Quality Report

Important: Click on the different icons for:

Help to analyze the results in the Quality Report

Additional information about the sections

Click here for additional tips to analyze the Quality Report

Summary

Project	sier_4k_2_re
Processed	2019-01-23 17:00:16
Camera Model Name(s)	RedEdge_5.5_1280x960 (Blue), RedEdge_5.5_1280x960 (Green), RedEdge_5.5_1280x960 (Red), RedEdge_5.5_1280x960 (NIR), RedEdge_5.5_1280x960 (Red edge)
Rig name(s)	«MicaSense 5 band»
Average Ground Sampling Distance (GSD)	8.46 cm / 3.33 in
Area Covered	0.607 km^2 / 60.6650 ha / 0.23 sq. mi. / 149.9840 acres
Time for Initial Processing (without report)	15h:42m:03s

Quality Check

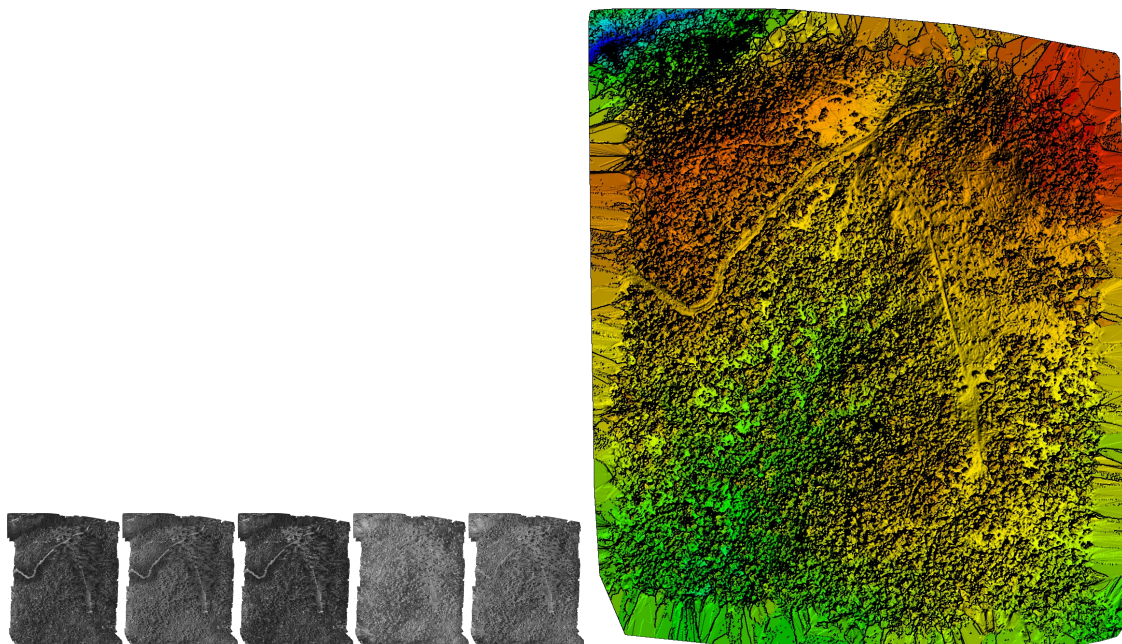|		
Images	median of 33784 keypoints per image	✓
Dataset	10415 out of 10435 images calibrated (99%), 5 images disabled	✓
Camera Optimization	1.35% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 8466.07 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Preview

Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

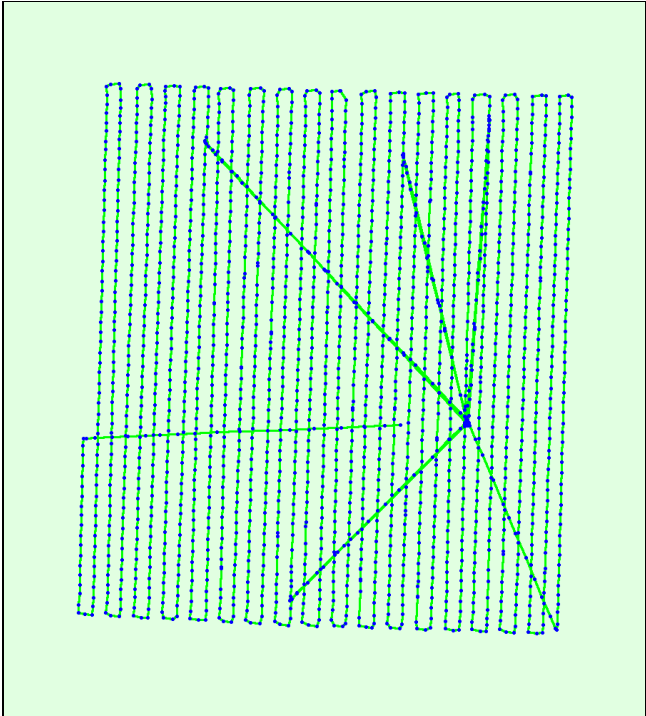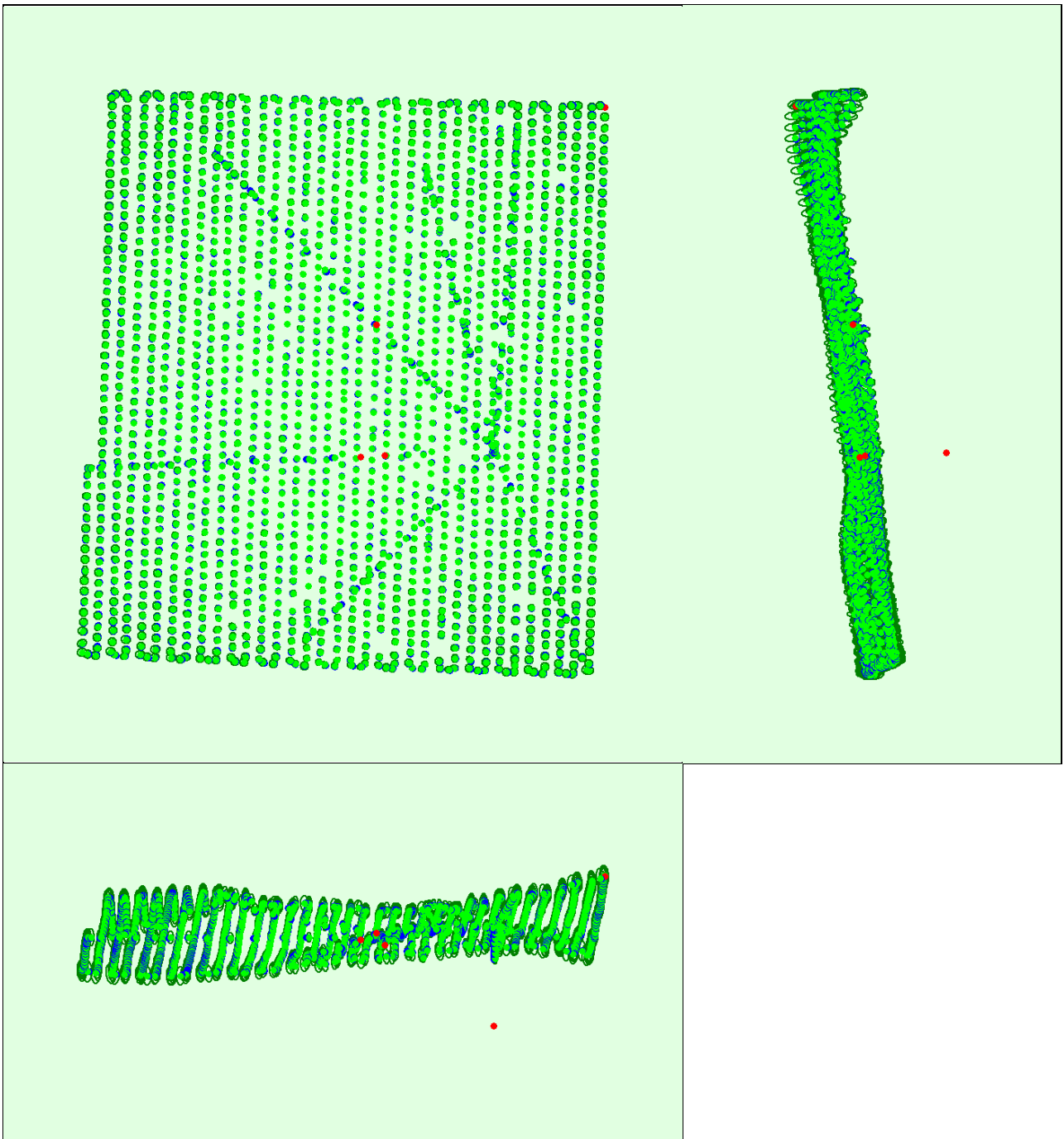| Number of Calibrated Images	10415 out of 10440
Number of Geolocated Images	10440 out of 10440

Initial Image Positions

Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions

Uncertainty ellipses 50x magnified

Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane). Red dots indicate disabled or uncalibrated images. Dark green ellipses indicate the absolute position uncertainty of the bundle block adjustment result.

❓ Absolute camera position and orientation uncertainties ℹ️

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.067	0.067	0.151	0.030	0.032	0.012
Sigma	0.010	0.010	0.032	0.002	0.002	0.002

❓ Overlap ℹ️

Number of overlapping images: 1 2 3 4 5+
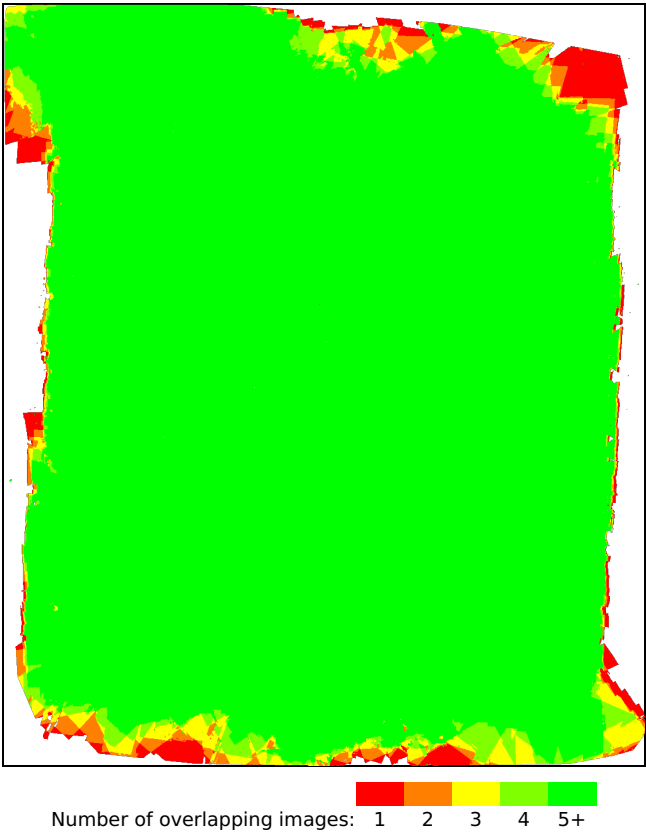
Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint matches is also sufficient for these areas (see Figure 5 for keypoint matches).

Bundle Block Adjustment Details

Number of 2D Keypoint Observations for Bundle Block Adjustment	25457085
Number of 3D Points for Bundle Block Adjustment	7875572
Mean Reprojection Error [pixels]	0.195

Internal Camera Parameters

RedEdge_5.5_1280x960 (Blue). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.605 [pixel] 2.466 [mm]	495.123 [pixel] 1.857 [mm]	-0.097	0.149	-0.017	0.000	0.000
Optimized Values	1446.427 [pixel] 5.424 [mm]	654.584 [pixel] 2.455 [mm]	495.365 [pixel] 1.858 [mm]	-0.097	0.158	-0.048	0.000	-0.000
Uncertainties (Sigma)	0.114 [pixel] 0.000 [mm]	0.086 [pixel] 0.000 [mm]	0.066 [pixel] 0.000 [mm]	0.001	0.004	0.009	0.000	0.000

The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.

The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.
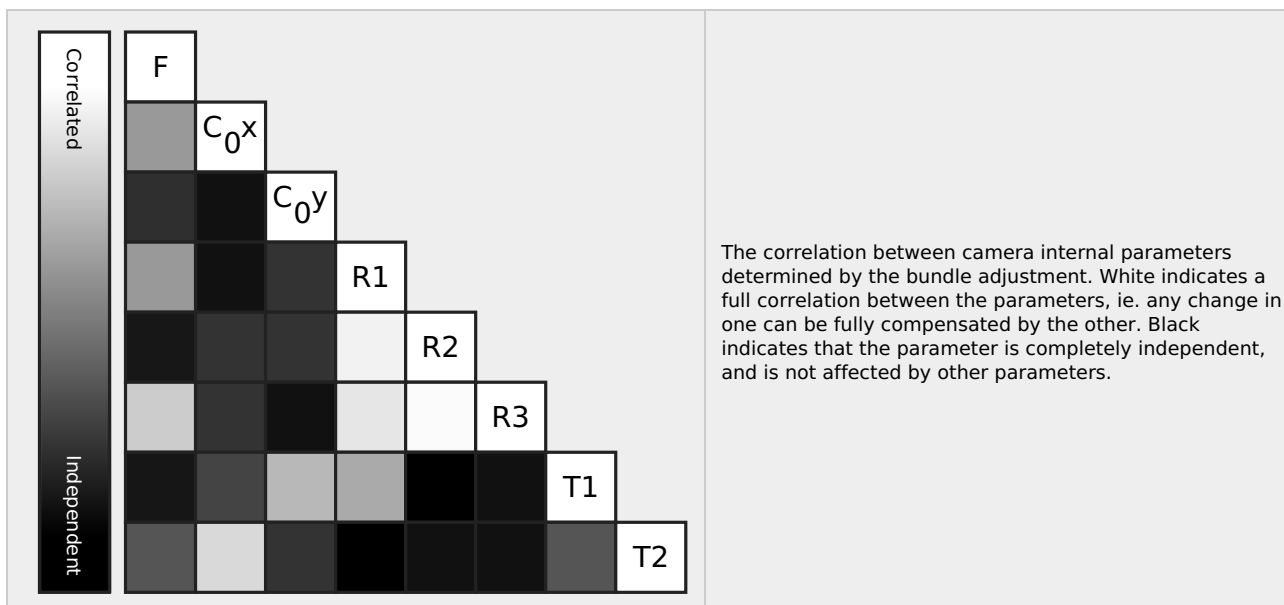
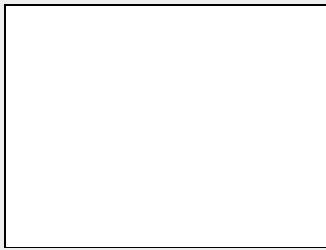## Internal Camera Parameters

RedEdge_5.5_1280x960 (Green). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.835 [pixel] 2.467 [mm]	481.299 [pixel] 1.805 [mm]	-0.099	0.143	-0.021	0.000	0.001
Optimized Values	1443.364 [pixel] 5.413 [mm]	655.611 [pixel] 2.459 [mm]	481.591 [pixel] 1.806 [mm]	-0.097	0.136	-0.002	0.000	0.000
Uncertainties (Sigma)	0.109 [pixel] 0.000 [mm]	0.026 [pixel] 0.000 [mm]	0.022 [pixel] 0.000 [mm]	0.000	0.001	0.003	0.000	0.000

The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.

The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.

ⓘ Internal Camera Parameters

🖹 RedEdge_5.5_1280x960 (Red). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.200 [pixel] 2.465 [mm]	493.864 [pixel] 1.852 [mm]	-0.100	0.131	-0.003	-0.000	0.000
Optimized Values	1448.381 [pixel] 5.431 [mm]	654.030 [pixel] 2.453 [mm]	493.921 [pixel] 1.852 [mm]	-0.096	0.111	0.039	-0.000	-0.000
Uncertainties (Sigma)	0.114 [pixel] 0.000 [mm]	0.091 [pixel] 0.000 [mm]	0.069 [pixel] 0.000 [mm]	0.001	0.004	0.010	0.000	0.000

The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.

The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.
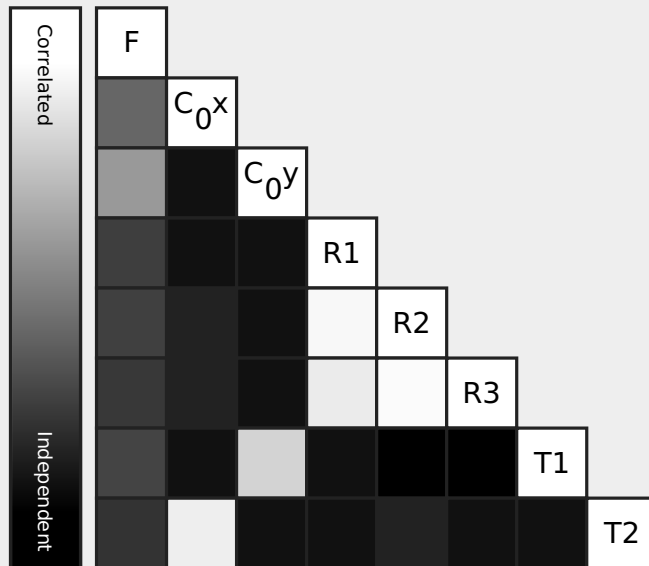
ⓘ Internal Camera Parameters

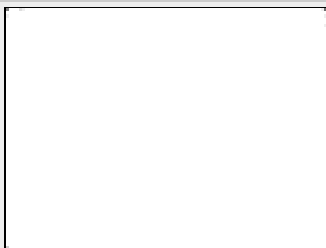### 🖹 RedEdge_5.5_1280x960 (NIR). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	666.605 [pixel] 2.500 [mm]	482.221 [pixel] 1.808 [mm]	-0.105	0.153	-0.045	0.000	0.000
Optimized Values	1449.204 [pixel] 5.435 [mm]	662.559 [pixel] 2.485 [mm]	482.539 [pixel] 1.810 [mm]	-0.102	0.143	-0.025	0.000	-0.000
Uncertainties (Sigma)	0.116 [pixel] 0.000 [mm]	0.102 [pixel] 0.000 [mm]	0.078 [pixel] 0.000 [mm]	0.001	0.005	0.011	0.000	0.000

The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.

The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.
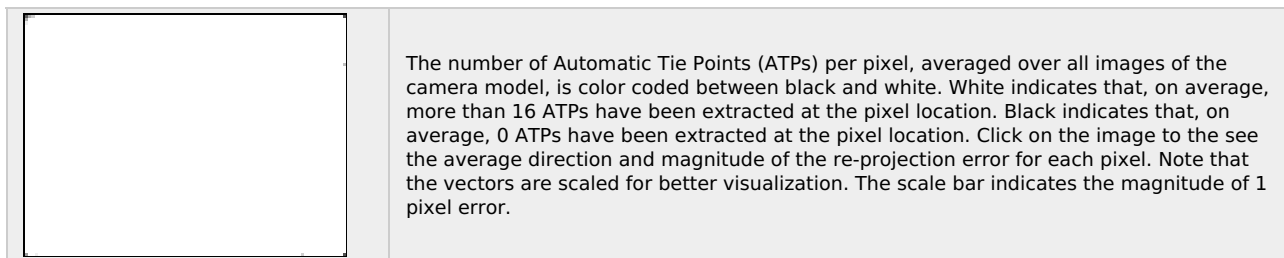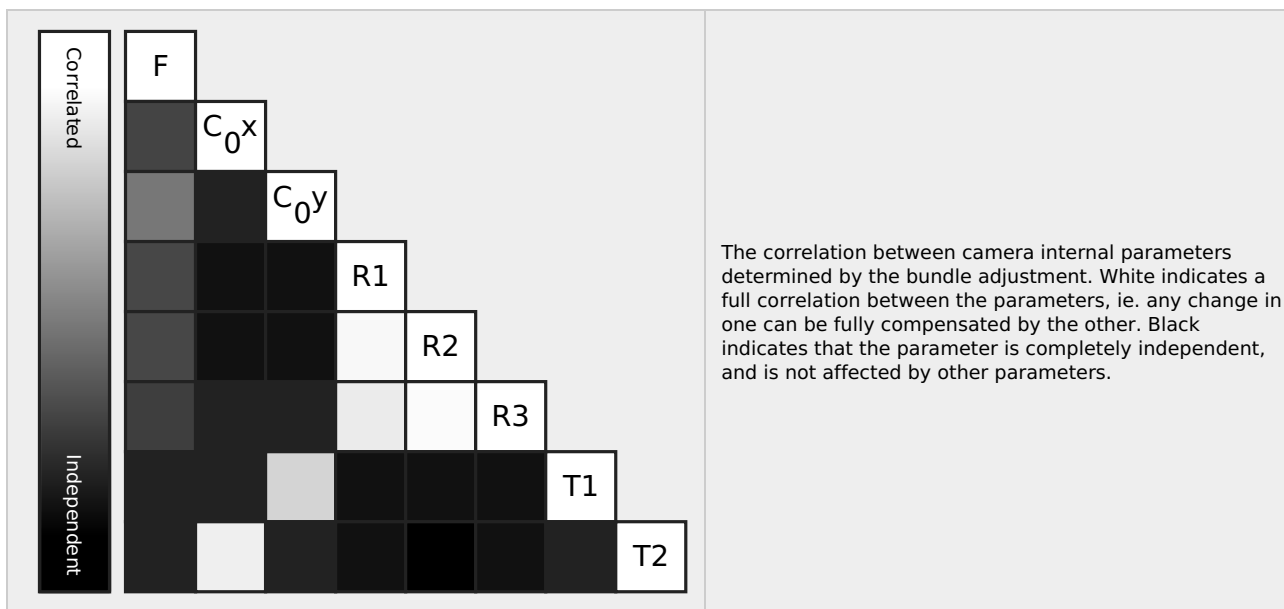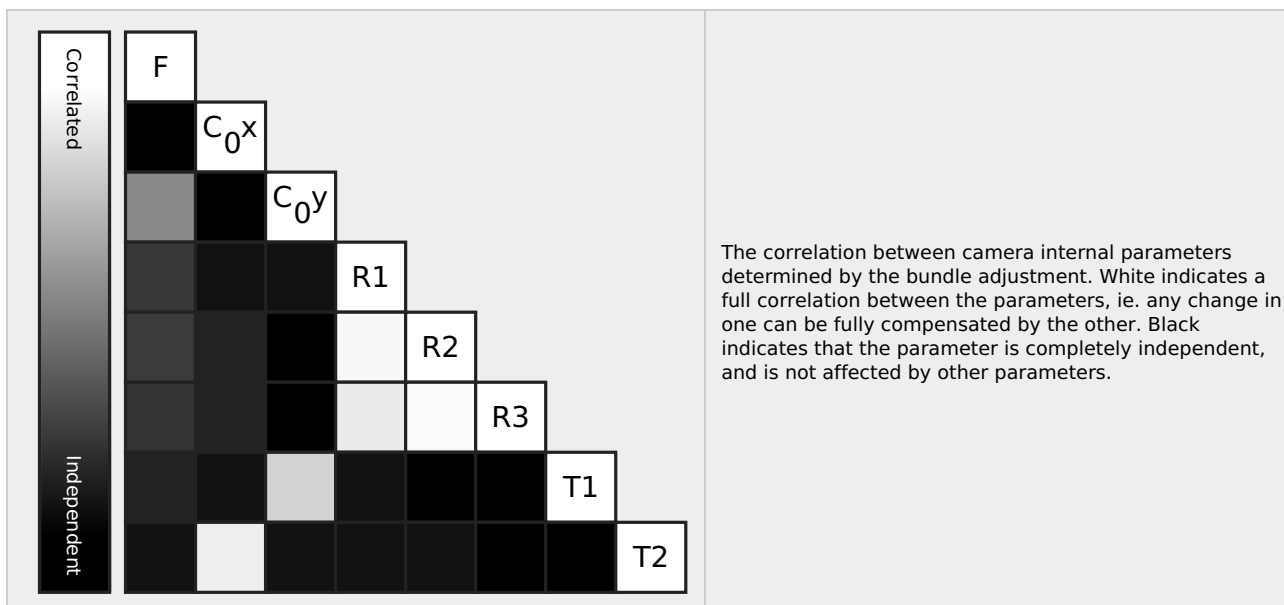
Internal Camera Parameters

RedEdge_5.5_1280x960 (Red edge). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	661.440 [pixel] 2.480 [mm]	495.379 [pixel] 1.858 [mm]	-0.103	0.155	-0.049	0.000	0.001
Optimized Values	1446.942 [pixel] 5.426 [mm]	657.754 [pixel] 2.467 [mm]	494.299 [pixel] 1.854 [mm]	-0.101	0.143	-0.026	0.000	0.000
Uncertainties (Sigma)	0.114 [pixel] 0.000 [mm]	0.083 [pixel] 0.000 [mm]	0.063 [pixel] 0.000 [mm]	0.001	0.004	0.009	0.000	0.000

The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.

The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.

Camera Rig «MicaSense 5 band» Relatives. Images: 10435

	Transl X [m]	Transl Y [m]	Transl Z [m]	Rot X [degree]	Rot Y [degree]	Rot Z [degree]
RedEdge_5.5_1280x960 (Green)	Reference Camera					
RedEdge_5.5_1280x960 (Blue)						
Initial Values	0.030	0.000	0.000	0.000	0.000	0.000
Optimized values	0.030	0.000	0.000	-0.113	0.135	-0.373
Uncertainties (sigma)				0.003	0.004	0.000
RedEdge_5.5_1280x960 (Red)						
Initial Values	0.000	0.022	0.000	0.000	0.000	0.000
Optimized values	0.000	0.022	0.000	0.046	0.103	-0.063
Uncertainties (sigma)				0.003	0.004	0.000
RedEdge_5.5_1280x960 (NIR)						
Initial Values	0.030	0.022	0.000	0.000	0.000	0.000
Optimized values	0.030	0.022	0.000	-0.149	-0.118	0.119
Uncertainties (sigma)				0.003	0.004	0.000
RedEdge_5.5_1280x960 (Red edge)						
Initial Values	0.015	0.011	0.000	0.000	0.000	0.000
Optimized values	0.015	0.011	0.000	-0.067	-0.558	-0.321
Uncertainties (sigma)				0.003	0.003	0.000

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	33784	8466
Min	19792	630
Max	43426	29500
Mean	32901	8697

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Blue)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	29338	5497
Min	19792	1079
Max	36599	22081
Mean	28479	6050

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Green)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	34580	9071
Min	20147	1345
Max	43426	29500
Mean	33700	9294

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Red)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	27612	4941

Min	19945	630
Max	36070	19975
Mean	27436	5895

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (NIR)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	32241	7254
Min	21935	632
Max	40181	24765
Mean	32131	8238

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Red edge)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	36068	8348
Min	21445	1287
Max	42418	25597
Mean	35667	8713

Median / 75% / Maximal Number of Matches Between Camera Models

	RedEdge_5.5_12... (Blue)	RedEdge_5.5_1... (Green)	RedEdge_5.5_128... (Red)	RedEdge_5.5_128... (NIR)	RedEdge_5.... (Red edge)
RedEdge_5.5_1280x960 (Blue)	50 / 361 / 17840	42 / 239 / 6171	63 / 535 / 9653	29 / 163 / 2136	40 / 276 / 3238
RedEdge_5.5_1280x960 (Green)		82 / 469 / 27372	37 / 208 / 5049	23 / 109 / 5756	37 / 206 / 9440
RedEdge_5.5_1280x960 (Red)			48 / 393 / 14941	28 / 151 / 2371	39 / 259 / 4298
RedEdge_5.5_1280x960 (NIR)				43 / 521 / 20082	46 / 452 / 11008
RedEdge_5.5_1280x960 (Red edge)					39 / 369 / 16748

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	5074258
In 3 Images	1305887
In 4 Images	563267
In 5 Images	275798
In 6 Images	164701
In 7 Images	103408
In 8 Images	70668
In 9 Images	52305
In 10 Images	40209
In 11 Images	31388
In 12 Images	25171
In 13 Images	20768
In 14 Images	17311
In 15 Images	14016
In 16 Images	12070
In 17 Images	10046
In 18 Images	8858
In 19 Images	7870
In 20 Images	6885
In 21 Images	6128
In 22 Images	5472
In 23 Images	4724
In 24 Images	4075

In 25 Images	3897
In 26 Images	3546
In 27 Images	3184
In 28 Images	2823
In 29 Images	2716
In 30 Images	2451
In 31 Images	2233
In 32 Images	2052
In 33 Images	1957
In 34 Images	1797
In 35 Images	1632
In 36 Images	1571
In 37 Images	1401
In 38 Images	1333
In 39 Images	1272
In 40 Images	1137
In 41 Images	1016
In 42 Images	920
In 43 Images	994
In 44 Images	843
In 45 Images	797
In 46 Images	757
In 47 Images	701
In 48 Images	663
In 49 Images	586
In 50 Images	517
In 51 Images	506
In 52 Images	490
In 53 Images	387
In 54 Images	377
In 55 Images	339
In 56 Images	306
In 57 Images	294
In 58 Images	229
In 59 Images	242
In 60 Images	191
In 61 Images	203
In 62 Images	165
In 63 Images	164
In 64 Images	142
In 65 Images	136
In 66 Images	115
In 67 Images	106
In 68 Images	111
In 69 Images	82
In 70 Images	83
In 71 Images	79
In 72 Images	85
In 73 Images	84
In 74 Images	63
In 75 Images	56
In 76 Images	75
In 77 Images	59
In 78 Images	62
In 79 Images	61
In 80 Images	51
In 81 Images	56
In 82 Images	70
In 83 Images	41

In 84 Images	39
In 85 Images	49
In 86 Images	51
In 87 Images	54
In 88 Images	49
In 89 Images	51
In 90 Images	44
In 91 Images	44
In 92 Images	41
In 93 Images	42
In 94 Images	57
In 95 Images	35
In 96 Images	53
In 97 Images	46
In 98 Images	44
In 99 Images	55
In 100 Images	56
In 101 Images	35
In 102 Images	47
In 103 Images	33
In 104 Images	35
In 105 Images	43
In 106 Images	51
In 107 Images	40
In 108 Images	51
In 109 Images	31
In 110 Images	40
In 111 Images	38
In 112 Images	45
In 113 Images	44
In 114 Images	29
In 115 Images	50
In 116 Images	38
In 117 Images	32
In 118 Images	34
In 119 Images	38
In 120 Images	35
In 121 Images	32
In 122 Images	25
In 123 Images	25
In 124 Images	28
In 125 Images	19
In 126 Images	30
In 127 Images	22
In 128 Images	26
In 129 Images	31
In 130 Images	23
In 131 Images	25
In 132 Images	18
In 133 Images	8
In 134 Images	8
In 135 Images	14
In 136 Images	7
In 137 Images	10
In 138 Images	7
In 139 Images	9
In 140 Images	3
In 141 Images	3
In 142 Images	1

In 143 Images	3
In 144 Images	1
In 146 Images	1
In 147 Images	2
In 148 Images	1
In 149 Images	1
In 154 Images	1

2D Keypoint Matches

Number of matches

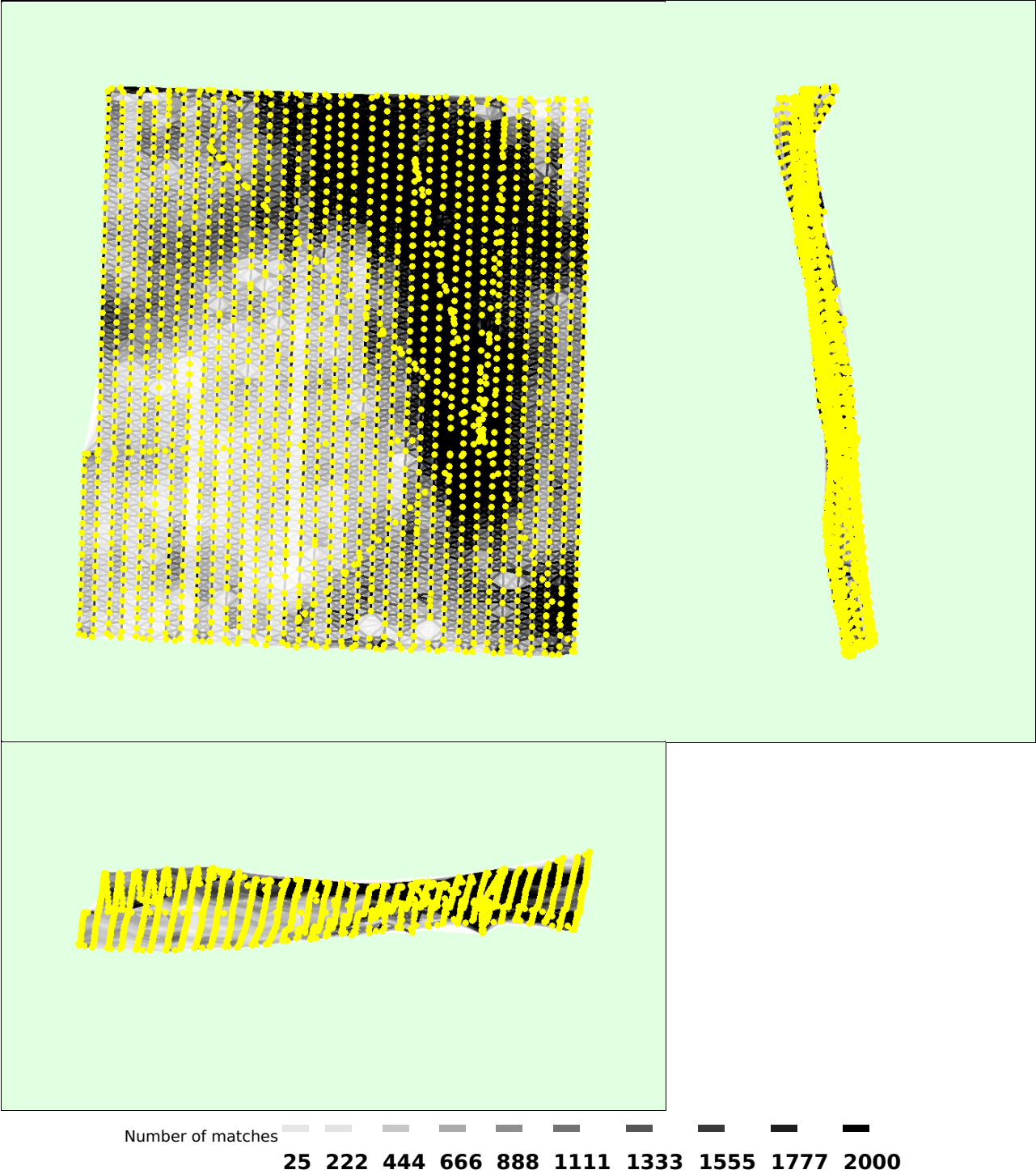25 222 444 666 888 1111 1333 1555 1777 2000

Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

Geolocation Details

❓ Absolute Geolocation Variance   ℹ

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-15.00	0.00	0.00	0.00
-15.00	-12.00	0.00	0.00	0.00
-12.00	-9.00	0.00	0.00	0.00
-9.00	-6.00	0.00	0.00	0.00
-6.00	-3.00	0.14	0.10	0.00
-3.00	0.00	46.86	51.95	45.69
0.00	3.00	53.00	47.85	54.31
3.00	6.00	0.00	0.10	0.00
6.00	9.00	0.00	0.00	0.00
9.00	12.00	0.00	0.00	0.00
12.00	15.00	0.00	0.00	0.00
15.00	-	0.00	0.00	0.00
Mean [m]		-0.000375	-0.000196	0.000273
Sigma [m]		0.463044	0.798275	0.631732
RMS Error [m]		0.463045	0.798275	0.631732

Min Error and Max Error represent geolocation error intervals between -1.5 and 1.5 times the maximum accuracy of all the images. Columns X, Y, Z show the percentage of images with geolocation errors within the predefined error intervals. The geolocation error is the difference between the initial and computed image positions. Note that the image geolocation errors do not correspond to the accuracy of the observed 3D points.

❓ Relative Geolocation Variance   ℹ

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	100.00	100.00	100.00
[-2.00, 2.00]	100.00	100.00	100.00
[-3.00, 3.00]	100.00	100.00	100.00
Mean of Geolocation Accuracy [m]	5.000000	5.000000	10.000000
Sigma of Geolocation Accuracy [m]	0.000000	0.000000	0.000000

Images X, Y, Z represent the percentage of images with a relative geolocation error in X, Y, Z.

Initial Processing Details   ℹ

System Information   ℹ

Hardware	CPU: Intel(R) Xeon(R) Platinum 8124M CPU @ 3.00GHz RAM: 69GB GPU: no info (Driver: unknown)
Operating System	Linux 4.15.0-1031-aws x86_64

Coordinate Systems   ℹ

Image Coordinate System	WGS 84 (EGM 96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 11N (EGM 96 Geoid)

Processing Options   ℹ

Detected Template	No Template Available
Keypoints Image Scale	Custom, Image Scale: 2
Advanced: Matching Image Pairs	Aerial Grid or Corridor

Advanced: Matching Strategy	Use Geometrically Verified Matching: no
Advanced: Keypoint Extraction	Targeted Number of Keypoints: Automatic
Advanced: Calibration	Calibration Method: Standard Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Custom, yes
Rig «MicaSense 5 band» processing	optimize relative rotation using a subset of secondary cameras

Point Cloud Densification details

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	Blue, Green, Red, NIR, Red edge
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	10m:14s
Time for Point Cloud Classification	59s
Time for 3D Textured Mesh Generation	10m:30s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	11249828
Average Density (per m^3)	5.7

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (8.46 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Raster DSM	Generated: yes Method: Triangulation Merge Tiles: yes
Orthomosaic	Generated: yes Merge Tiles: yes GeoTIFF Without Transparency: no Google Maps Tiles and KML: no
Radiometric calibration with reflectance target	yes
Index Calculator: Reflectance Map	Generated: yes Resolution: 1 x GSD (8.46 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Index Calculator: Index Values	Polygon Shapefile [cm/grid]: 400
Time for DSM Generation	50s
Time for Orthomosaic Generation	51m:53s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	01h:01m:51s

Time for Index Map Generation	37s

Camera Radiometric Correction

Camera Name	Band	Radiometric Correction Type	Reflectance target
RedEdge_5.5_1280x960	Blue	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	Green	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	Red	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	NIR	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	Red edge	Camera and Sun Irradiance	✓