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	sequ_5k_2_re
Processed	2019-01-24 11:14:09
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)	7.72 cm / 3.04 in
Area Covered	0.545 km^2 / 54.4737 ha / 0.21 sq. mi. / 134.6770 acres
Time for Initial Processing (without report)	12h:05m:32s

Quality Check

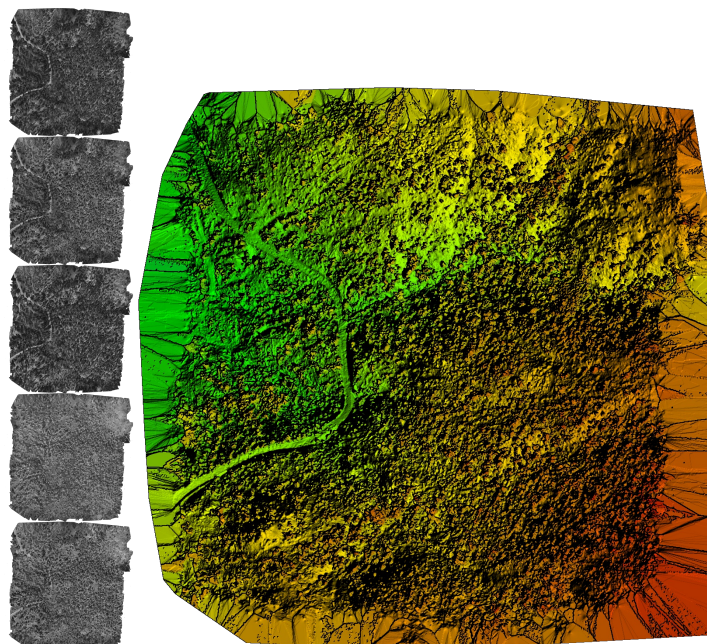|		
Images	median of 31161 keypoints per image	✓
Dataset	10705 out of 10705 images calibrated (100%), 5 images disabled	✓
Camera Optimization	1.31% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 6483.58 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Preview

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

Calibration Details

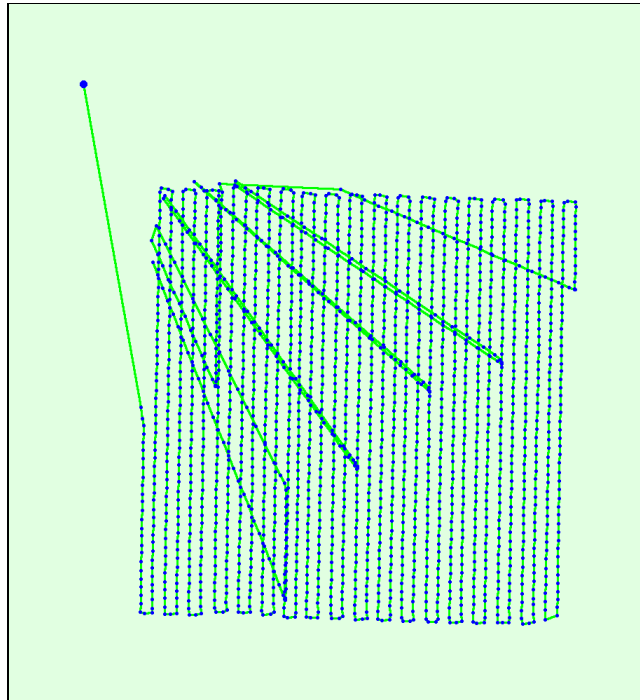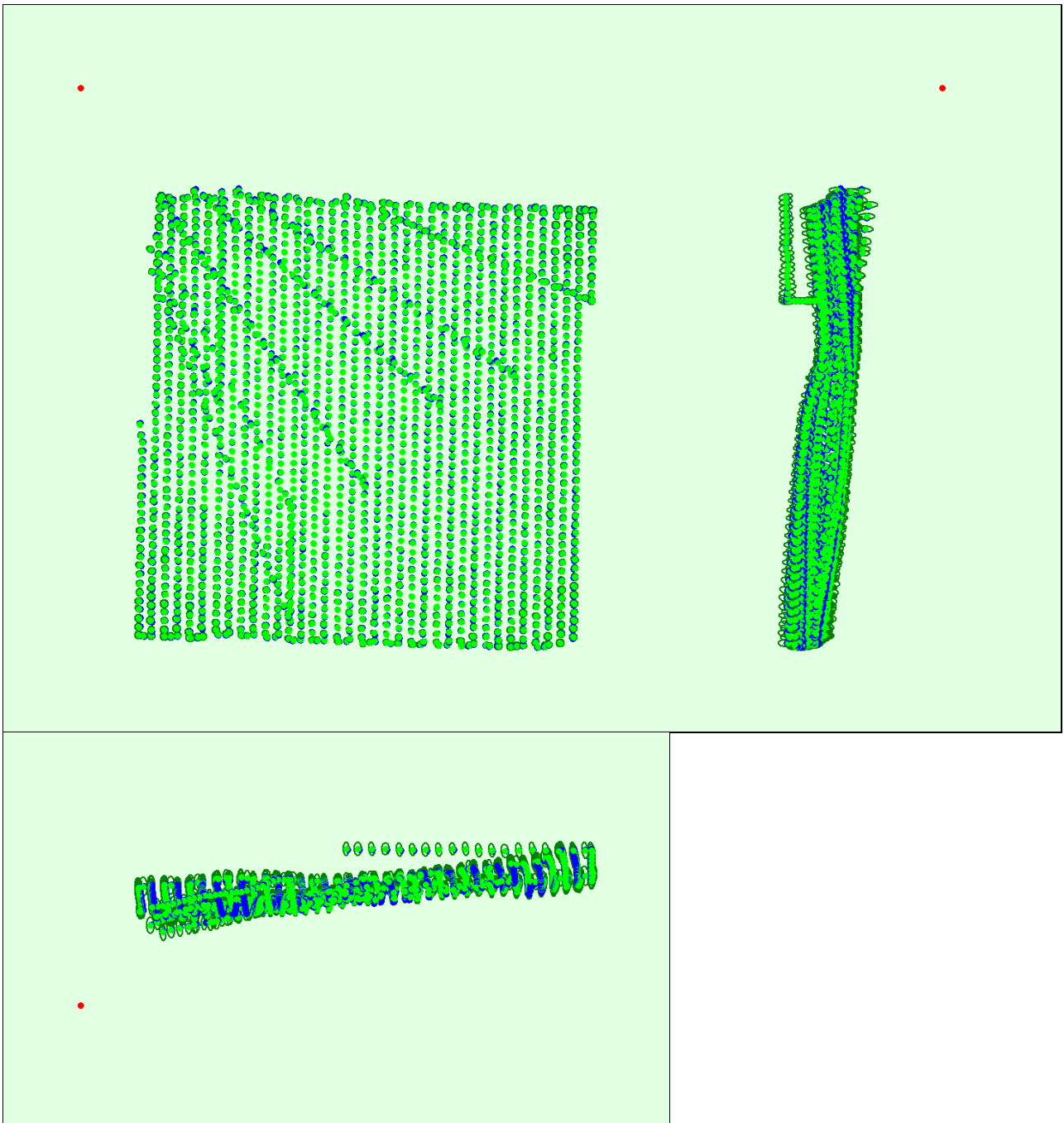| Number of Calibrated Images	10705 out of 10710
Number of Geolocated Images	10710 out of 10710

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.

⑦ Absolute camera position and orientation uncertainties ⓘ

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.073	0.073	0.167	0.034	0.034	0.013
Sigma	0.012	0.011	0.036	0.002	0.002	0.003

⑦ Overlap ⓘ

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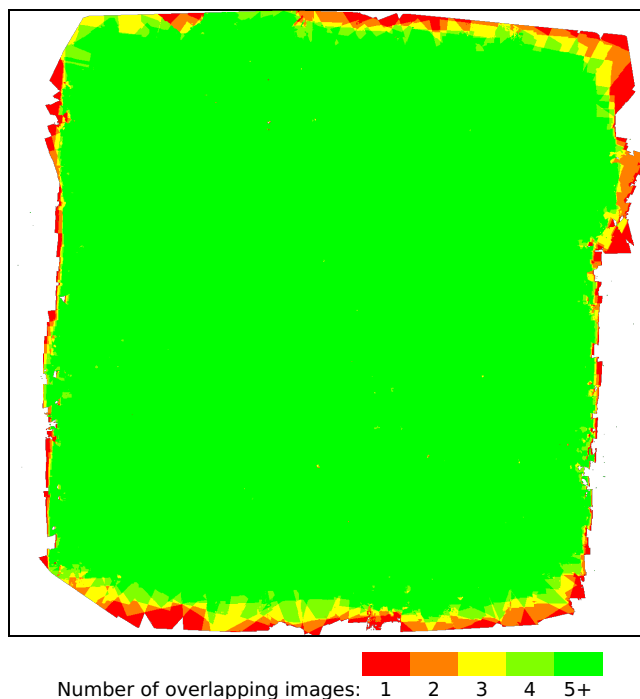
Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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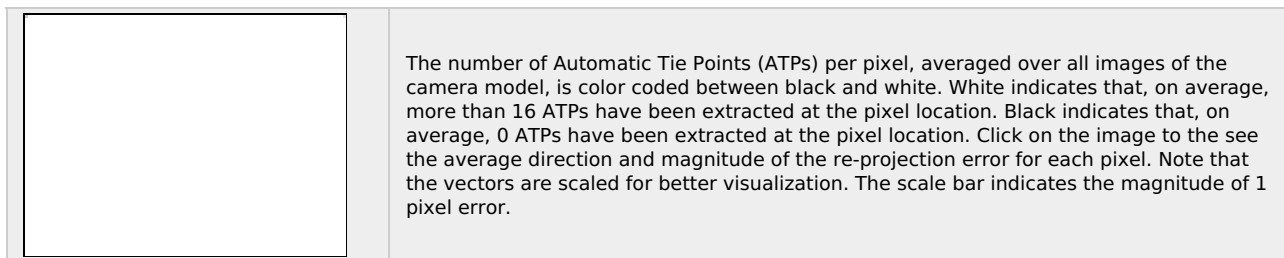
Bundle Block Adjustment Details

Number of 2D Keypoint Observations for Bundle Block Adjustment	20897980
Number of 3D Points for Bundle Block Adjustment	6068159
Mean Reprojection Error [pixels]	0.204

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	1446.893 [pixel] 5.426 [mm]	654.238 [pixel] 2.453 [mm]	494.550 [pixel] 1.855 [mm]	-0.099	0.174	-0.076	0.000	-0.000
Uncertainties (Sigma)	0.124 [pixel] 0.000 [mm]	0.085 [pixel] 0.000 [mm]	0.064 [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.
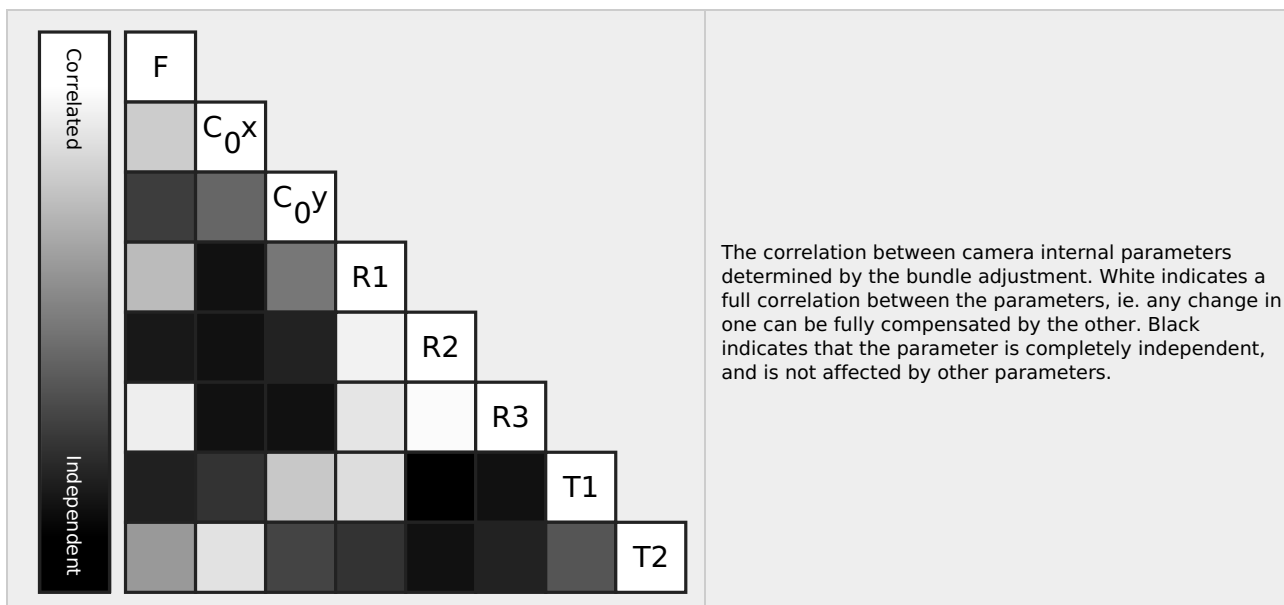
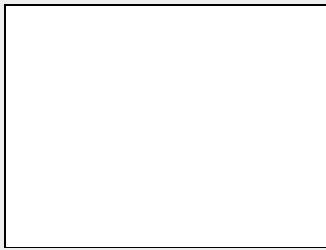## ⓘ Internal Camera Parameters

🗎 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	1443.751 [pixel] 5.414 [mm]	655.640 [pixel] 2.459 [mm]	481.505 [pixel] 1.806 [mm]	-0.100	0.156	-0.048	0.000	0.000
Uncertainties (Sigma)	0.120 [pixel] 0.000 [mm]	0.029 [pixel] 0.000 [mm]	0.024 [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.
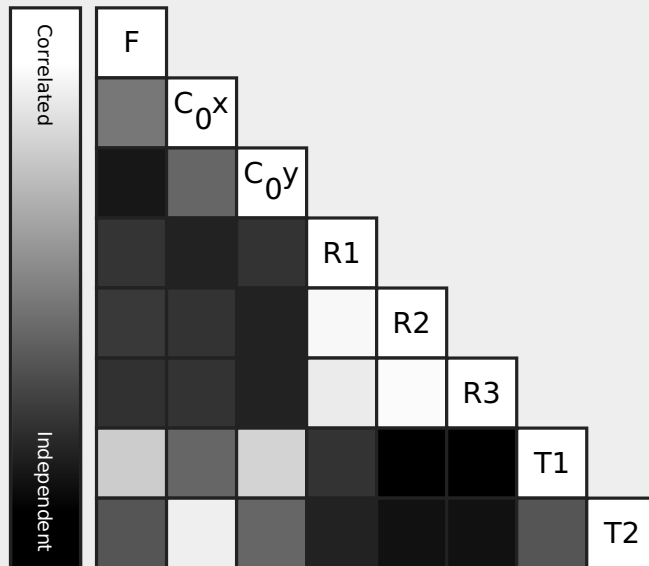
⑦ Internal Camera Parameters

☷ 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	1448.910 [pixel] 5.433 [mm]	653.740 [pixel] 2.452 [mm]	493.479 [pixel] 1.851 [mm]	-0.100	0.135	-0.008	-0.000	-0.000
Uncertainties (Sigma)	0.124 [pixel] 0.000 [mm]	0.088 [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.

⑦ Internal Camera Parameters

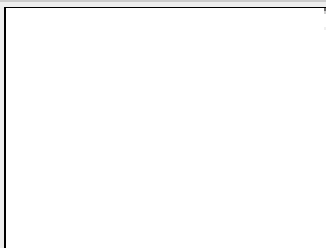### ☷ RedEdge_5.5_1280x960 (NIR). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]　ⓘ

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	1449.715 [pixel] 5.436 [mm]	662.015 [pixel] 2.483 [mm]	482.150 [pixel] 1.808 [mm]	-0.105	0.154	-0.041	0.000	-0.000
Uncertainties (Sigma)	0.126 [pixel] 0.000 [mm]	0.106 [pixel] 0.000 [mm]	0.079 [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.
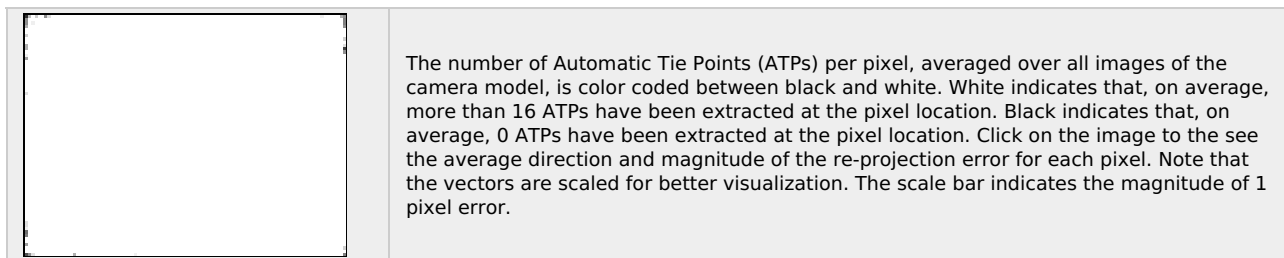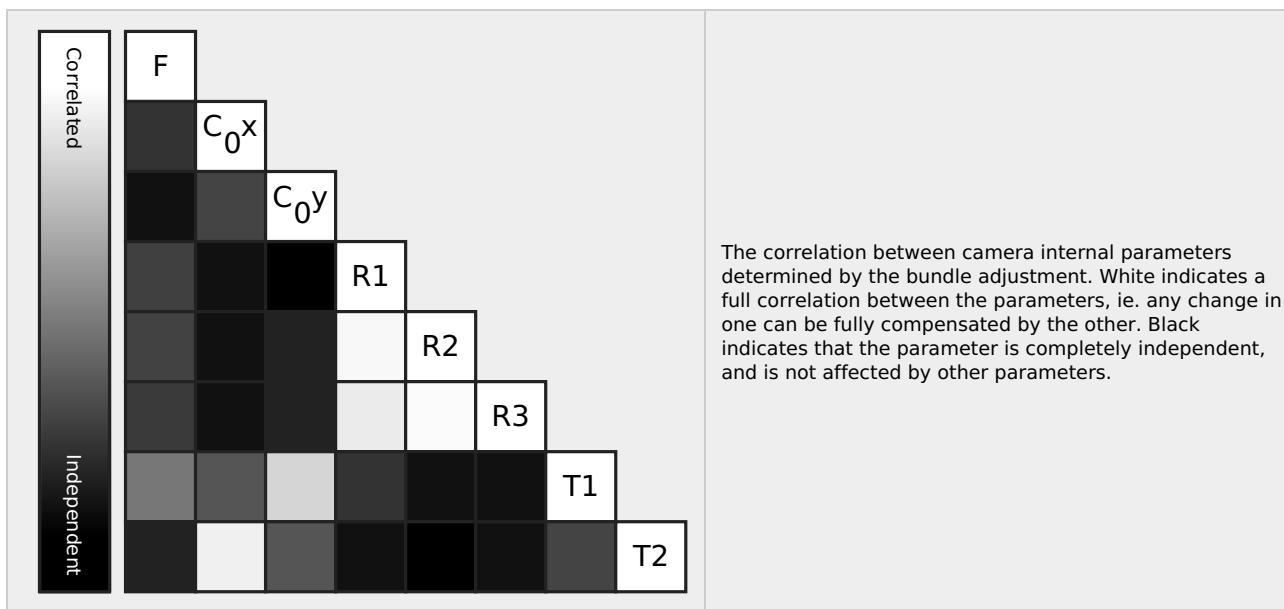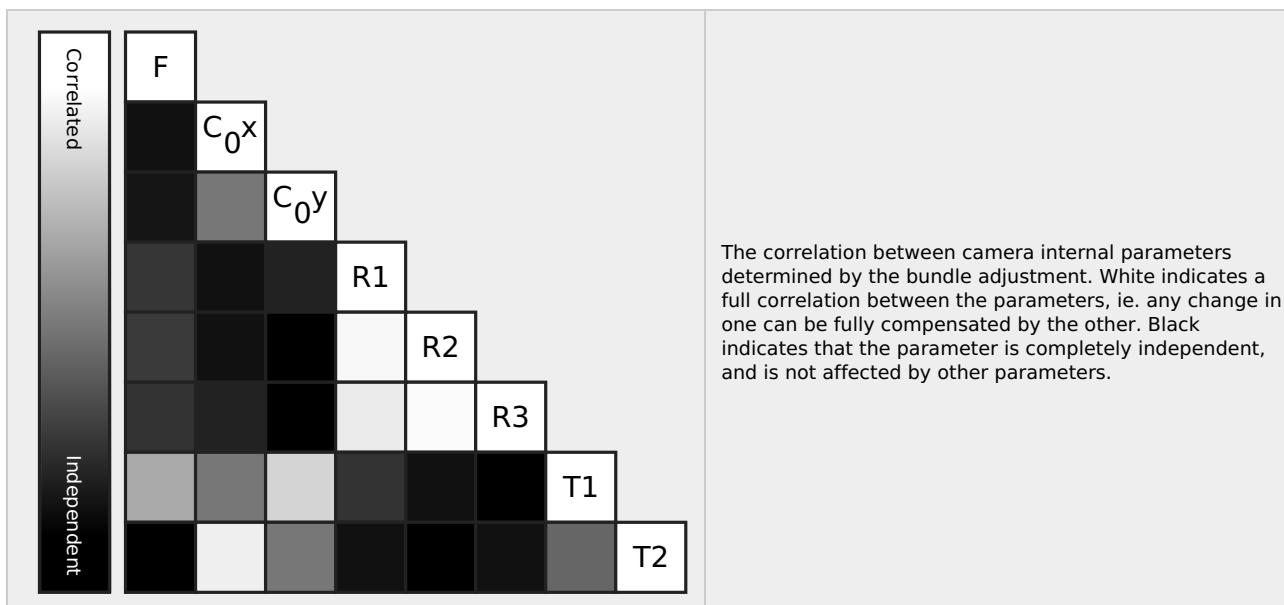
⑦ Internal Camera Parameters

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

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	1447.443 [pixel] 5.428 [mm]	657.871 [pixel] 2.467 [mm]	493.943 [pixel] 1.852 [mm]	-0.104	0.167	-0.077	0.000	-0.000
Uncertainties (Sigma)	0.124 [pixel] 0.000 [mm]	0.090 [pixel] 0.000 [mm]	0.068 [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.

Camera Rig «MicaSense 5 band» Relatives. Images: 10705

	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	-0.095	0.106	-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	0.062	0.078	-0.062
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	-0.133	-0.158	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	-0.055	-0.578	-0.321
Uncertainties (sigma)				0.003	0.004	0.000

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	31161	6484
Min	18137	1056
Max	40213	24864
Mean	30710	6964

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	28099	5161
Min	19651	1601
Max	36392	17635
Mean	27501	5828

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	31916	6941
Min	19617	1526
Max	40213	24864
Mean	31478	7431

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	28181	5284

Min	18267	1173
Max	35990	18946
Mean	27836	5950

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	28502	4512
Min	18137	1056
Max	35257	18806
Mean	28053	5173

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	32115	5554
Min	20365	1549
Max	38712	20775
Mean	31793	6247

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)	55 / 494 / 12386	45 / 250 / 10030	80 / 830 / 8691	44 / 355 / 2121	55 / 570 / 4999
RedEdge_5.5_1280x960 (Green)		57 / 300 / 17050	43 / 236 / 9567	21 / 109 / 4624	31 / 177 / 8516
RedEdge_5.5_1280x960 (Red)			58 / 578 / 13105	52 / 427 / 2532	63 / 685 / 6162
RedEdge_5.5_1280x960 (NIR)				37 / 491 / 14765	64 / 822 / 7051
RedEdge_5.5_1280x960 (Red edge)					47 / 568 / 14146

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	3649202
In 3 Images	1011624
In 4 Images	471657
In 5 Images	256450
In 6 Images	163019
In 7 Images	106072
In 8 Images	75736
In 9 Images	58275
In 10 Images	46570
In 11 Images	36854
In 12 Images	29627
In 13 Images	23547
In 14 Images	18980
In 15 Images	15844
In 16 Images	13090
In 17 Images	11278
In 18 Images	9662
In 19 Images	8313
In 20 Images	7253
In 21 Images	6006
In 22 Images	5183
In 23 Images	4691
In 24 Images	4145

In 25 Images	3690
In 26 Images	3322
In 27 Images	2990
In 28 Images	2573
In 29 Images	2350
In 30 Images	2120
In 31 Images	1953
In 32 Images	1584
In 33 Images	1473
In 34 Images	1284
In 35 Images	1151
In 36 Images	1059
In 37 Images	909
In 38 Images	834
In 39 Images	749
In 40 Images	707
In 41 Images	619
In 42 Images	587
In 43 Images	551
In 44 Images	456
In 45 Images	378
In 46 Images	343
In 47 Images	336
In 48 Images	321
In 49 Images	291
In 50 Images	273
In 51 Images	238
In 52 Images	219
In 53 Images	179
In 54 Images	148
In 55 Images	159
In 56 Images	113
In 57 Images	110
In 58 Images	96
In 59 Images	94
In 60 Images	78
In 61 Images	77
In 62 Images	51
In 63 Images	67
In 64 Images	52
In 65 Images	46
In 66 Images	50
In 67 Images	36
In 68 Images	32
In 69 Images	23
In 70 Images	42
In 71 Images	30
In 72 Images	28
In 73 Images	22
In 74 Images	17
In 75 Images	18
In 76 Images	22
In 77 Images	21
In 78 Images	18
In 79 Images	14
In 80 Images	15
In 81 Images	15
In 82 Images	9
In 83 Images	10

In 84 Images	9
In 85 Images	10
In 86 Images	7
In 87 Images	2
In 89 Images	1

2D Keypoint Matches

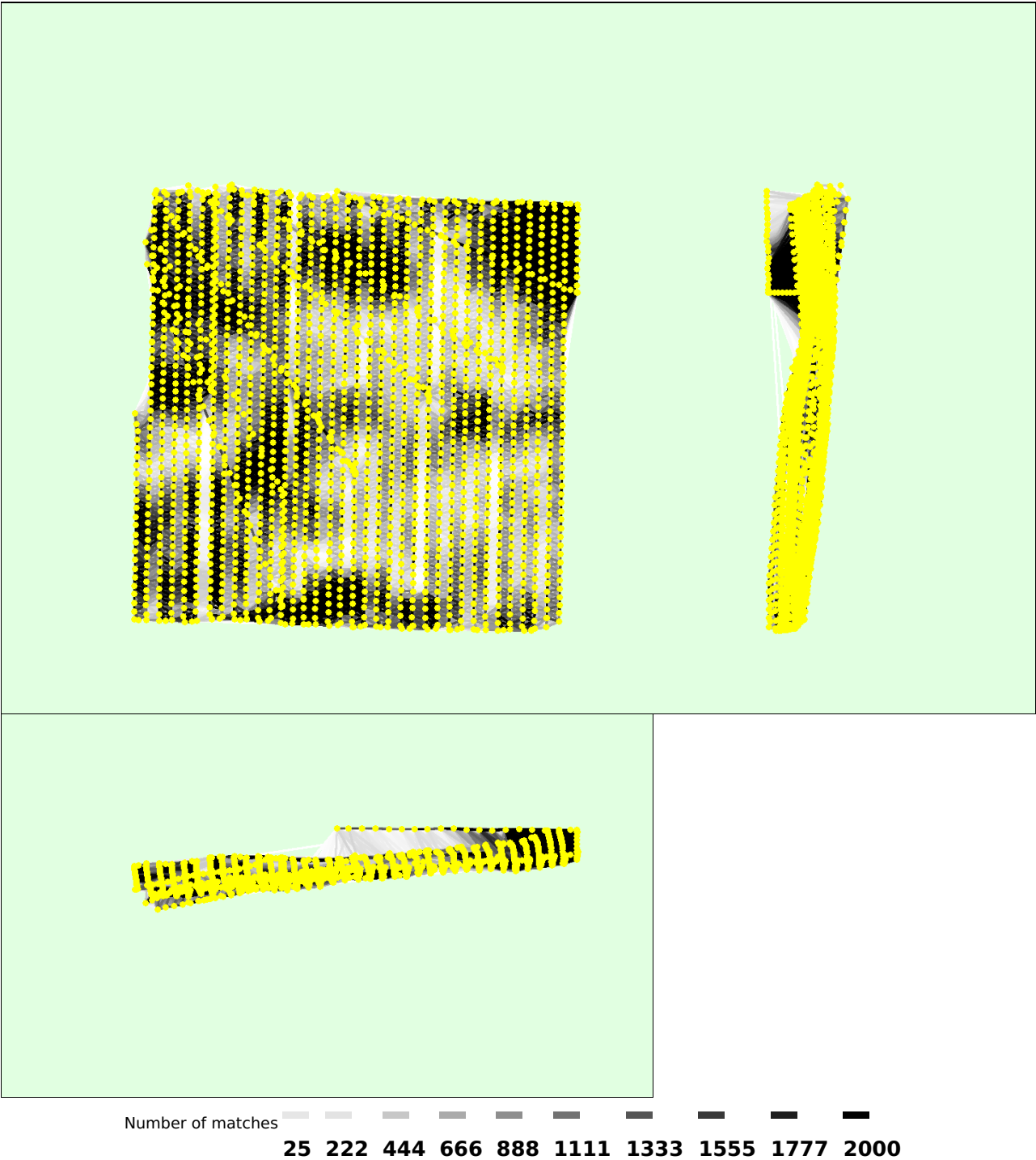| Number of matches	25	222	444	666	888	1111	1333	1555	1777	2000

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 ⓘ

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	0.05	0.00	7.33
-3.00	0.00	48.14	50.02	25.64
0.00	3.00	51.82	48.57	66.93
3.00	6.00	0.00	1.41	0.09
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]		0.000815	0.000496	0.004511
Sigma [m]		0.683838	1.309603	1.677124
RMS Error [m]		0.683838	1.309603	1.677130

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 ⓘ

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	99.95	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 ⓘ

System Information ⓘ

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 ⓘ

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

Processing Options ⓘ

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	09m:17s
Time for Point Cloud Classification	01m:05s
Time for 3D Textured Mesh Generation	10m:40s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	11607117
Average Density (per m^3)	6.05

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (7.72 [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 (7.72 [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	01h:05m:28s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	01h:17m:43s
Time for Index Map Generation	41s

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	✅