

# Metadata Report

Project Name: High-Resolution SfM Topography of Stromboli volcano (Italy), 22-23 May 2023.

Summary: Structure-from-Motion digital surface model (DSM) of Stromboli Volcano (Italy) produced by photogrammetry from UAS survey. Coverage includes the crater terrace, all vents, and the Sciara del Fuoco.

## Personnel

- Pls: Riccardo Civico, Tullio Ricci (Istituto Nazionale di Geofisica e Vulcanologia, Italy).

Dates of Collection: May 22-23, 2023

## Site Information

- Site description: Stromboli volcano, Aeolian Islands, Italy
- Site objective: The objective was to document at high resolution the morphological changes of the crater terrace and of the Sciara del Fuoco at Stromboli volcano.
- Site location: 38.795, 15.209
- Site conditions: Volcanic plume and atmospheric clouds affecting the mid-upper portion of the Sciara del Fuoco and the crater terrace. Cloudy to partly sunny. Wind varied between light to strong breeze.

## Survey Results

- Equipment used: DJI Matrice 300 RTK with DJI Zenmuse P1.
- GPS solutions: data on camera position were collected using GNSS-RTK information embedded in the image metadata, with differential corrections sent in real-time by a local RTK network.
- Errors: camera location total error estimate is approximately 2.7 cm.

## Products

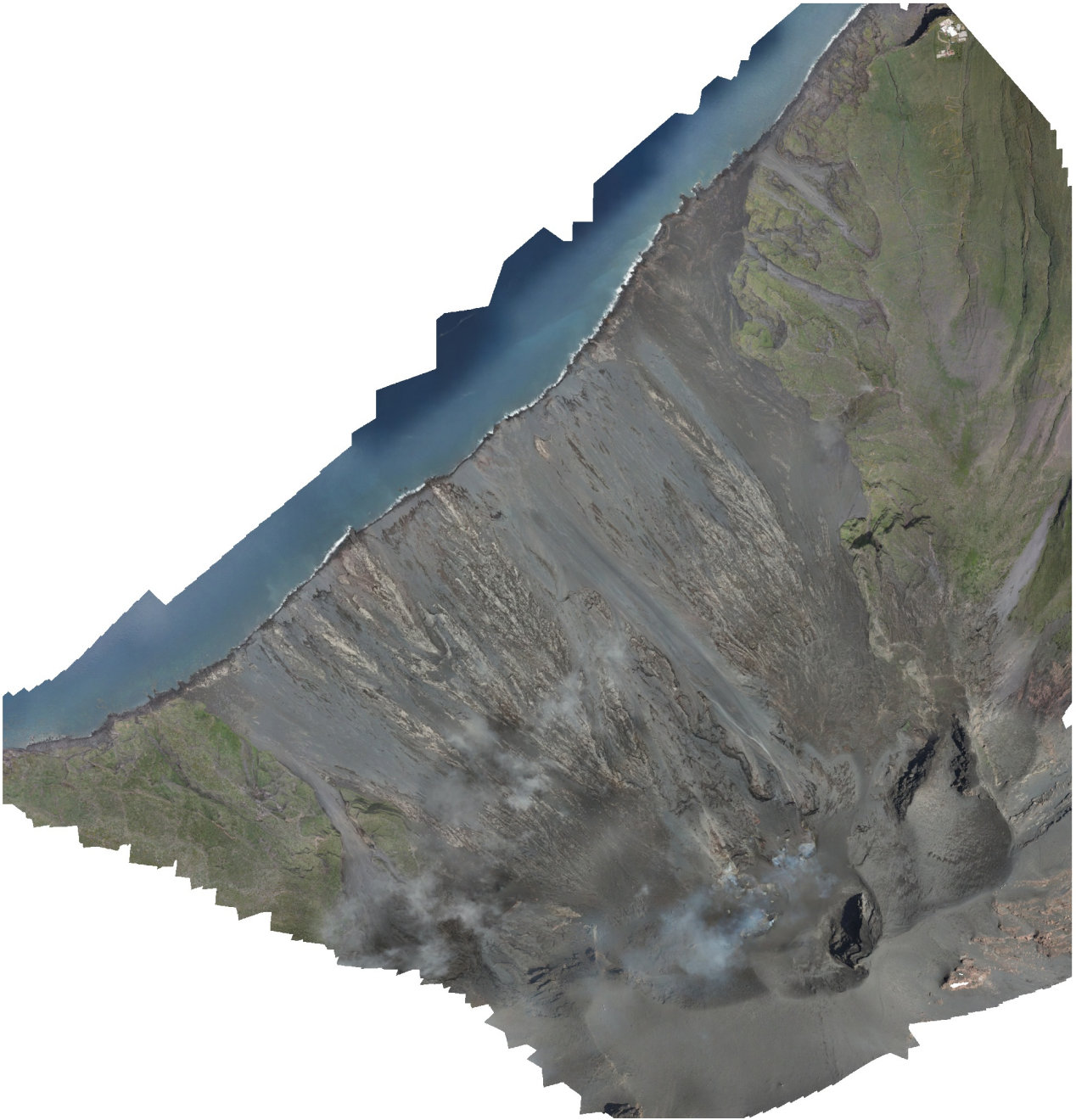
- Date of dataset collection: May 22-23, 2023.
- Coordinate system of datasets: Horizontal WGS 84 / UTM zone 33N [EPSG: 32633]; Vertical ITALGEO 2005 geoid.
- Spatial resolution: 20 cm/pixel.
- Data formats: .tif DSM geotiff.

## Misc Notes

Please refer to the Agisoft Metashape report attached for additional information and details on survey and processing.

# **Stromboli Sciara-Terrace 20230522-23 P1**

**Processing Report  
01 August 2024**



# Survey Data

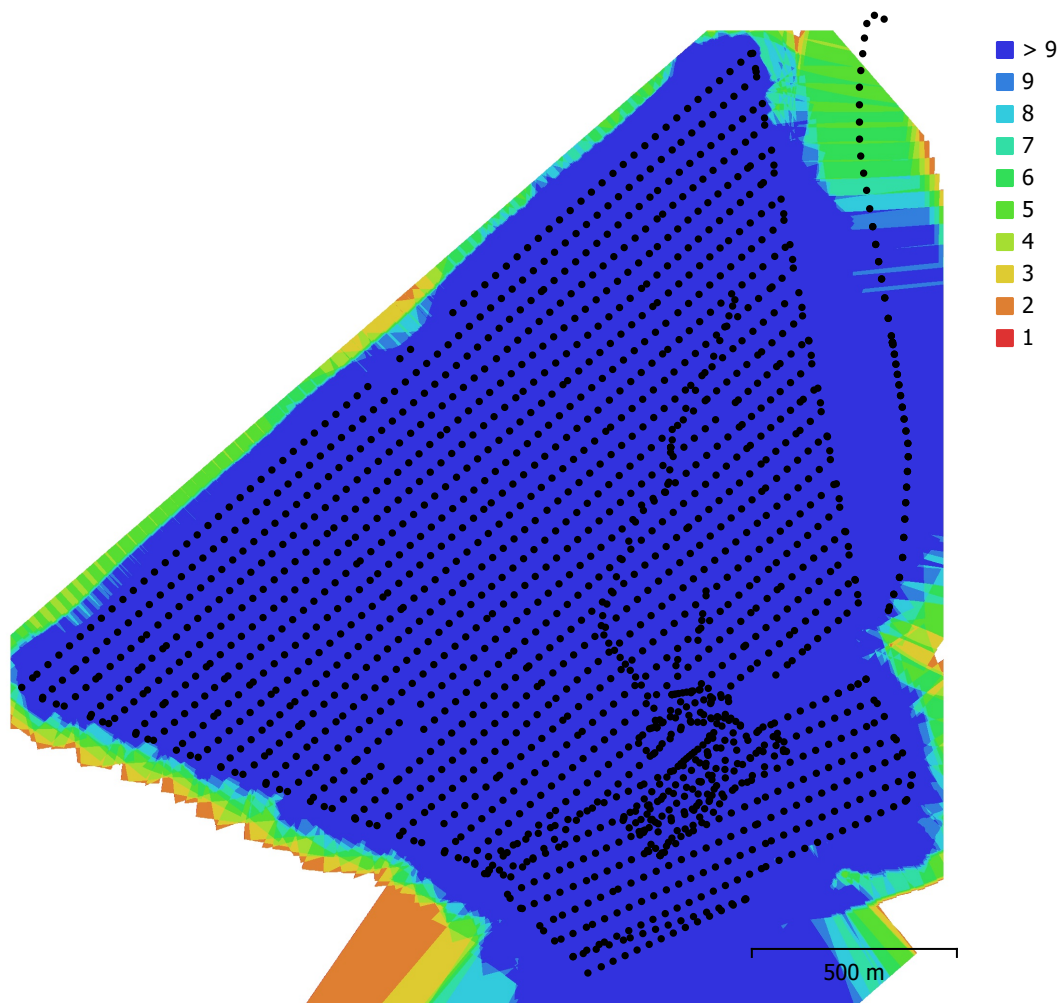


Fig. 1. Camera locations and image overlap.

Number of images:	1,857	Camera stations:	1,842
Flying altitude:	228 m	Tie points:	3,440,829
Ground resolution:	10 cm/pix	Projections:	14,537,520
Coverage area:	3.65 km <sup>2</sup>	Reprojection error:	0.478 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
ZenmuseP1 (35mm)	8192 x 5460	35 mm	4.39 x 4.39 $\mu\text{m}$	No

Table 1. Cameras.

# Camera Calibration

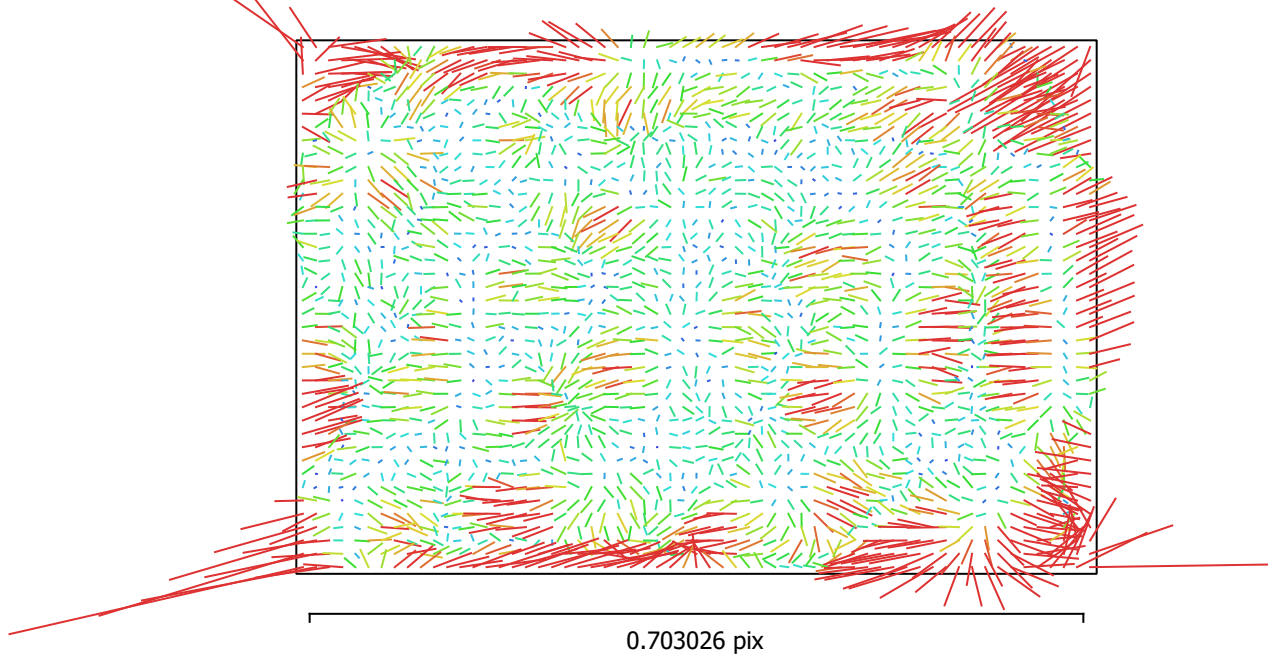


Fig. 2. Image residuals for ZenmuseP1 (35mm).

## ZenmuseP1 (35mm)

1857 images, additional corrections

Type	Resolution	Focal Length	Pixel Size
<b>Frame</b>	<b>8192 x 5460</b>	<b>35 mm</b>	<b>4.39 x 4.39 <math>\mu</math>m</b>

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
<b>F</b>	<b>8192.13</b>	0.068	1.00	0.02	0.03	-0.25	0.00	-0.99	0.97	-0.95	0.92	0.03	0.03
<b>Cx</b>	<b>-17.2682</b>	0.032		1.00	0.01	-0.10	0.18	-0.02	0.02	-0.02	0.02	0.99	0.01
<b>Cy</b>	<b>40.4897</b>	0.036			1.00	-0.14	-0.12	-0.02	0.02	-0.02	0.02	0.00	0.99
<b>B1</b>	<b>0.703551</b>	0.0037				1.00	0.02	0.28	-0.29	0.29	-0.27	-0.10	-0.14
<b>B2</b>	<b>-0.0673732</b>	0.0026					1.00	0.00	-0.00	0.01	-0.01	0.18	-0.12
<b>K1</b>	<b>-0.0482174</b>	0.00015						1.00	-1.00	0.98	-0.96	-0.03	-0.02
<b>K2</b>	<b>0.0479086</b>	0.00096							1.00	-0.99	0.98	0.03	0.02
<b>K3</b>	<b>-0.234803</b>	0.0027								1.00	-0.99	-0.03	-0.02
<b>K4</b>	<b>0.202629</b>	0.0028									1.00	0.02	0.02
<b>P1</b>	<b>-0.000977268</b>	1.7e-06										1.00	0.00
<b>P2</b>	<b>0.00156046</b>	1.9e-06											1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Locations

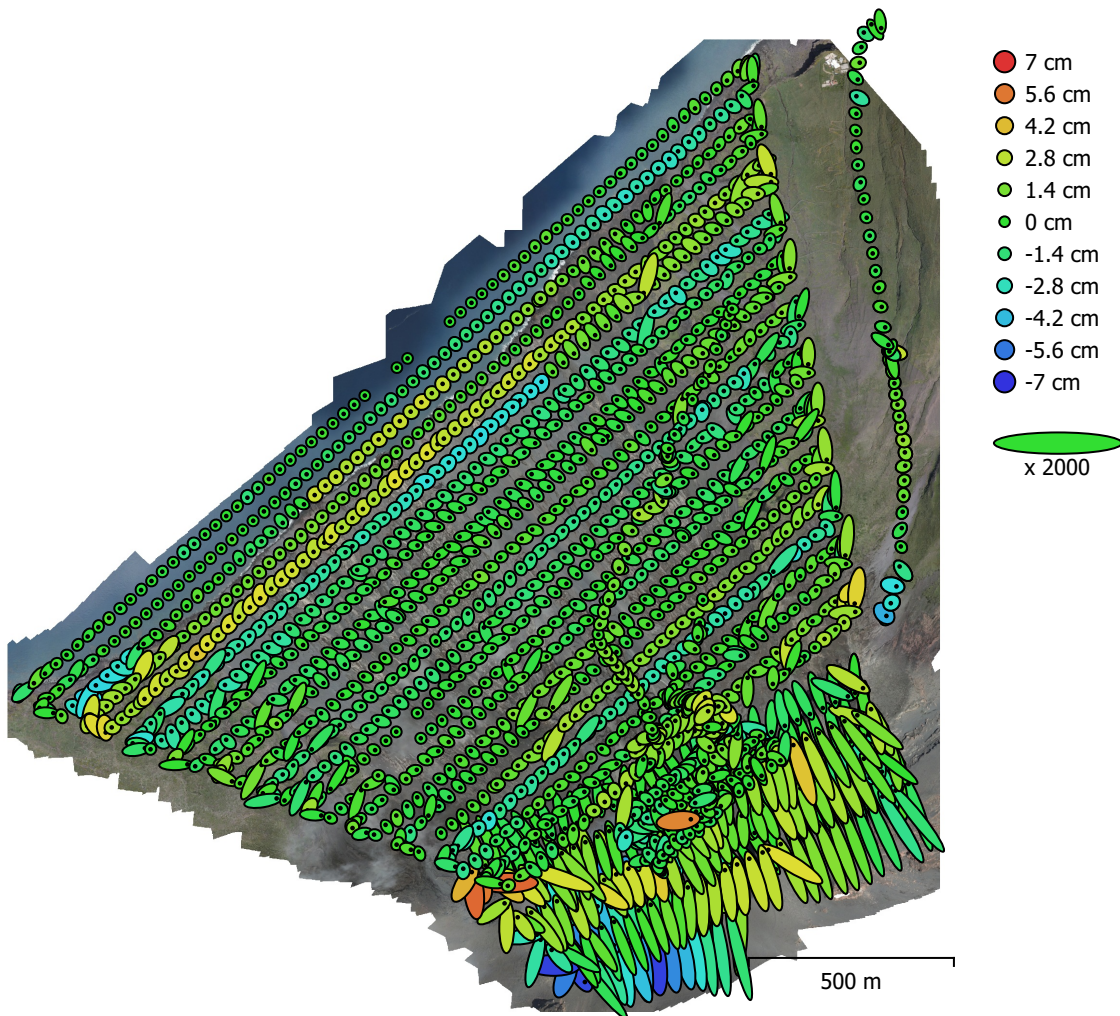


Fig. 3. Camera locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.

Estimated camera locations are marked with a black dot.

<b>X error (cm)</b>	<b>Y error (cm)</b>	<b>Z error (cm)</b>	<b>XY error (cm)</b>	<b>Total error (cm)</b>
1.08497	1.94184	1.49131	2.22439	2.67804

Table 3. Average camera location error.

X - Easting, Y - Northing, Z - Altitude.

# Digital Elevation Model

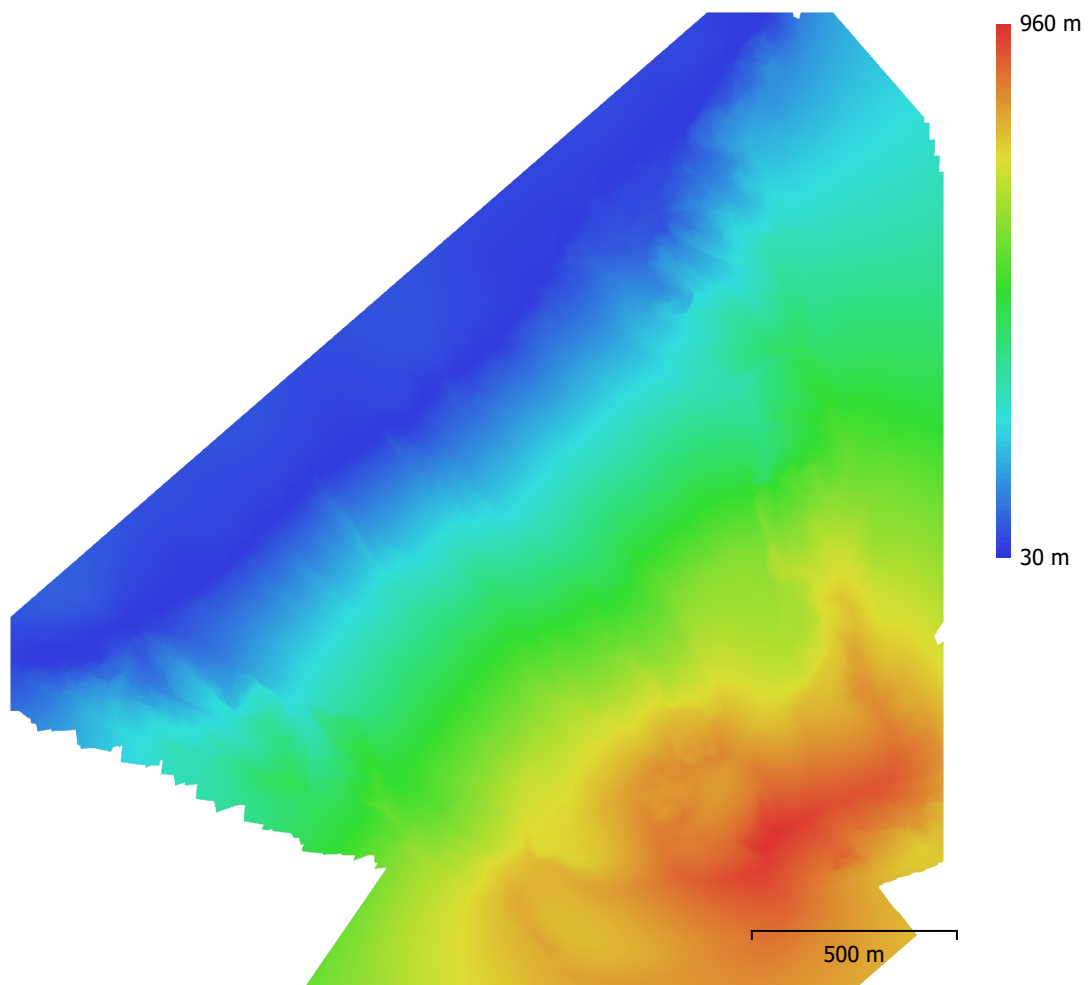


Fig. 4. Reconstructed digital elevation model.

Resolution: 10 cm/pix  
Point density: 100 points/m<sup>2</sup>

# Processing Parameters

## General

Images	1857
Aligned images	1842
Coordinate system	WGS 84 / UTM zone 33N (EPSG::32633)
Camera coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

## Tie Points

Points	3,440,829 of 4,050,681
RMS reprojection error	0.131816 (0.477888 pix)
Max reprojection error	0.606993 (46.8047 pix)
Mean key point size	2.80947 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.47341

## Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Key point limit per Mpx	1,000
Tie point limit	10,000
Filter points by mask	Yes
Mask tie points	No
Exclude stationary tie points	No
Guided image matching	No
Adaptive camera model fitting	No
Matching time	8 minutes 38 seconds
Matching memory usage	2.74 GB
Alignment time	9 minutes 43 seconds
Alignment memory usage	3.08 GB

## Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Fit additional corrections	Yes
Adaptive camera model fitting	No
Exclude corners	No
Optimization time	1 minutes 40 seconds
Date created	2024:07:31 19:03:39
Software version	2.1.2.18358
File size	367.08 MB

## Depth Maps

Count	1840
-------	------

## Depth maps generation parameters

Quality	High
Filtering mode	Aggressive
Max neighbors	16
Processing time	1 hours 53 minutes
Memory usage	12.09 GB
Date created	2024:07:31 22:14:59
Software version	2.1.2.18358
File size	25.50 GB



**Point Cloud**

Points 435,714,325  
Coordinate precision 1.59 cm

**Point attributes**

Color 3 bands, uint8  
Normal  
Confidence 4 - 113

**Point classes**

Created (never classified) 435,714,325

**Point cloud generation parameters**

Processing time 6 hours 31 minutes  
Memory usage 37.77 GB  
Date created 2024:08:01 04:47:00  
Software version 2.1.2.18358  
File size 5.97 GB

**DEM**

Size 22,719 x 23,676  
Resolution 10 cm/pix  
Coordinate system WGS 84 / UTM zone 33N (EPSG::32633)

**Reconstruction parameters**

Source data Point cloud  
Interpolation Enabled  
Processing time 10 minutes 8 seconds  
Memory usage 307.05 MB  
Date created 2024:08:01 09:25:24  
Software version 2.1.2.18358  
File size 1.58 GB

**Orthomosaic**

Size 45,420 x 47,333  
Resolution 5 cm/pix  
Coordinate system WGS 84 / UTM zone 33N (EPSG::32633)  
Colors 3 bands, uint8

**Reconstruction parameters**

Blending mode Mosaic  
Surface DEM  
Enable hole filling Yes  
Enable ghosting filter Yes  
Processing time 1 hours 4 minutes  
Memory usage 33.22 GB  
Date created 2024:08:01 10:06:04  
Software version 2.1.2.18358  
File size 18.35 GB

**System**

Software name Agisoft Metashape Professional  
Software version 2.1.2 build 18358  
OS Windows 64 bit  
RAM 63.72 GB  
CPU Intel(R) Core(TM) i9-14900KF  
GPU(s) NVIDIA GeForce RTX 4090