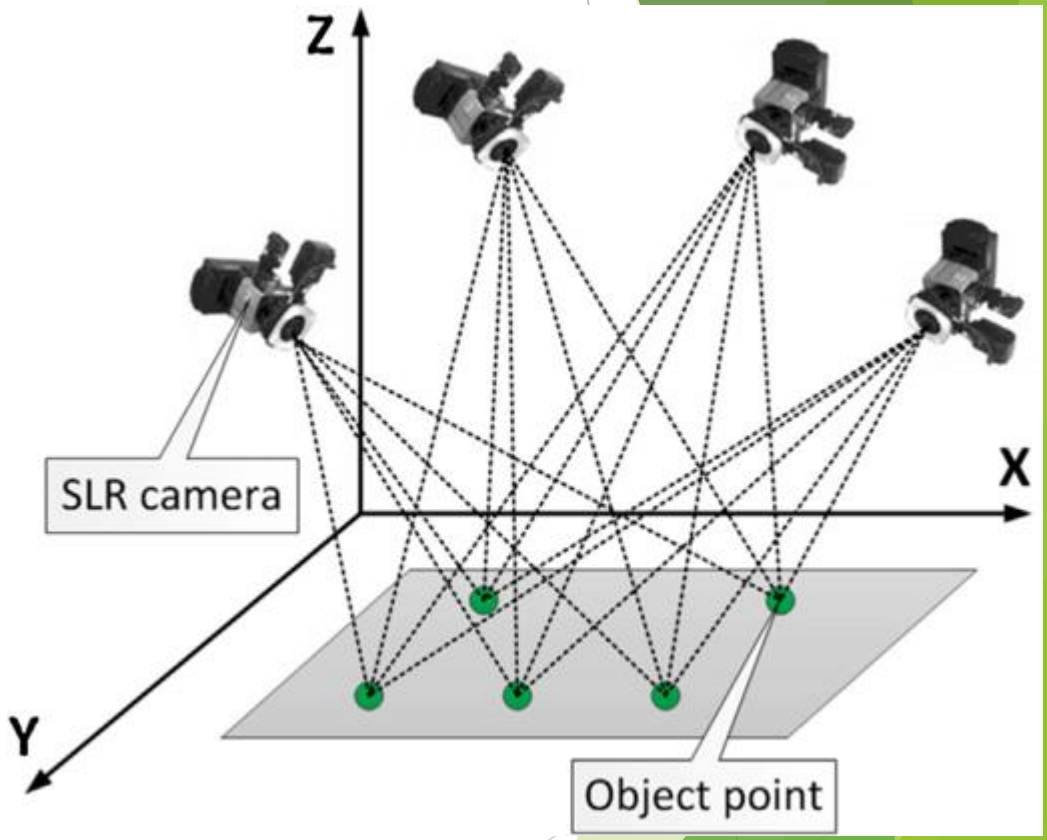
Utilizing Terrestrial Photogrammetry to Identify and Track Landslide Geometry and Potentially Movement

By: Max Winn

What is photogrammetry?

"Photogrammetry is the science of making measurements from photographs." – ***photogrammetry.com***

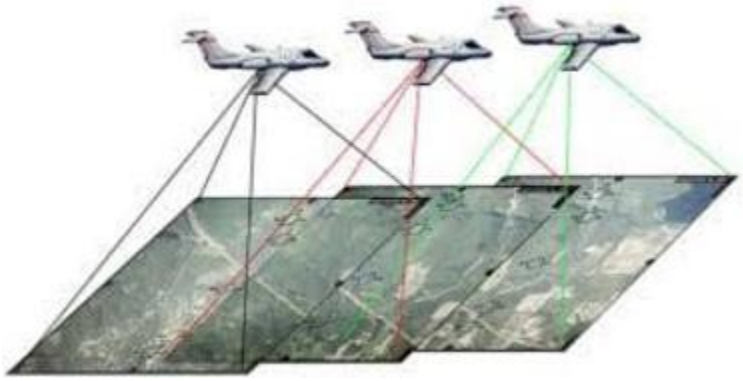
"Photogrammetry is the science and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting photographic images and patterns of electromagnetic radiant imagery and other phenomena." – **Wikipedia**



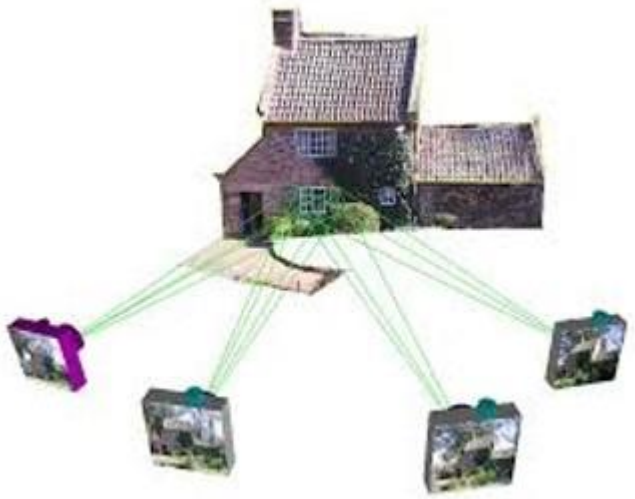
https://www.researchgate.net/figure/Schematic-drawing-of-photogrammetry_fig4_272609988

Two common types of photogrammetry

- Aerial Photogrammetry



- Terrestrial Photogrammetry



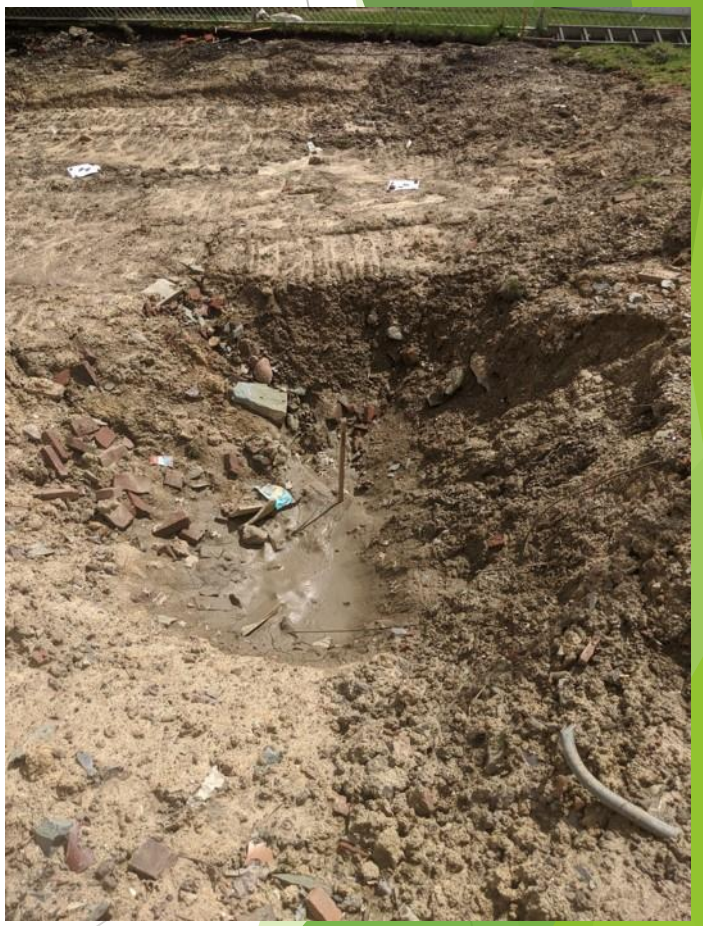
Pros and Cons of Terrestrial Photogrammetry

- Pros
  - Cost-effective
  - No need for drones/airplanes
  - Can get into spaces these vehicles cannot
  - All you need is your smart phone
- Cons
  - Scale is limited

Cost effective

- Proprietary
  - **AGISOFT - $59 standard/$549 professional (educational license)**
  - Autodesk ReCap - $40 monthly/$325 one year (1-month free trial)
- Open Source
  - MicMac
  - Meshroom
  - 3DF Zephyr (Free version)
  - Visual SFM
  - Regard3D

Creating a photogrammetric model



Test2.psx* — Agisoft Metashape Professional

File Edit View Workflow Model Photo Ortho Tools Help

Workspace

Workspace (4 chunks, 96 cameras)

Chunk 1 (24 cameras, 5 markers, 235,500 points) [5]

Cameras (24/24 aligned)

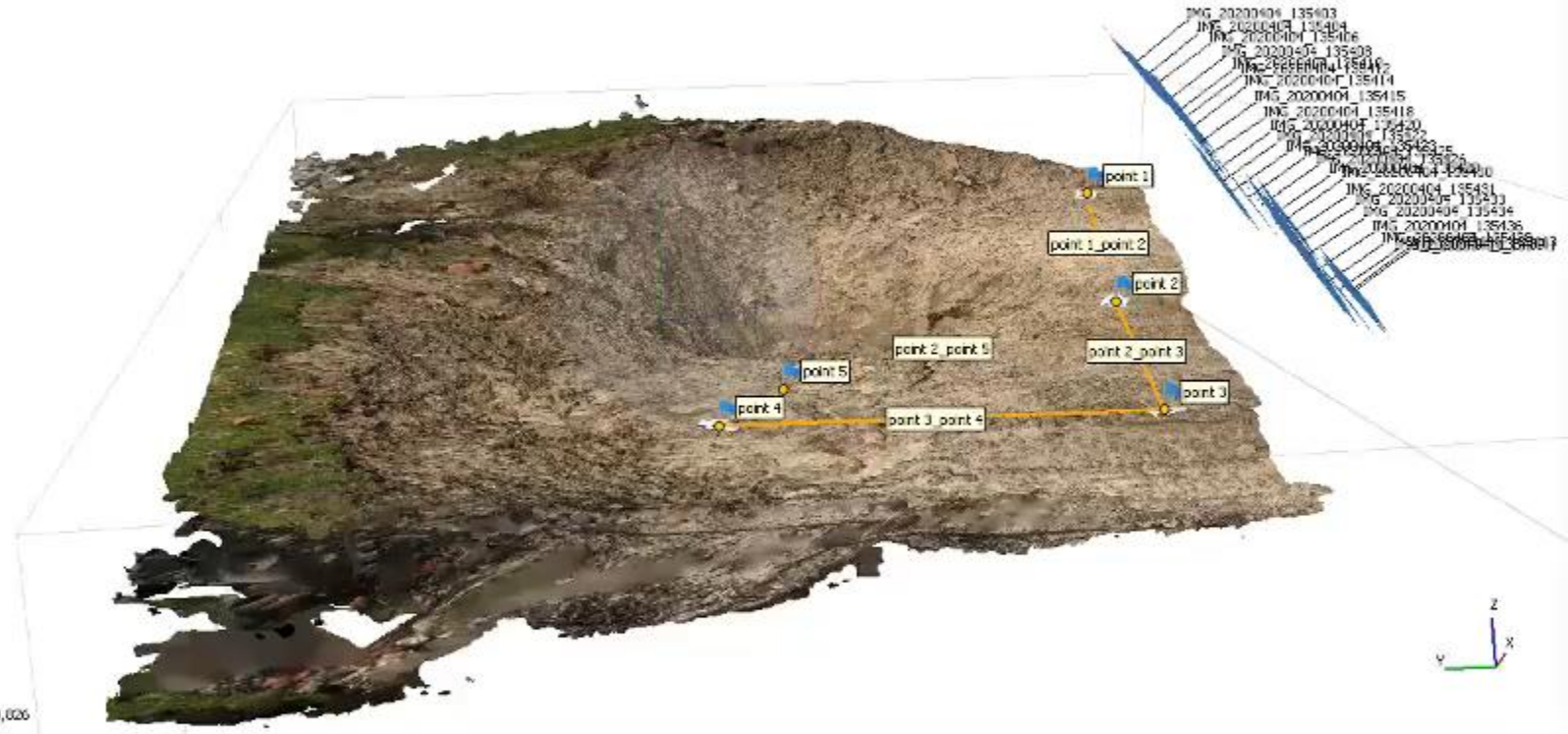
IMG_20200404_135403
IMG_20200404_135404
IMG_20200404_135406
IMG_20200404_135408
IMG_20200404_135410
IMG_20200404_135412
IMG_20200404_135414
IMG_20200404_135415
IMG_20200404_135418
IMG_20200404_135420
IMG_20200404_135422
IMG_20200404_135423
IMG_20200404_135425
IMG_20200404_135426
IMG_20200404_135428
IMG_20200404_135430
IMG_20200404_135431
IMG_20200404_135433
IMG_20200404_135434
IMG_20200404_135436
IMG_20200404_135438

IMG_20200404_135403.jpg
Dimensions: 3024 x 4032
Date/Time: 2020:04:04 13:54:03

Workspace Reference

Model Ortho IMG_20200404_135414

Perspective 30°



Faces: 455,602 vertices: 230,026

Photos

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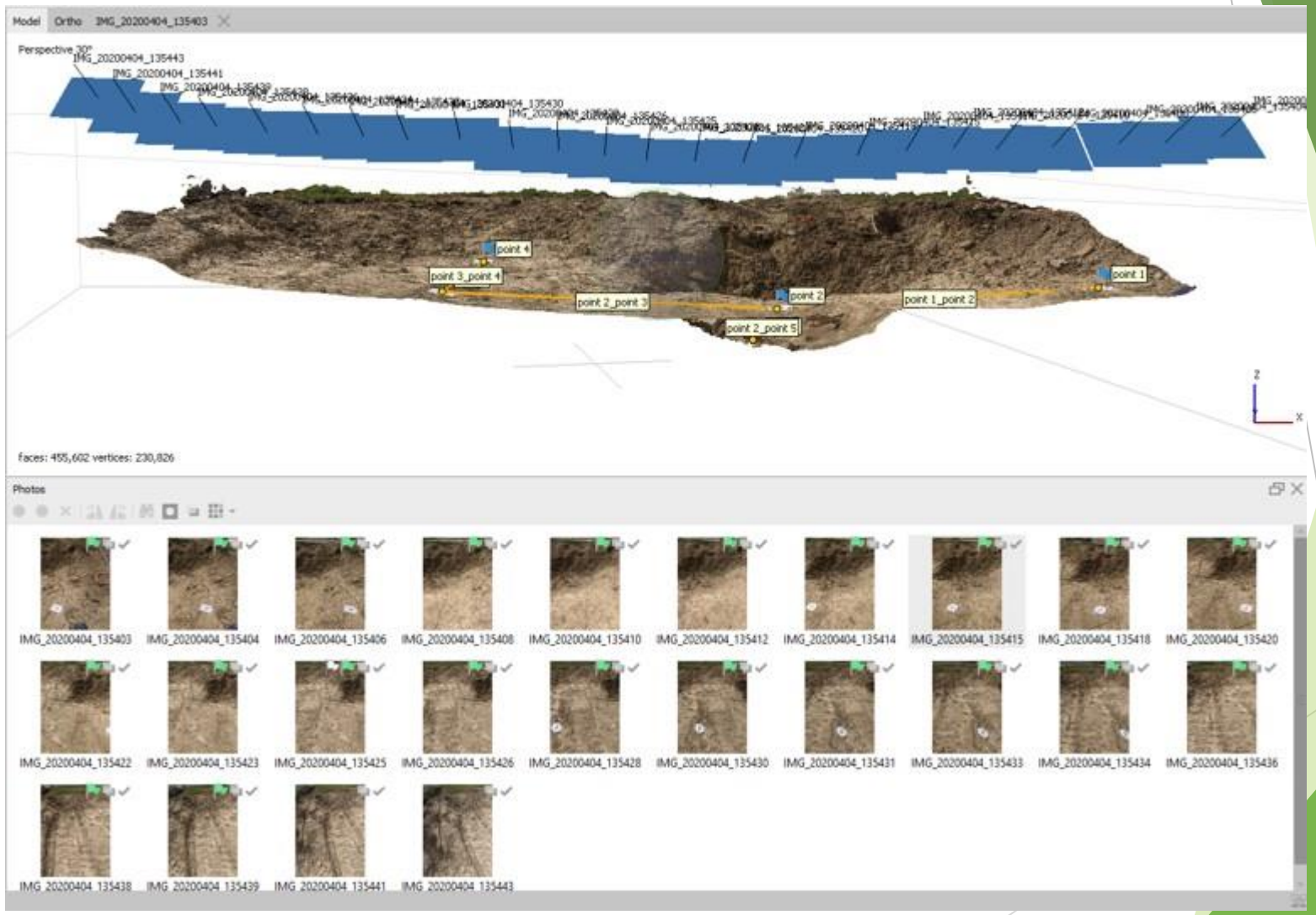
9/2/2020

The Workflow

- Align Photos
- Build Dense Cloud
- Scale the Model
- Align Chunks
- Build Mesh
- Build Digital Elevation Model



Align Photos

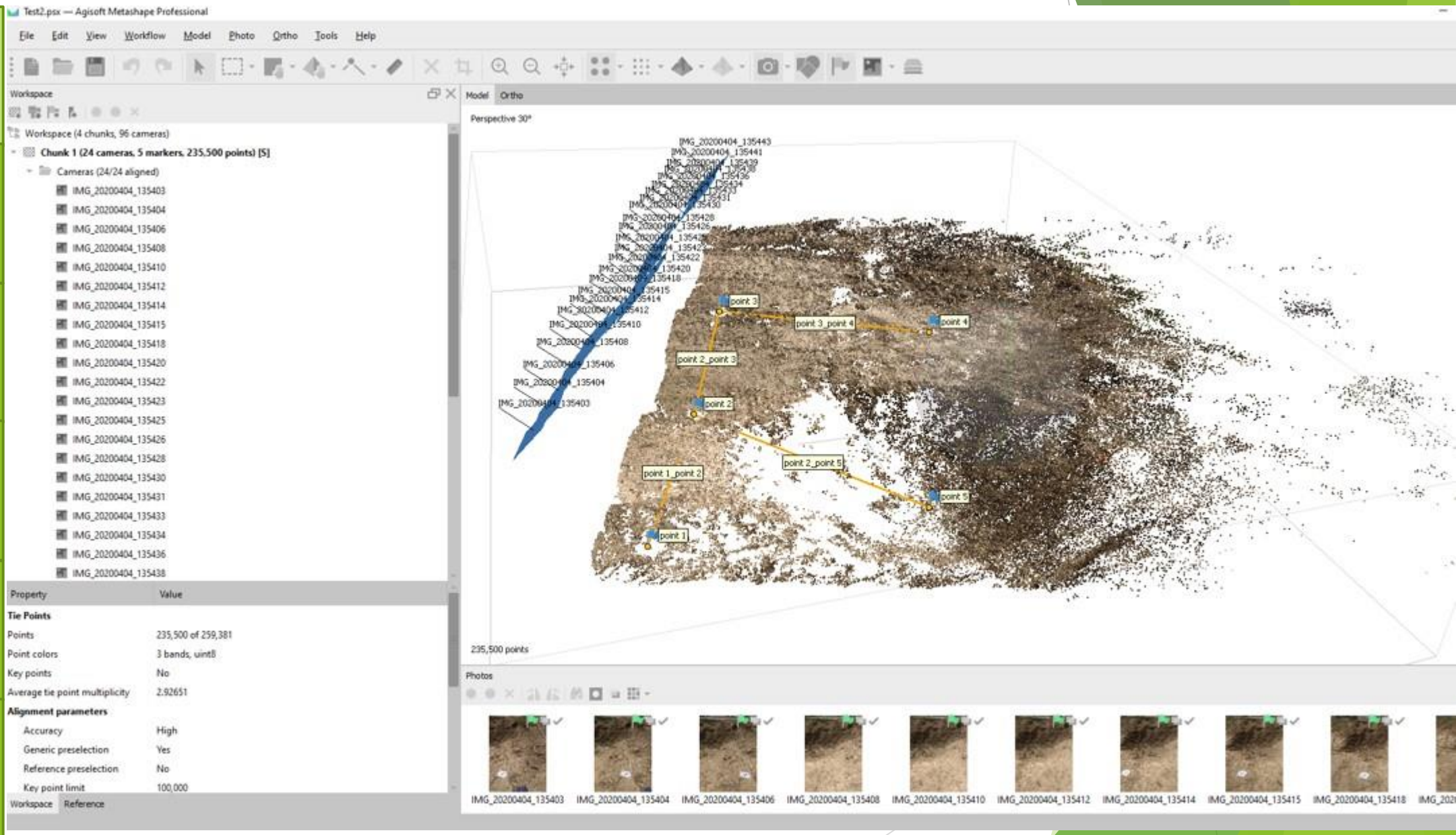
Build Dense Cloud

Scale the Model

Align Chunks

Build Mesh

Build Digital Elevation Model



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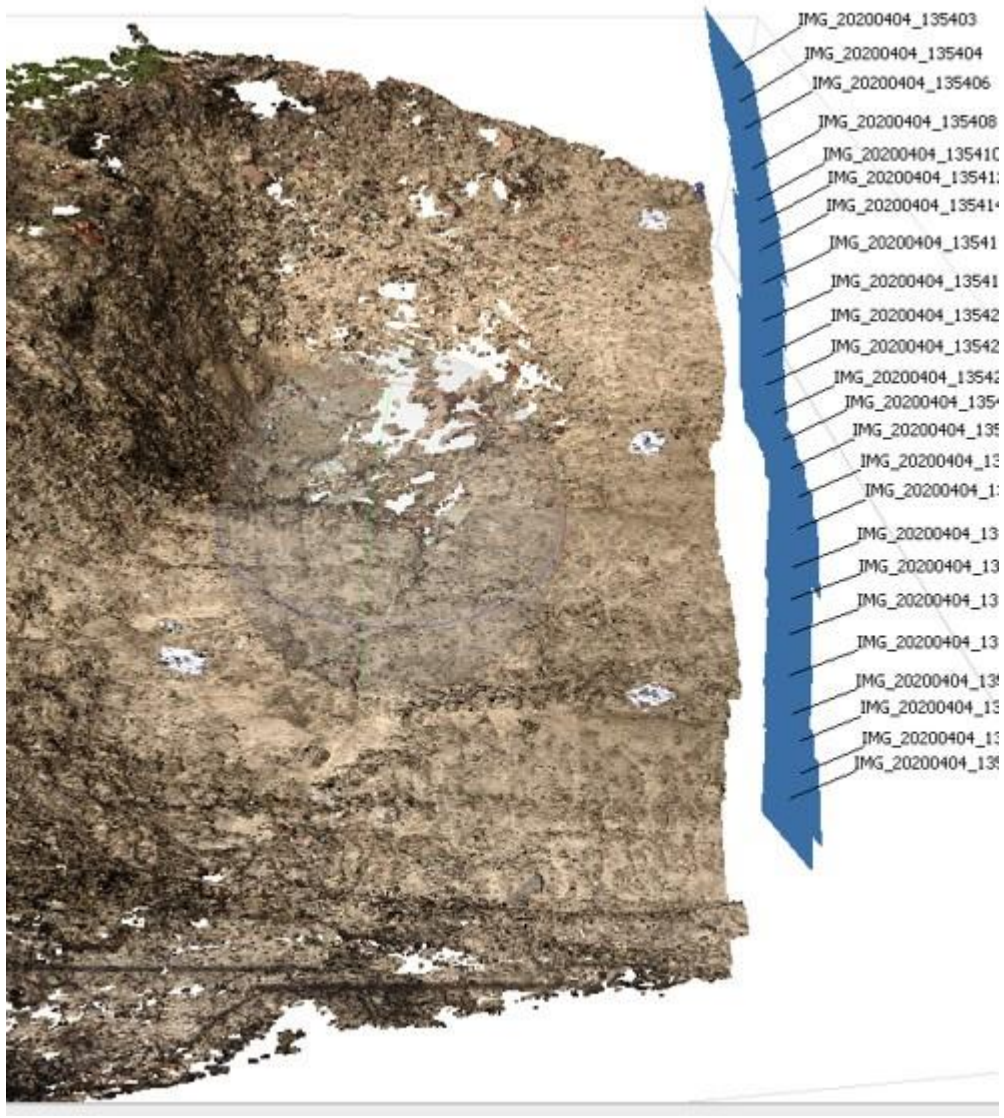
- Align Chunks
- Build Mesh
- Build DEM



Align Photos

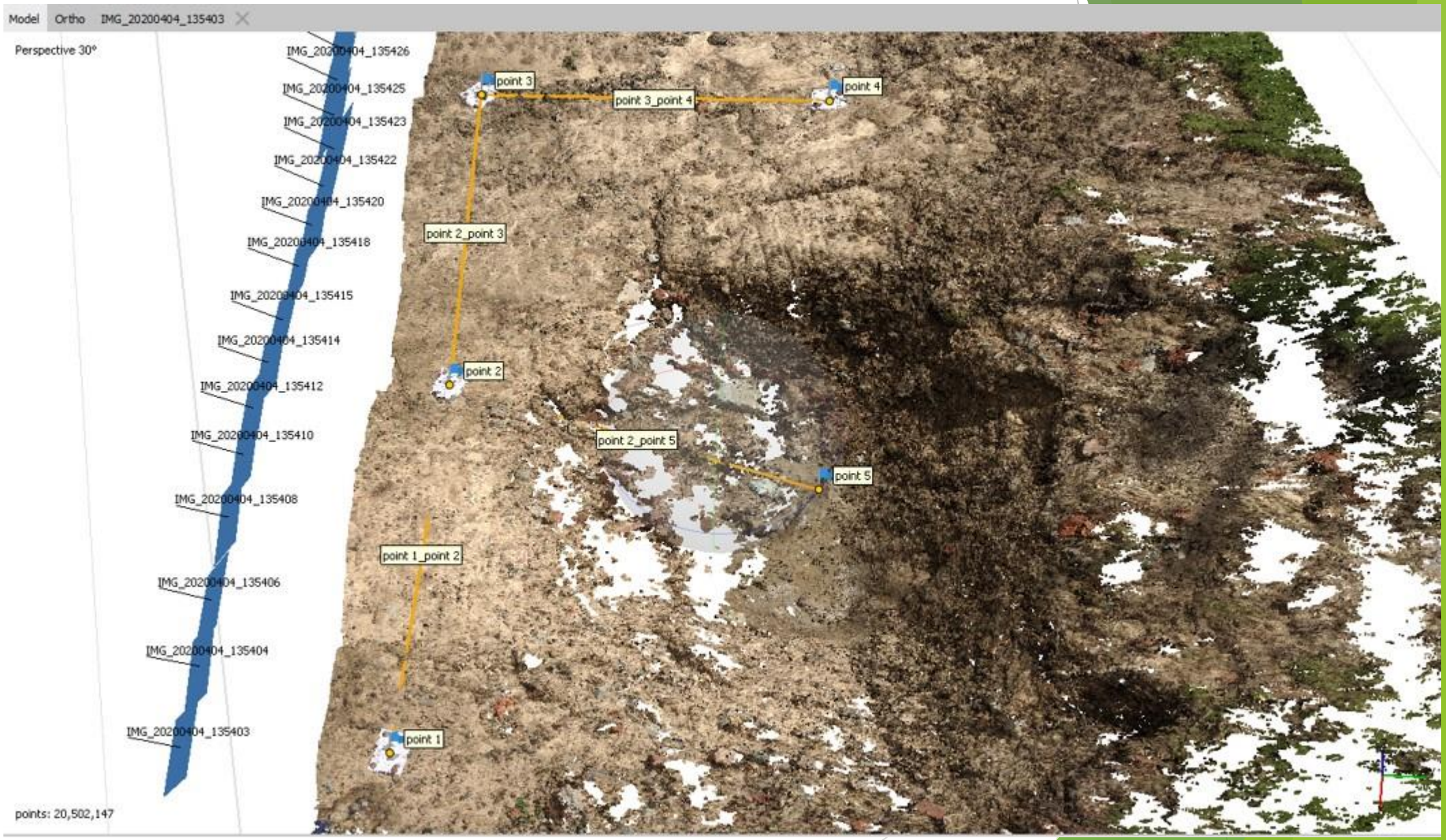
Build Dense Cloud

Scale the Model

Align Chunks

Build Mesh

Build Digital Elevation Model



Create Tie Points

- Align Photos
- Build Dense Cloud
- Scale the Model
- Align Chunks
- Build Mesh
- Build Digital Elevation Model

- Align Photos
- Build Dense Cloud
- Scale the Model
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- Build Digital Elevation Model

Scale Bars	Distance (ft)	Accuracy (m)	Error (m)
point 1_point 2	10.000000	0.001000	0.037738
point 2_point 3	10.000000	0.001000	-0.057653
point 2_point 5	10.000000	0.001000	0.017323
point 3_point 4	10.000000	0.001000	0.013166

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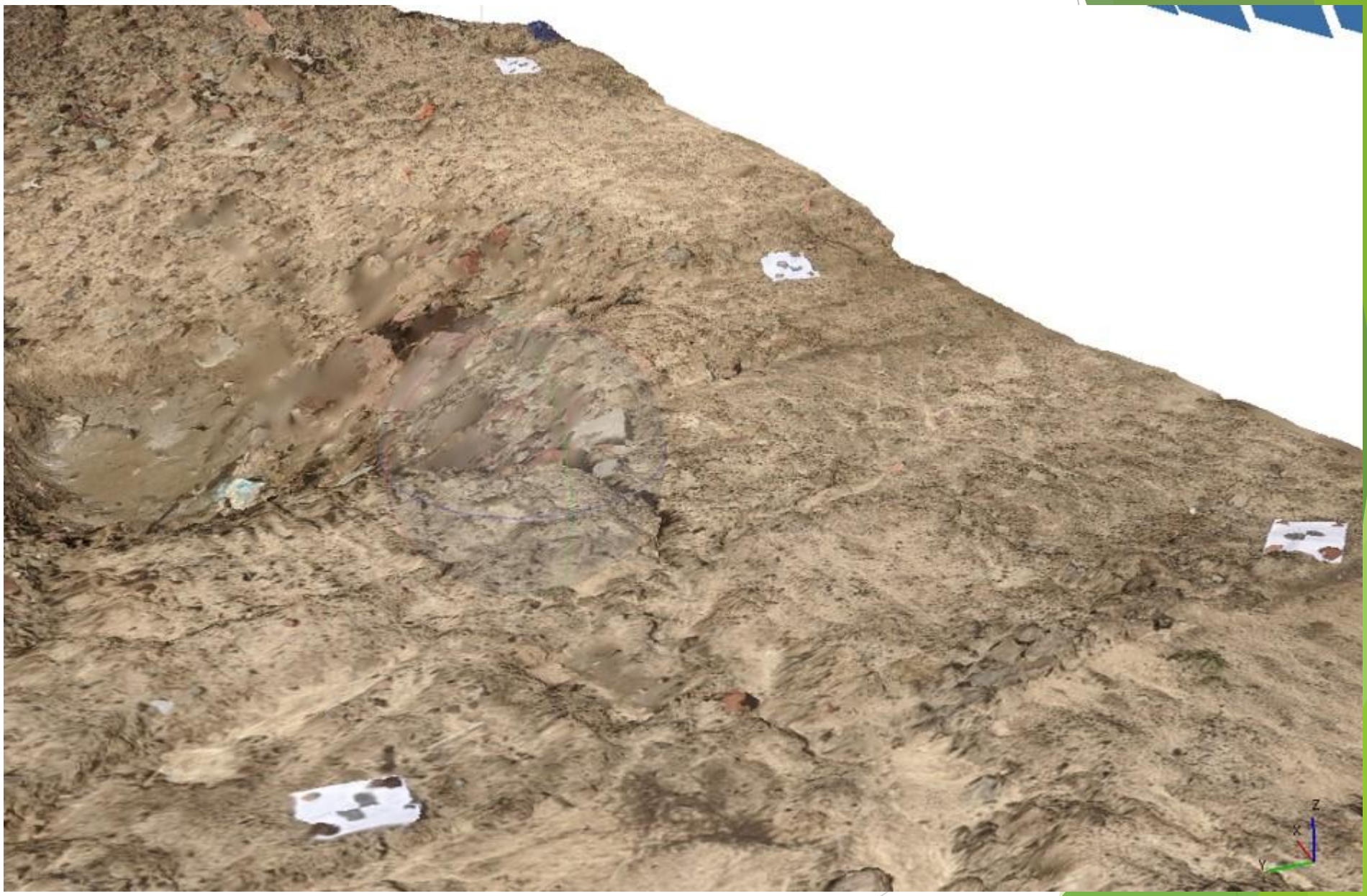


Align Photos

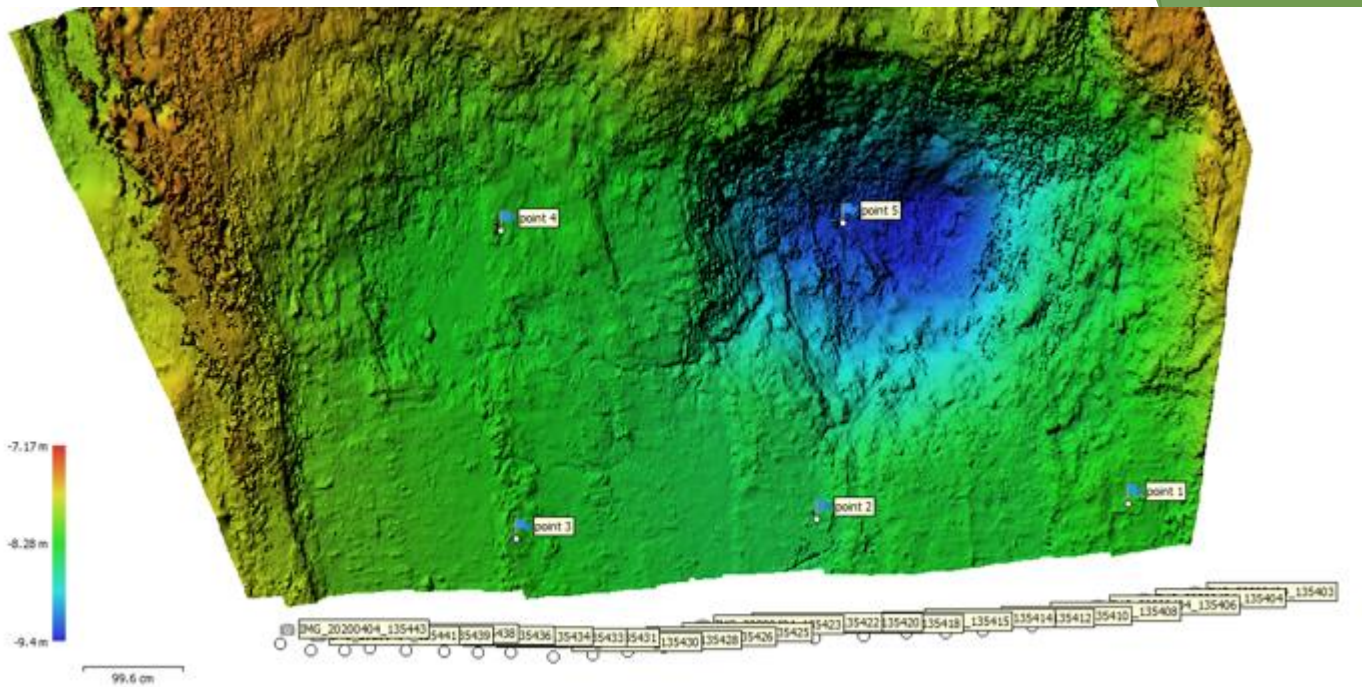
Build Dense Cloud

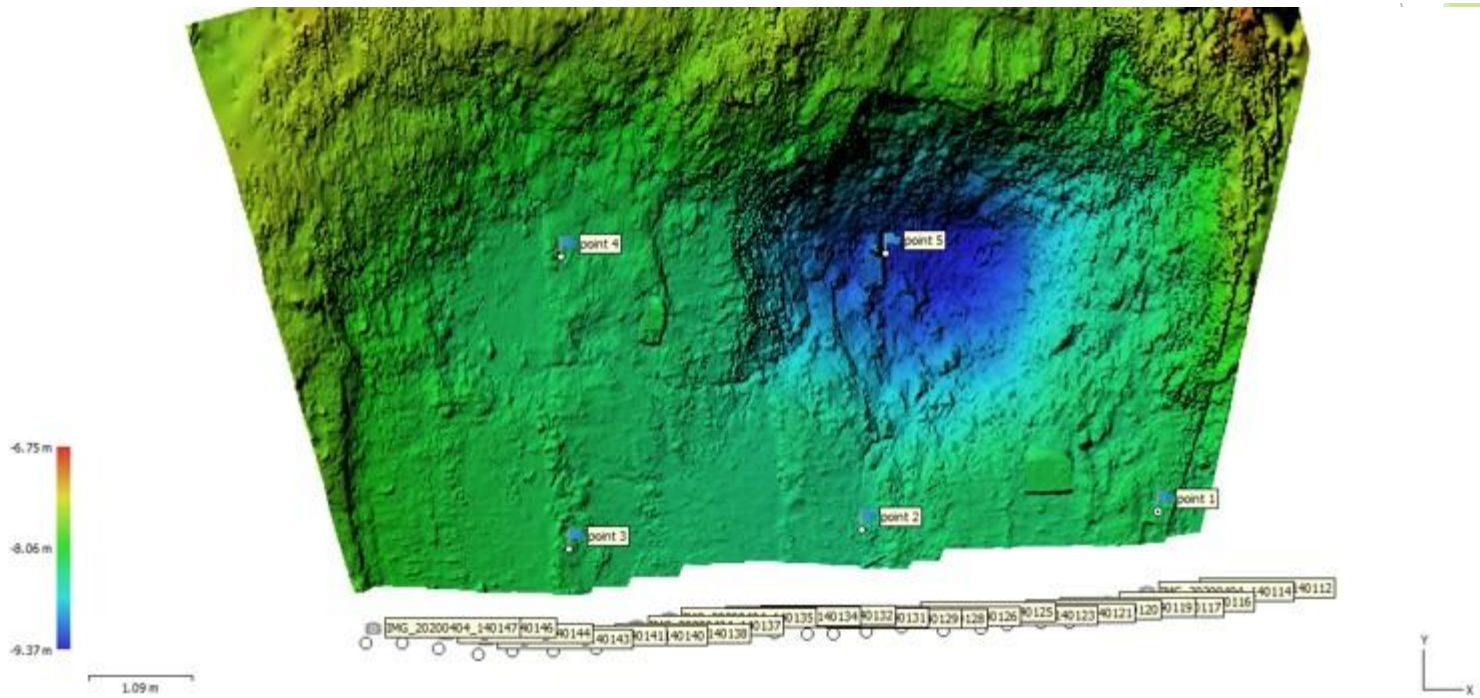
Scale the Model

Align Chunks

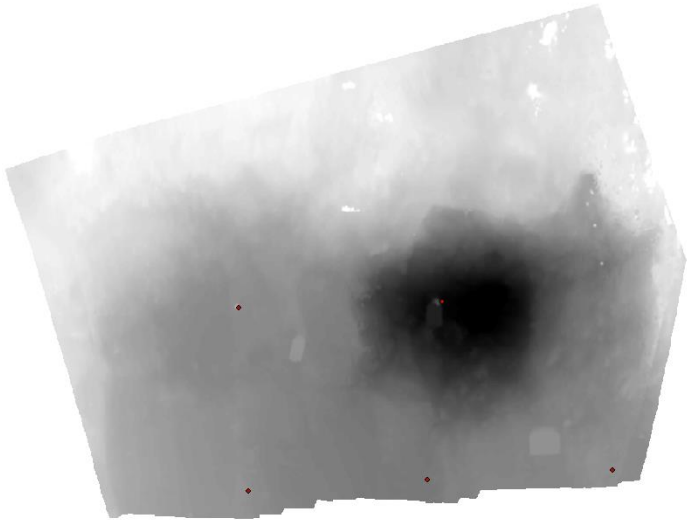
Build Mesh

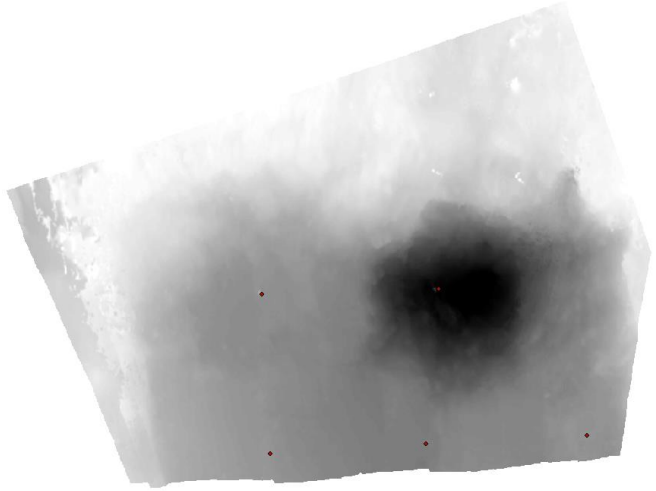
Build Digital Elevation Model

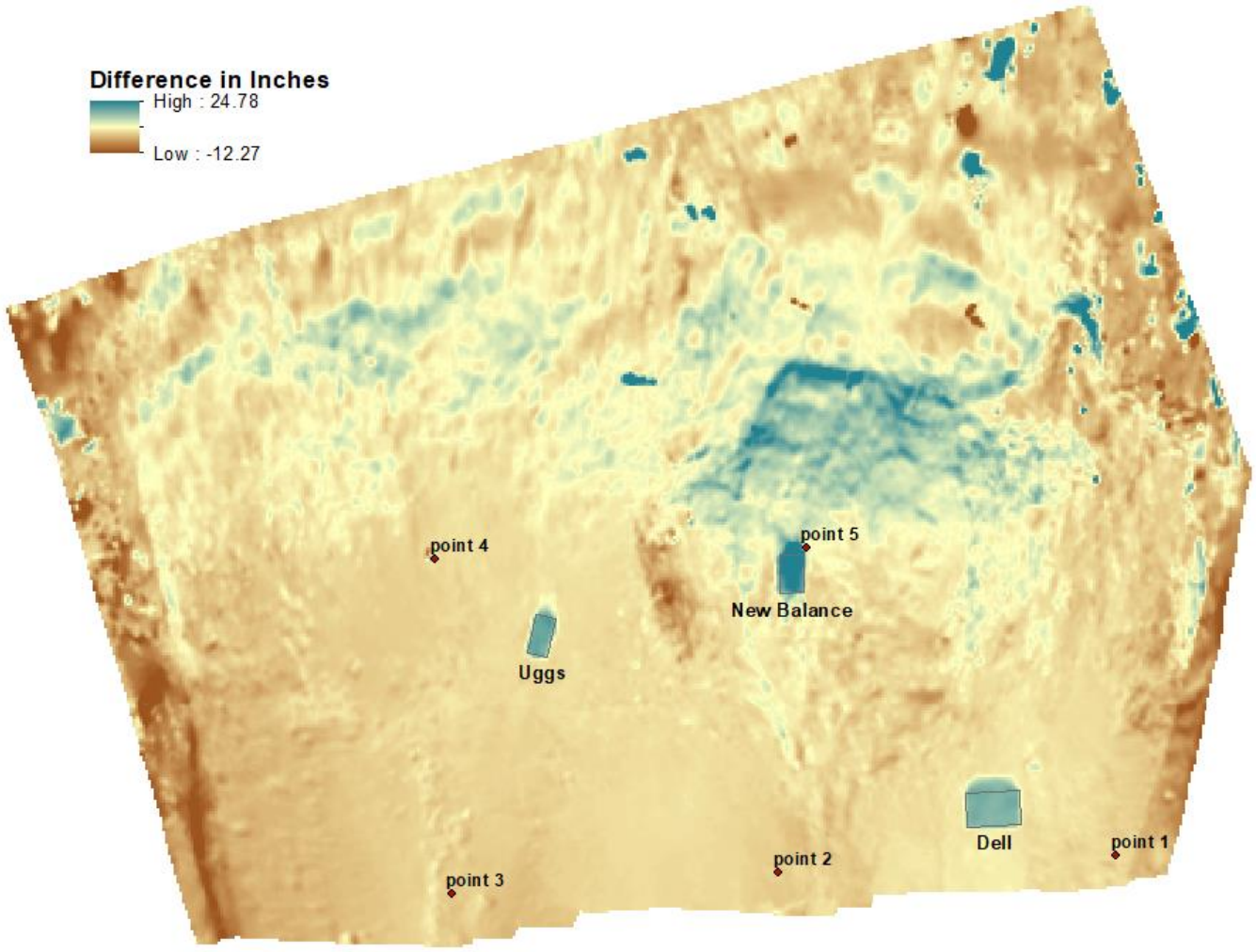




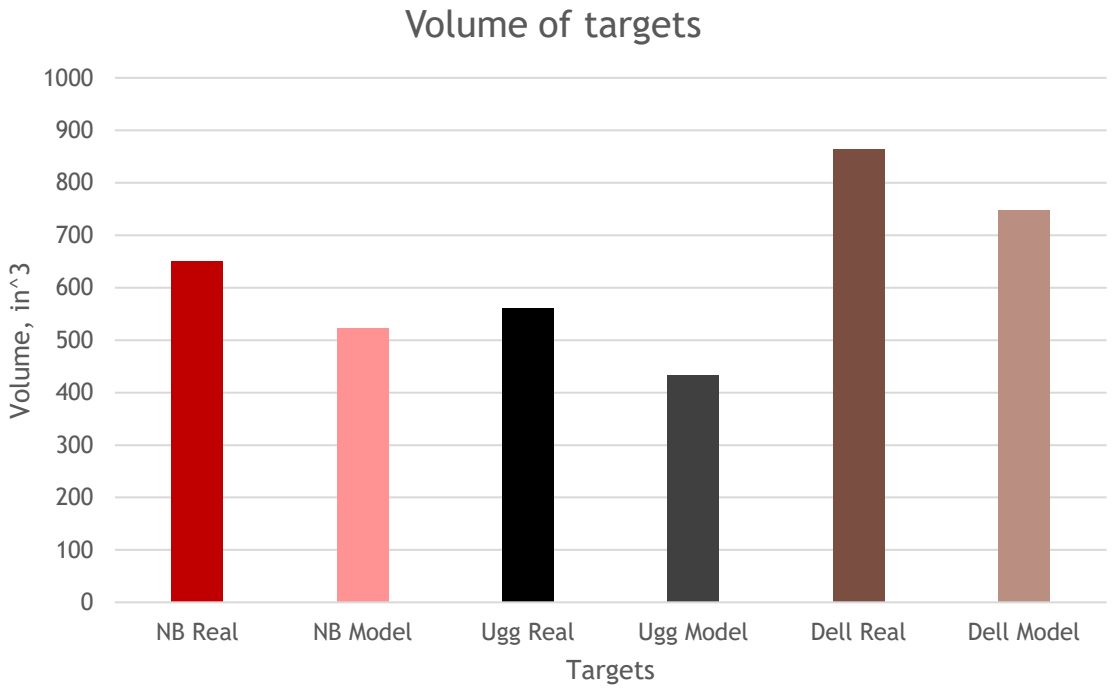
Results: Height Difference Map







Results

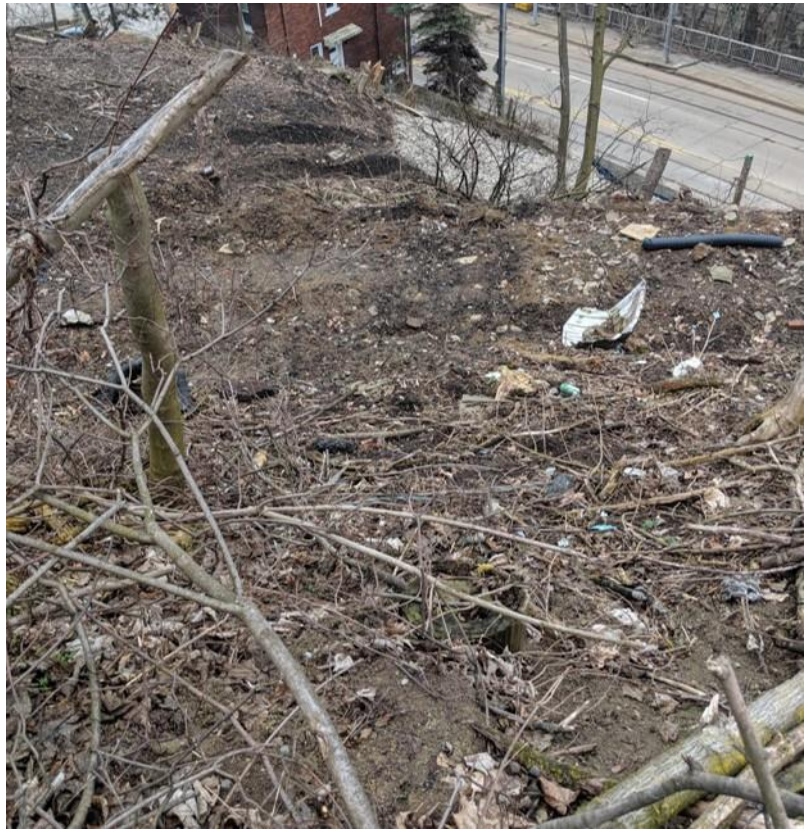
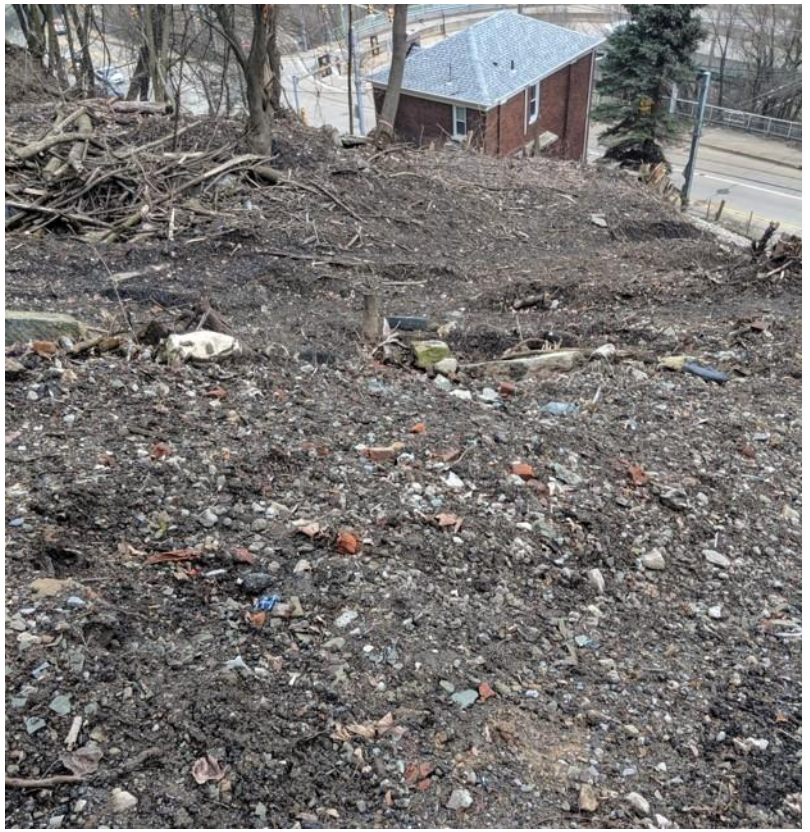

Volume of targets
1000
900
800
700
600
500
400
300
200
100
0
Volume, in^3
NB Real
NB Model
Ugg Real
Ugg Model
Dell Real
Dell Model
Targets


19" 48.26cm
13" 33.02cm
PACKING LIST ENCLOSED
DELL
220-6000FL

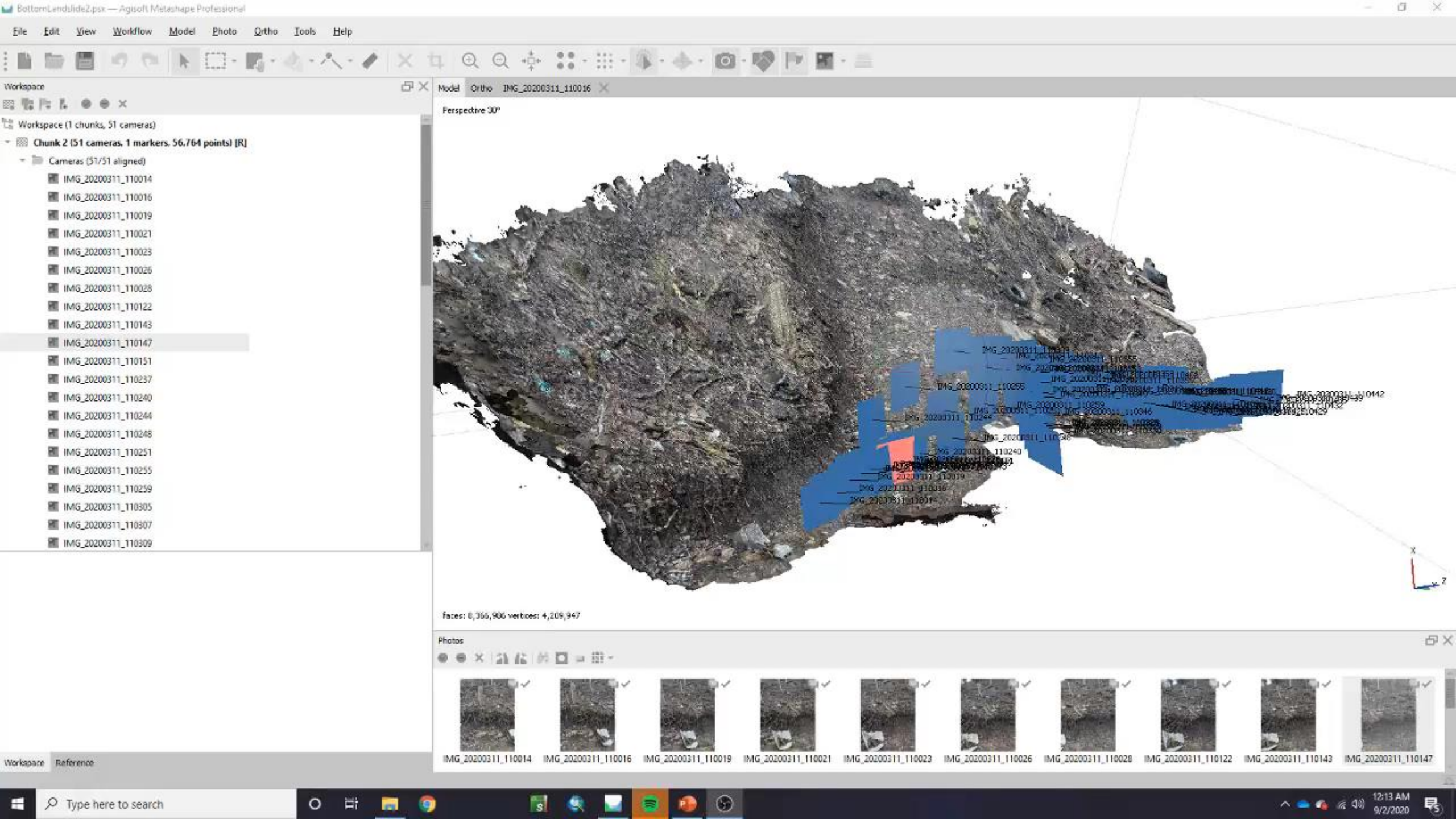
Make sure you have the necessary processing power

- System requirements
  - At least 32 GB RAM
  - You need a good graphics card
- Most companies have a system requirements page, check this before considering any software
  - Ask your advisors if there is a computer lab where you can use this type of software

William Street Landslide


William Street Landslide


BottomLandslide2.psx — Agisoft Metashape Professional
File Edit View Workflow Model Photo Ortho Tools Help
Workspace
Workspace (1 chunks, 51 cameras)
Chunk 2 (51 cameras, 1 markers, 56,764 points) [R]
Cameras (51/51 aligned)
IMG_20200311_110014
IMG_20200311_110016
IMG_20200311_110019
IMG_20200311_110021
IMG_20200311_110023
IMG_20200311_110026
IMG_20200311_110028
IMG_20200311_110122
IMG_20200311_110143
IMG_20200311_110147
IMG_20200311_110151
IMG_20200311_110237
IMG_20200311_110240
IMG_20200311_110244
IMG_20200311_110248
IMG_20200311_110251
IMG_20200311_110255
IMG_20200311_110259
IMG_20200311_110305
IMG_20200311_110307
IMG_20200311_110309
Workspace Reference
Model Ortho IMG_20200311_110016
Perspective 30°
Faces: 8,366,986 vertices: 4,209,947
Photos
IMG_20200311_110014 IMG_20200311_110016 IMG_20200311_110019 IMG_20200311_110021 IMG_20200311_110023 IMG_20200311_110026 IMG_20200311_110028 IMG_20200311_110122 IMG_20200311_110143 IMG_20200311_110147
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9/2/2020

Summary

- Photogrammetry offers an effective way to characterize landslide geometry – elevation, slope, volume
- Taking sequential surveys offers the potential to track the surface movements at a landslide prone site
- Based on results, assess what mitigation techniques could be taken