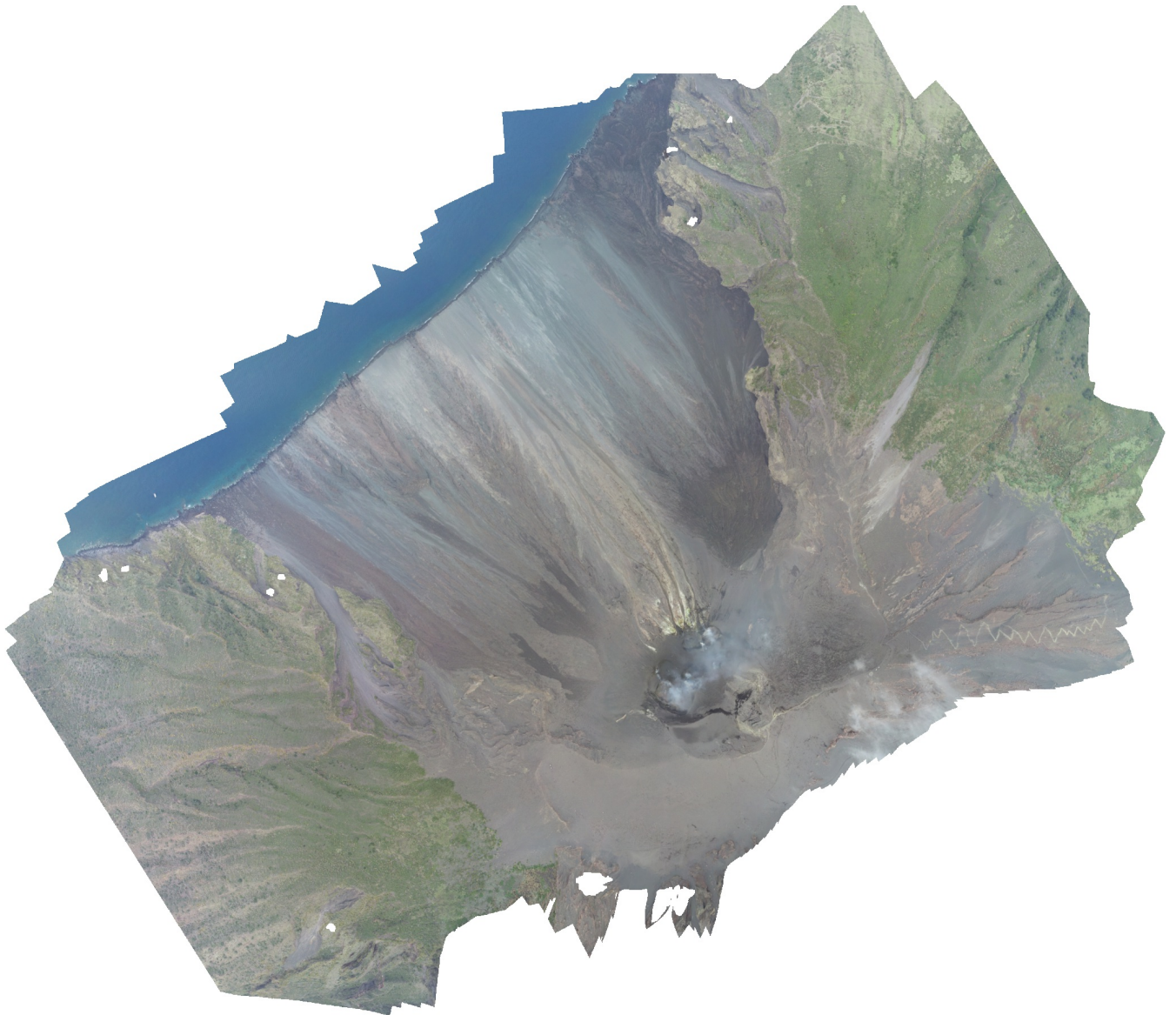


# Stromboli\_Sept10-2018

Processing Report

Stromboli Volcano, Italy  
Sept 10, 2018  
sUAS Survey (DJI M210, X4S)  
Coverage: Vents & Sciara  
06 August 2019



# Survey Data

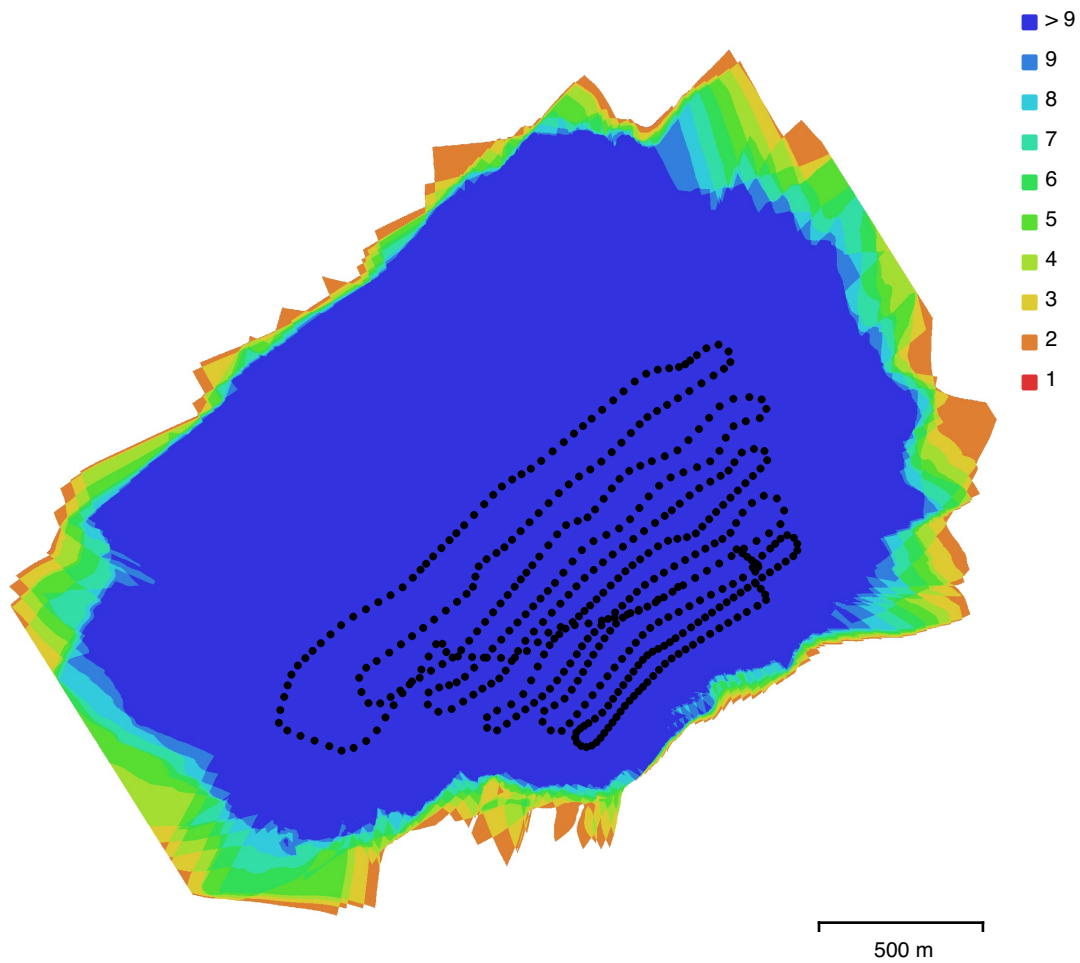


Fig. 1. Camera locations and image overlap.

Number of images:	458	Camera stations:	458
Flying altitude:	408 m	Tie points:	2,429,986
Ground resolution:	11.5 cm/pix	Projections:	9,641,744
Coverage area:	4.68 km <sup>2</sup>	Reprojection error:	0.744 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6510 (8.8mm)	5472 x 3078	8.8 mm	2.53 x 2.53 $\mu$ m	No
FC6510 (8.8mm)	5472 x 3078	8.8 mm	2.53 x 2.53 $\mu$ m	No

Table 1. Cameras.

# Camera Calibration

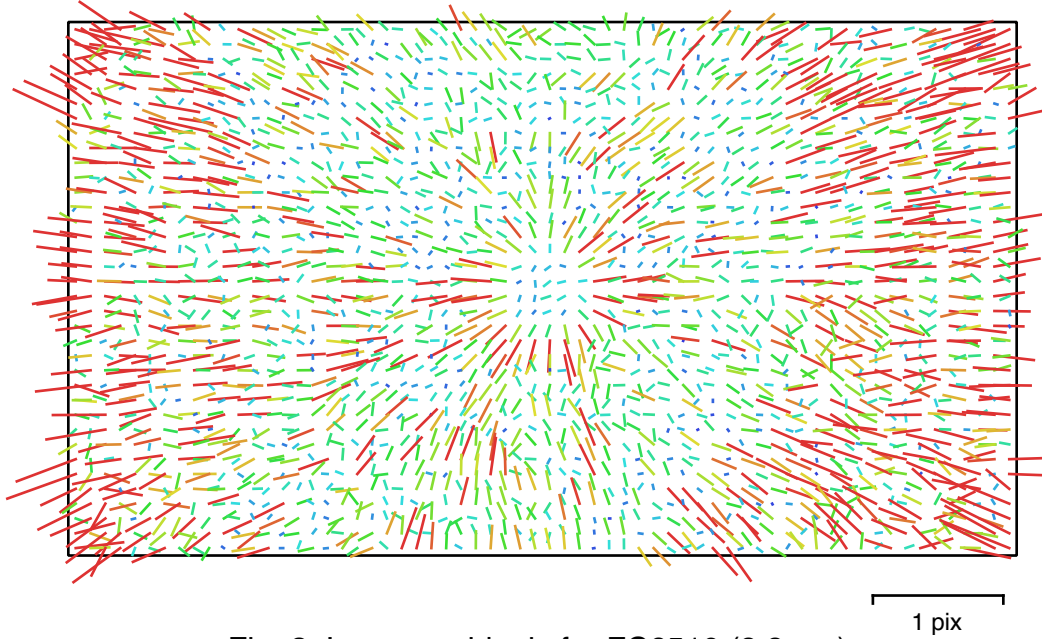


Fig. 2. Image residuals for FC6510 (8.8mm).

FC6510 (8.8mm)  
122 images

Type	Resolution	Focal Length	Pixel Size
Frame	5472 x 3078	8.8 mm	2.53 x 2.53 $\mu\text{m}$

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
F	3677.63	0.044	1.00	-0.04	-0.90	0.40	-0.07	-0.15	0.13	-0.11	0.09	0.03	-0.06
Cx	14.1804	0.015		1.00	0.04	0.01	0.13	-0.01	0.01	-0.01	0.02	0.90	0.01
Cy	21.3879	0.021			1.00	-0.42	0.06	-0.02	0.02	-0.03	0.03	-0.03	0.26
B1	-7.24347	0.0048				1.00	-0.04	-0.01	-0.04	0.04	-0.04	0.08	0.19
B2	0.300922	0.0041					1.00	-0.00	0.00	-0.00	0.00	0.00	0.04
K1	0.0209418	3.7e-05						1.00	-0.97	0.92	-0.88	-0.01	-0.07
K2	-0.101796	0.0002							1.00	-0.99	0.96	0.01	0.00
K3	0.193411	0.00043								1.00	-0.99	-0.01	-0.00
K4	-0.123573	0.00031									1.00	0.01	0.00
P1	0.00177124	1.4e-06										1.00	0.03
P2	0.000126904	1.2e-06											1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Calibration

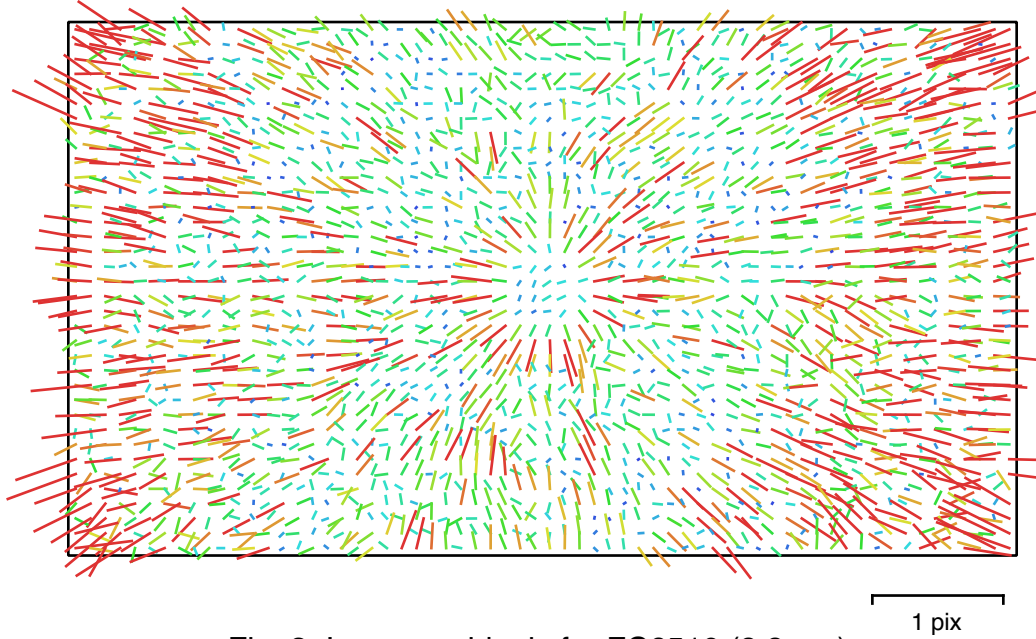


Fig. 3. Image residuals for FC6510 (8.8mm).

FC6510 (8.8mm)  
336 images

Type	Resolution	Focal Length	Pixel Size
Frame	5472 x 3078	8.8 mm	2.53 x 2.53 $\mu\text{m}$

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
F	3677.52	0.044	1.00	-0.06	-0.95	0.46	-0.11	-0.06	0.05	-0.03	0.02	0.05	-0.08
Cx	14.1943	0.01		1.00	0.06	0.00	0.16	-0.01	0.02	-0.02	0.02	0.89	0.02
Cy	21.362	0.02			1.00	-0.48	0.11	-0.03	0.03	-0.04	0.05	-0.05	0.19
B1	-7.24225	0.004				1.00	-0.07	-0.02	-0.05	0.05	-0.05	0.08	0.25
B2	0.306986	0.0032					1.00	-0.00	0.00	-0.01	0.01	0.03	0.02
K1	0.0210218	2.3e-05						1.00	-0.96	0.91	-0.86	-0.02	-0.13
K2	-0.102194	0.00012							1.00	-0.99	0.96	0.01	0.00
K3	0.194278	0.00026								1.00	-0.99	-0.01	-0.00
K4	-0.124252	0.00019									1.00	0.01	0.01
P1	0.00177101	9e-07										1.00	0.05
P2	0.00012986	9.6e-07											1.00

Table 3. Calibration coefficients and correlation matrix.



# Camera Locations

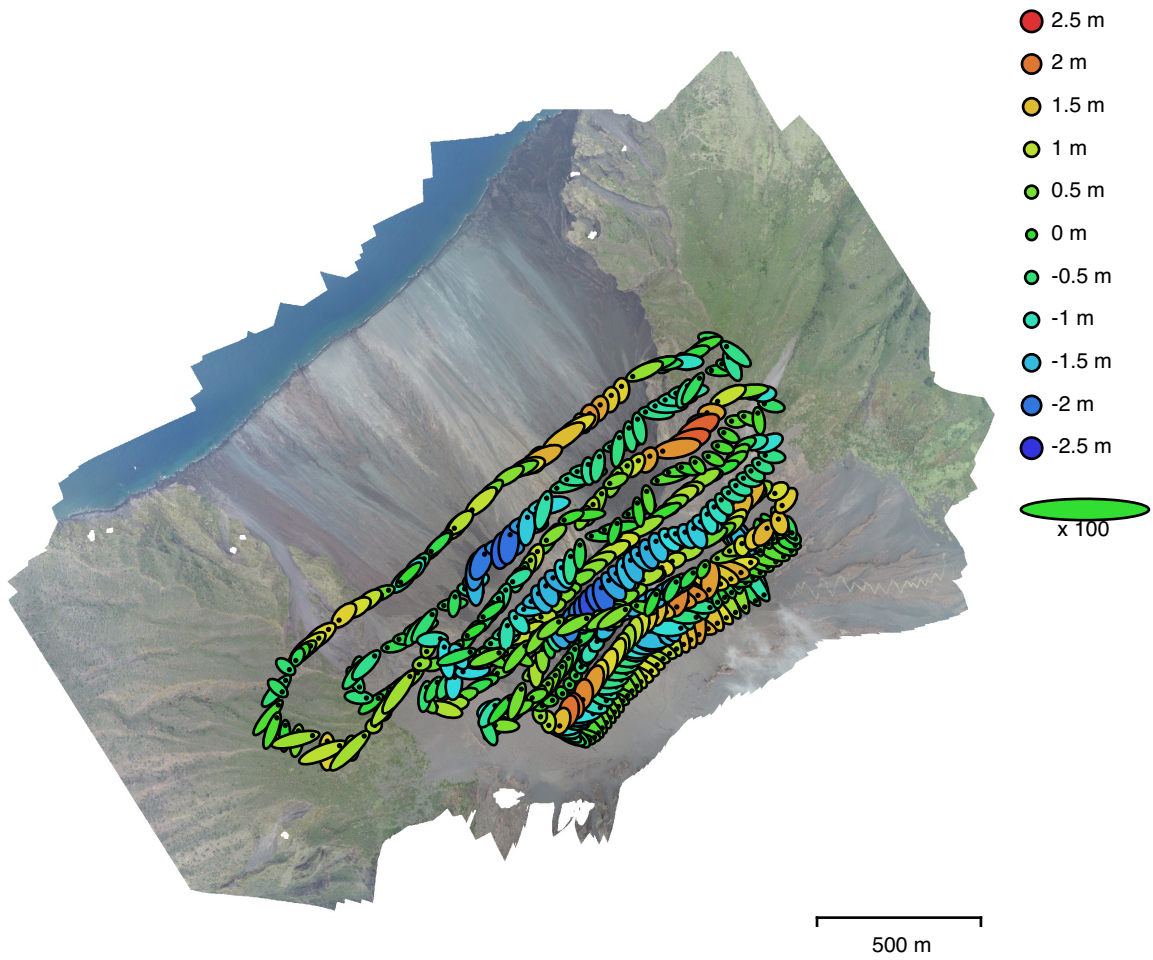


Fig. 4. Camera locations and error estimates.  
 Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.  
 Estimated camera locations are marked with a black dot.

X error (m)	Y error (m)	Z error (m)	XY error (m)	Total error (m)
0.433677	0.391614	0.969514	0.584326	1.13199

Table 4. Average camera location error.  
 X - Longitude, Y - Latitude, Z - Altitude.

# Digital Elevation Model

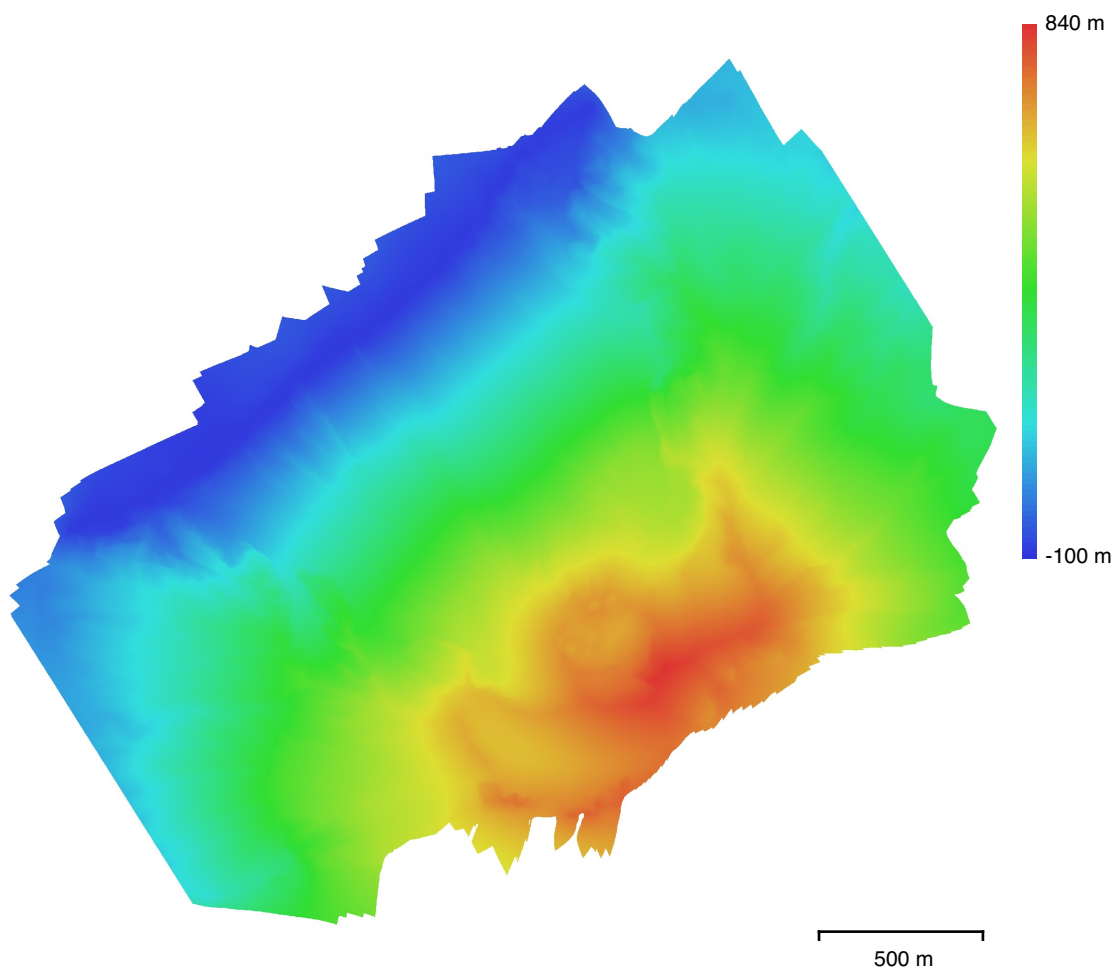


Fig. 5. Reconstructed digital elevation model.

Resolution: 23 cm/pix  
Point density: 18.9 points/m<sup>2</sup>

# Processing Parameters

## General

Cameras	458
Aligned cameras	458
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

## Point Cloud

Points	2,429,986 of 2,876,262
RMS reprojection error	0.187736 (0.743712 pix)
Max reprojection error	0.5693 (11.4239 pix)
Mean key point size	3.72755 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.63743

## Alignment parameters

Accuracy	High
Generic preselection	No
Reference preselection	Yes
Key point limit	0
Tie point limit	0
Filter points by mask	No
Adaptive camera model fitting	Yes
Matching time	42 minutes 46 seconds
Alignment time	8 minutes 17 seconds

## Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	1 minutes 14 seconds

## Dense Point Cloud

Points	109,312,158
Point colors	3 bands, uint8
Reconstruction parameters	
Quality	High
Depth filtering	Aggressive
Depth maps generation time	21 hours 19 minutes
Dense cloud generation time	4 hours 23 minutes

## Model

Faces	21,862,421
Vertices	10,937,897
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8
Reconstruction parameters	
Surface type	Arbitrary
Source data	Dense
Interpolation	Enabled
Quality	High
Depth filtering	Aggressive
Face count	21,862,421
Processing time	1 hours 46 minutes

## Texturing parameters

Mapping mode	Generic
Blending mode	Mosaic

## General

Texture size	4,096 x 4,096
Enable hole filling	Yes
Enable ghosting filter	No
UV mapping time	4 minutes 12 seconds
Blending time	4 minutes 13 seconds

## DEM

Size	15,561 x 14,687
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	2 minutes 53 seconds

## Orthomosaic

Size	26,142 x 22,958
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	6 minutes 30 seconds

## Software

Version	1.5.1 build 7618
Platform	Mac OS 64