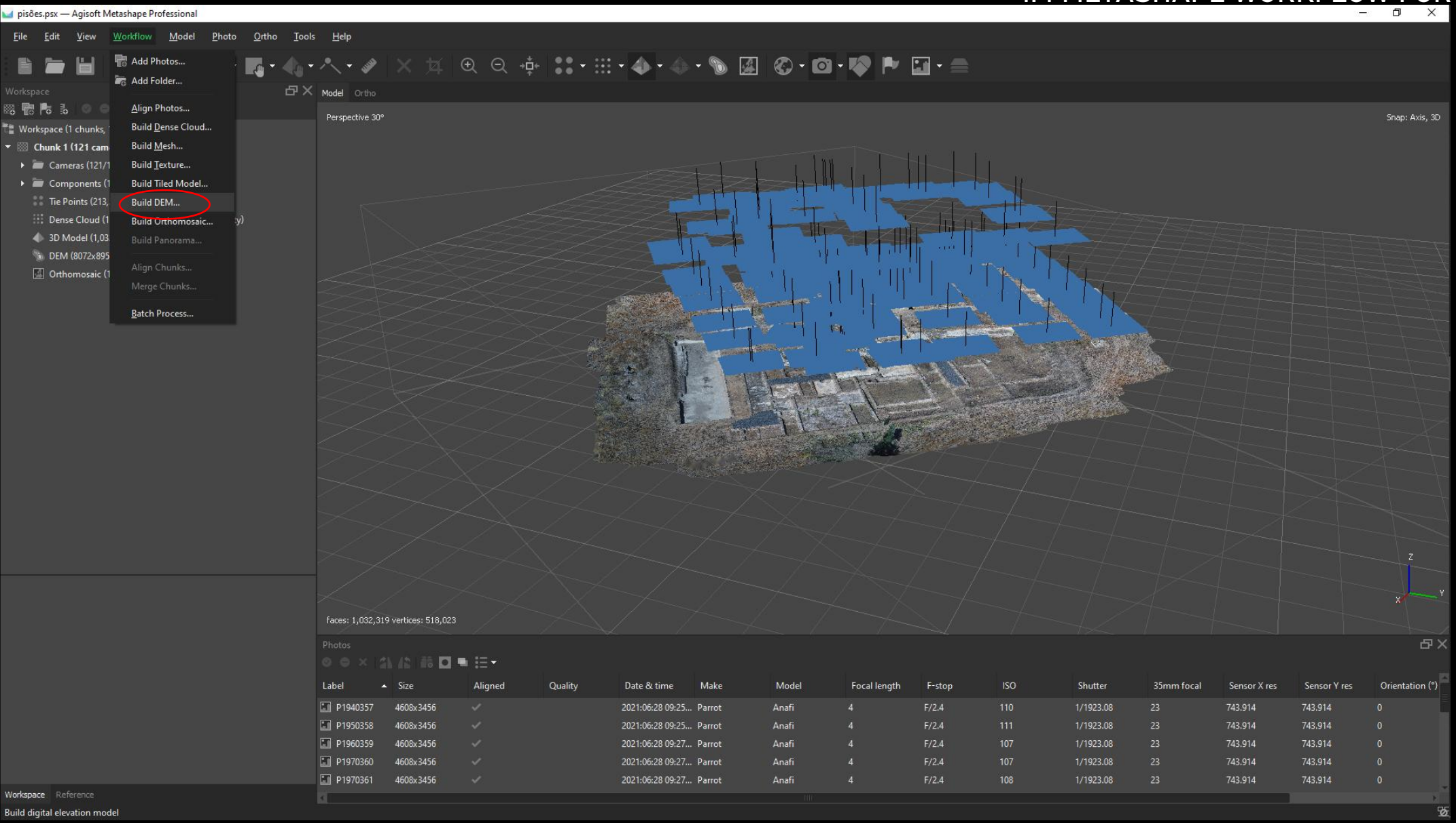
4.3 DH APP FOR PLANNED FLIGHTS

General overview of you planned flight

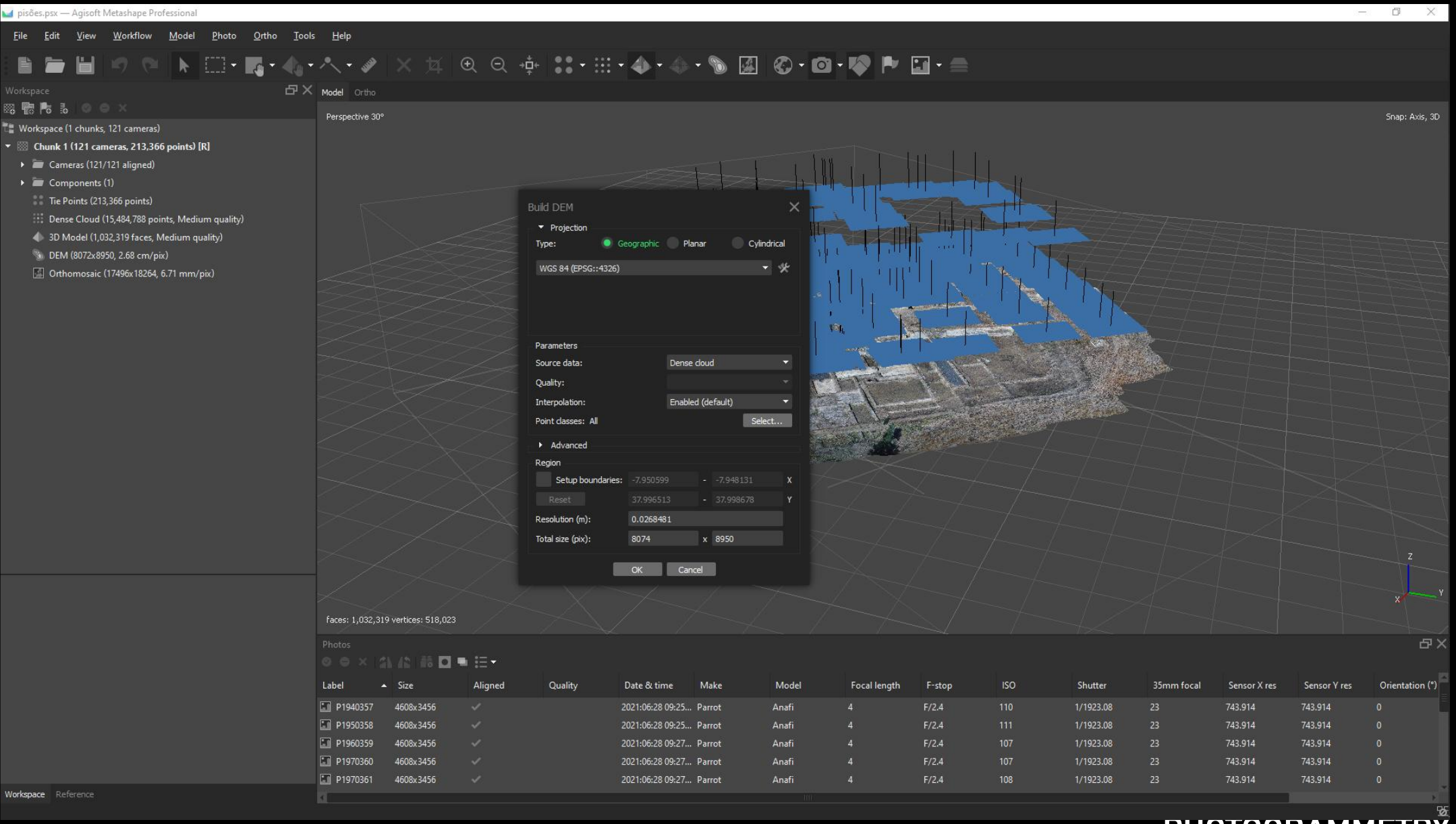
BORSIPPA TRIP!!!

PHOTOGRAMMETRY AND DRONES

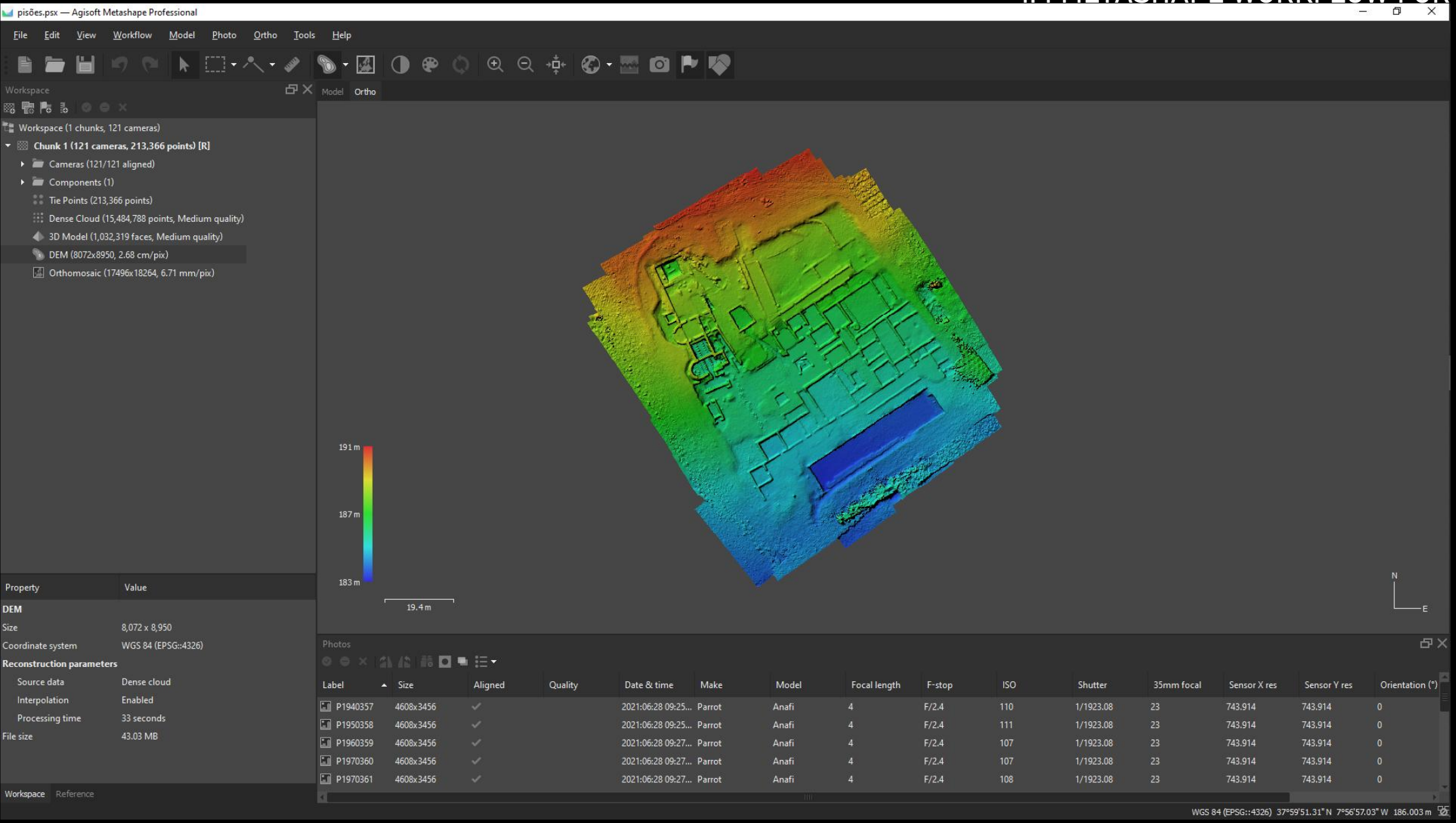

File Edit View Workflow Model Photo Ortho Tools Help
Workspace
Workspace (1 chunks, 121 cameras)
Chunk 1 (121 cameras, 213,366 points) [R]
Cameras (121/121 aligned)
Components (1)
Tie Points (213,366 points)
Dense Cloud (15,484,788 points, Medium quality)
3D Model (1,032,319 faces, Medium quality)
DEM (8072x8950, 2.68 cm/pix)
Orthomosaic (17496x18264, 6.71 mm/pix)
Model Ortho
Perspective 30°
Snap: Axis, 3D
faces: 1,032,319 vertices: 518,023
Photos
Label Size Aligned Quality Date & time Make Model Focal length F-stop ISO Shutter 35mm focal Sensor X res Sensor Y res Orientation (°)
P1940357 4608x3456 2021:06:28 09:25... Parrot Anafi 4 F/2.4 110 1/1923.08 23 743.914 743.914 0
P1950358 4608x3456 2021:06:28 09:25... Parrot Anafi 4 F/2.4 111 1/1923.08 23 743.914 743.914 0
P1960359 4608x3456 2021:06:28 09:27... Parrot Anafi 4 F/2.4 107 1/1923.08 23 743.914 743.914 0
P1970360 4608x3456 2021:06:28 09:27... Parrot Anafi 4 F/2.4 107 1/1923.08 23 743.914 743.914 0
P1970361 4608x3456 2021:06:28 09:27... Parrot Anafi 4 F/2.4 108 1/1923.08 23 743.914 743.914 0
Workspace Reference
Show or hide basemap



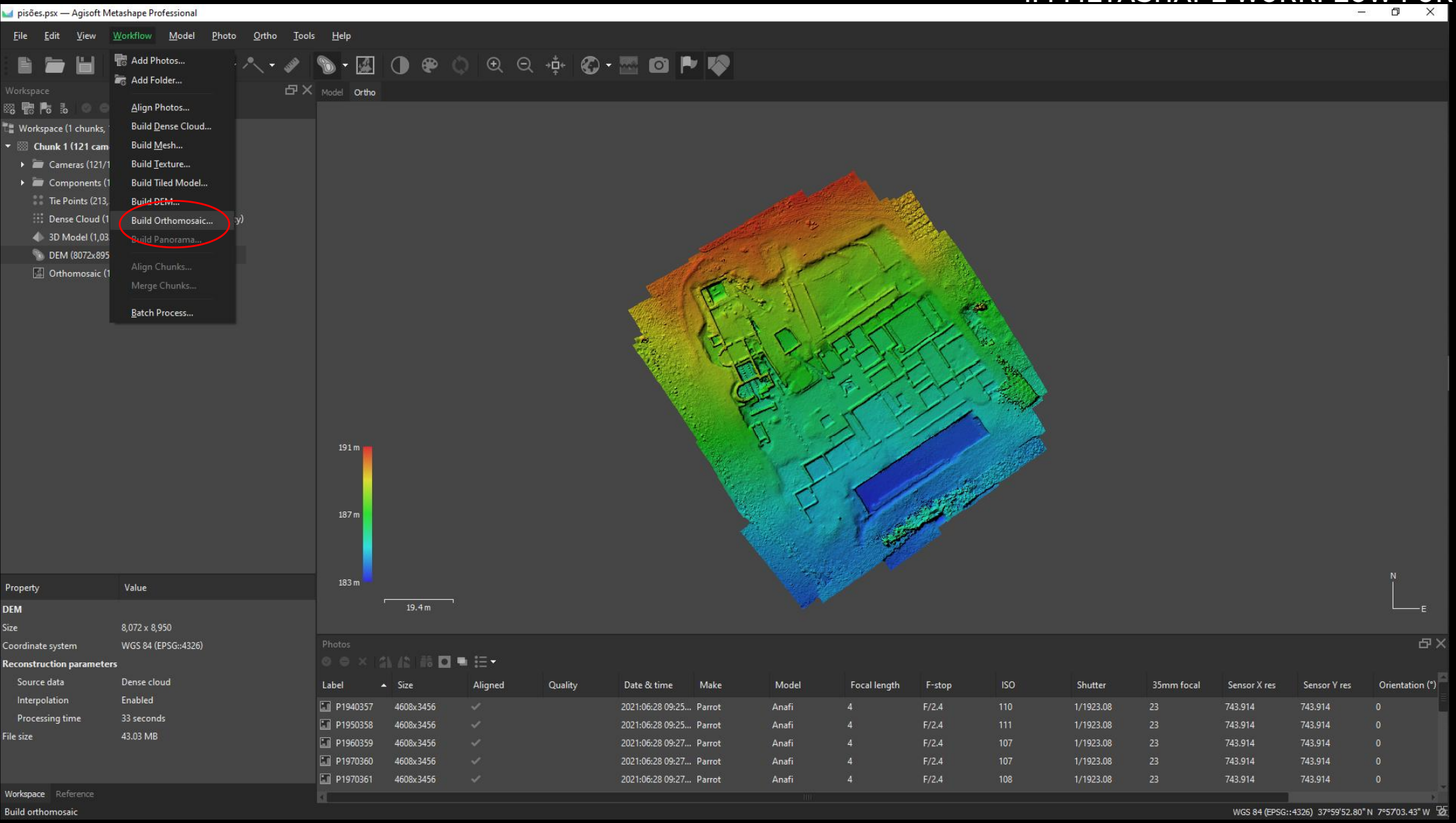
Creating DEM



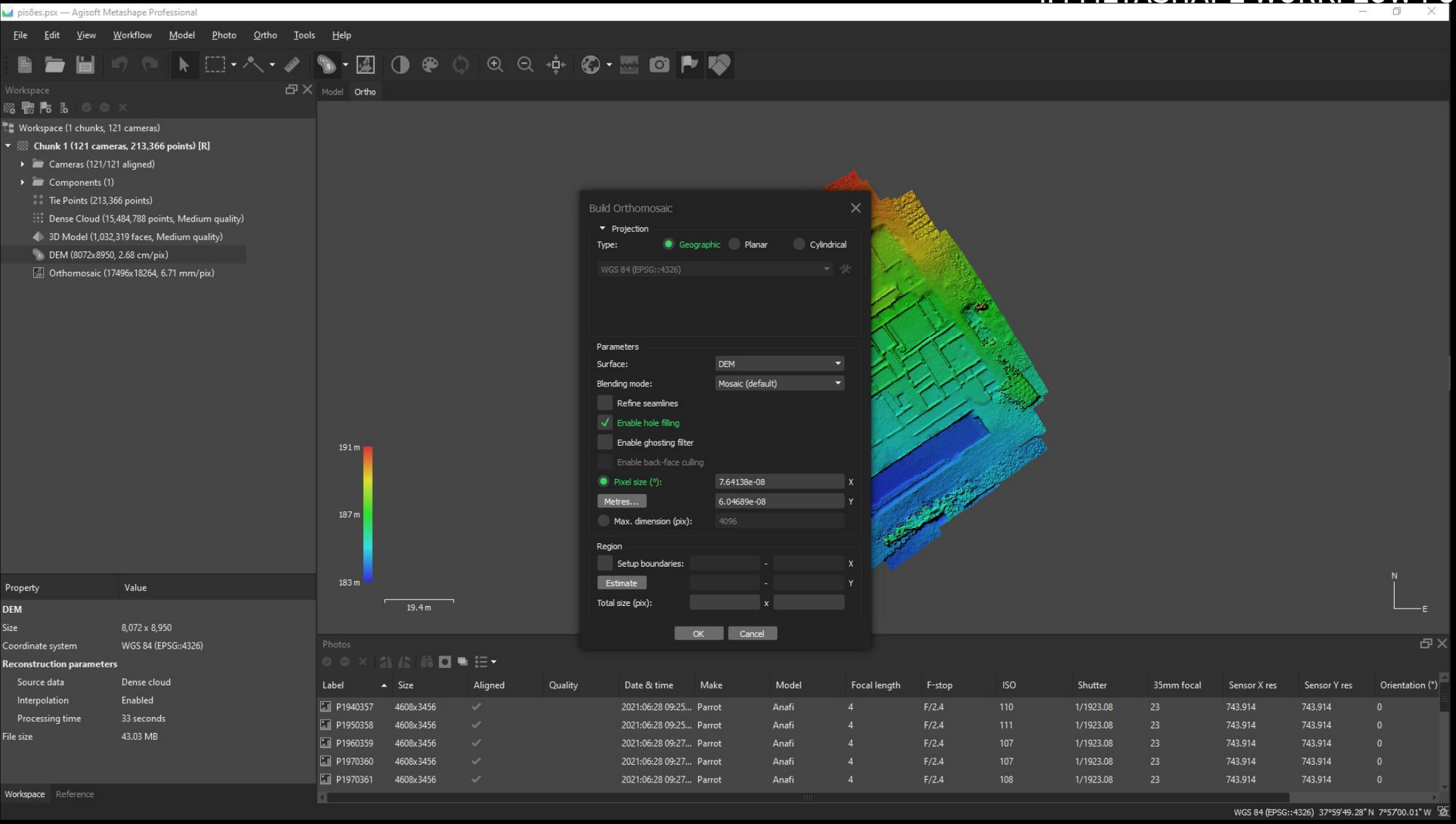
Creating DEM


pisões.psx — Agisoft Metashape Professional
File Edit View Workflow Model Photo Ortho Tools Help
Workspace
Workspace (1 chunks, 121 cameras)
Chunk 1 (121 cameras, 213,366 points) [R]
Cameras (121/121 aligned)
Components (1)
Tie Points (213,366 points)
Dense Cloud (15,484,788 points, Medium quality)
3D Model (1,032,319 faces, Medium quality)
DEM (8072x8950, 2.68 cm/pix)
Orthomosaic (17496x18264, 6.71 mm/pix)
Model
Ortho
191 m
187 m
183 m
19.4 m
N
E
Property
Value
DEM
Size
8,072 x 8,950
Coordinate system
WGS 84 (EPSG::4326)
Reconstruction parameters
Source data
Dense cloud
Interpolation
Enabled
Processing time
33 seconds
File size
43.03 MB
Photos
Label
Size
Aligned
Quality
Date & time
Make
Model
Focal length
F-stop
ISO
Shutter
35mm focal
Sensor X res
Sensor Y res
Orientation (°)
P1940357 4608x3456 2021:06:28 09:25... Parrot Anafi 4 F/2.4 110 1/1923.08 23 743.914 743.914 0
P1950358 4608x3456 2021:06:28 09:25... Parrot Anafi 4 F/2.4 111 1/1923.08 23 743.914 743.914 0
P1960359 4608x3456 2021:06:28 09:27... Parrot Anafi 4 F/2.4 107 1/1923.08 23 743.914 743.914 0
P1970360 4608x3456 2021:06:28 09:27... Parrot Anafi 4 F/2.4 107 1/1923.08 23 743.914 743.914 0
P1970361 4608x3456 2021:06:28 09:27... Parrot Anafi 4 F/2.4 108 1/1923.08 23 743.914 743.914 0
Workspace
Reference
WGS 84 (EPSG::4326) 37°59'51.31" N 7°56'57.03" W 186.003 m

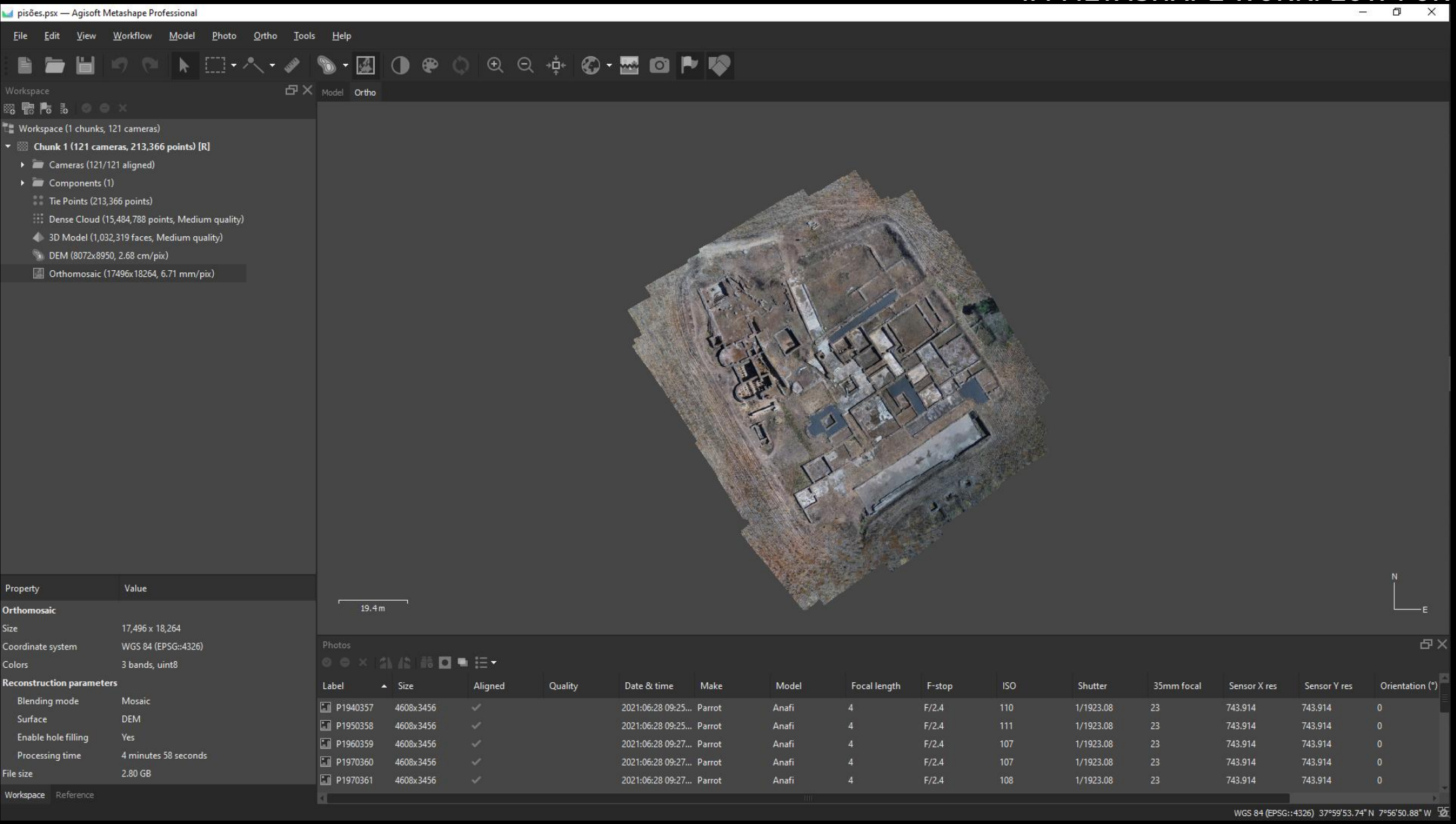
DEM



Creating Orthomosaic

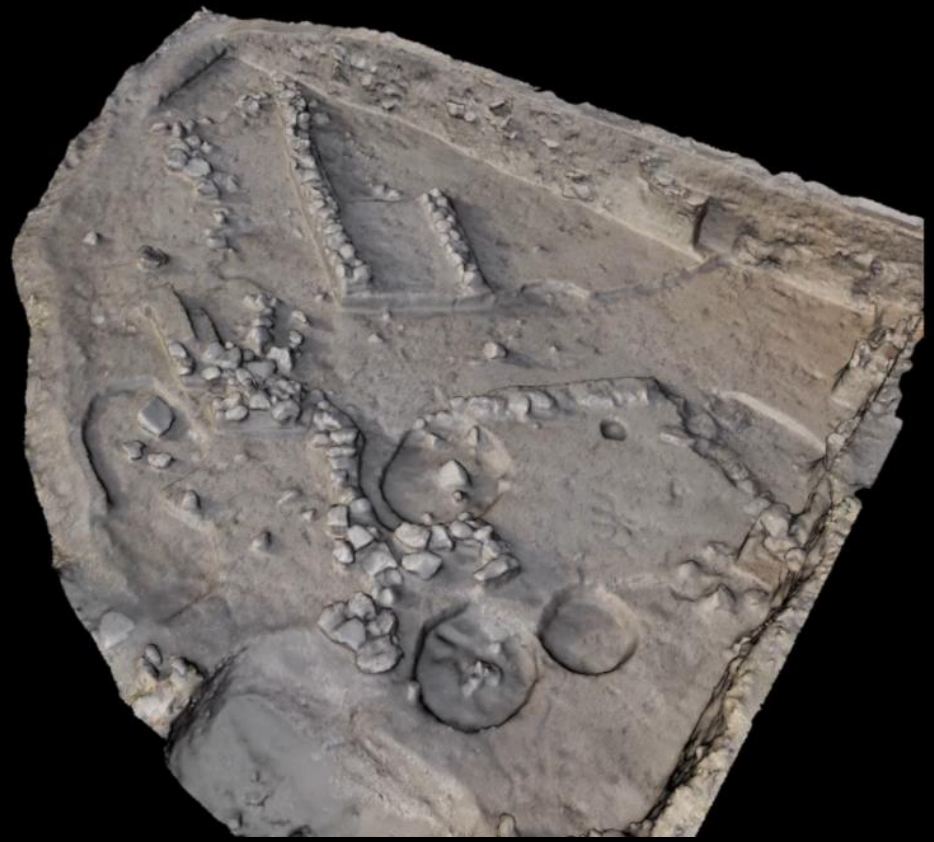


Creating Orthomosaic



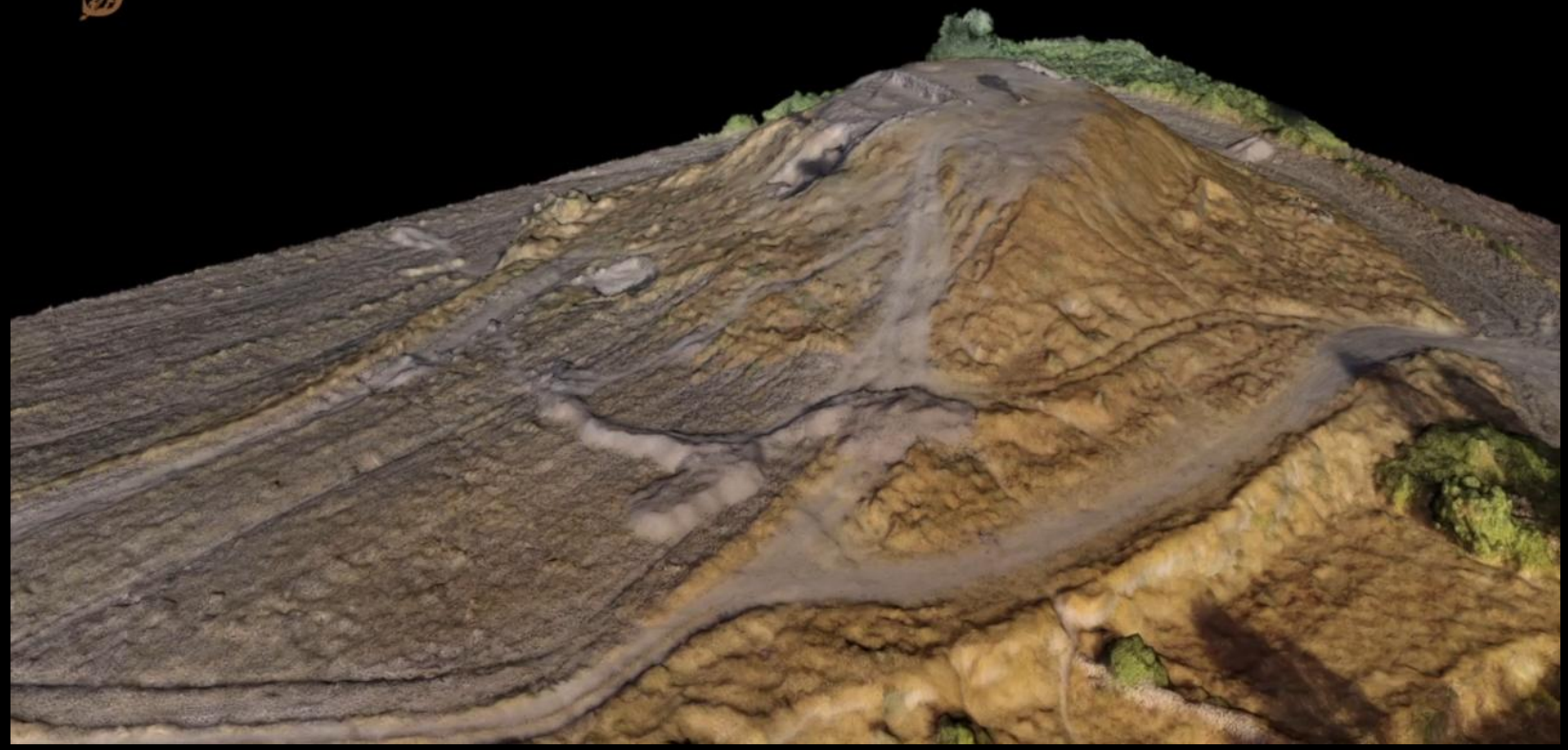
Orthomosaic

4.5 USES AND APPLICATIONS OF AERIAL PHOTOGRAMMETRY IN CULTURAL HERITAGE



PHOTOGRAMMETRY AND DRONES

4.5 USES AND APPLICATIONS OF AERIAL PHOTOGRAMMETRY IN CULTURAL HERITAGE



PHOTOGRAMMETRY AND DRONES