Quality Report

⚠ **Important**: Click on the different icons for:

② 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_3k_2_re
Processed	2019-01-24 02:06:49
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)	8.16 cm / 3.21 in
Area Covered	0.571 km^2 / 57.0731 ha / 0.22 sq. mi. / 141.1037 acres
Time for Initial Processing (without report)	06h:25m:14s

Quality Check

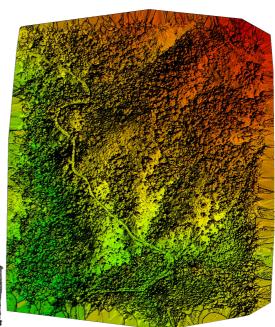|		
② **Images**	median of 7022 keypoints per image	⚠
② **Dataset**	10620 out of 10625 images calibrated (99%), 5 images disabled	✓
② **Camera Optimization**	1.38% relative difference between initial and optimized internal camera parameters	✓
② **Matching**	median of 2763.53 matches per calibrated image	✓
② **Georeferencing**	yes, no 3D GCP	⚠

② Preview

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

Calibration Details

Number of Calibrated Images	10620 out of 10630
Number of Geolocated Images	10625 out of 10630

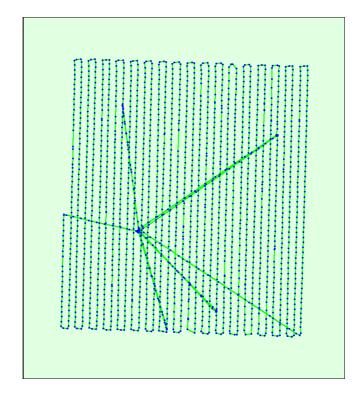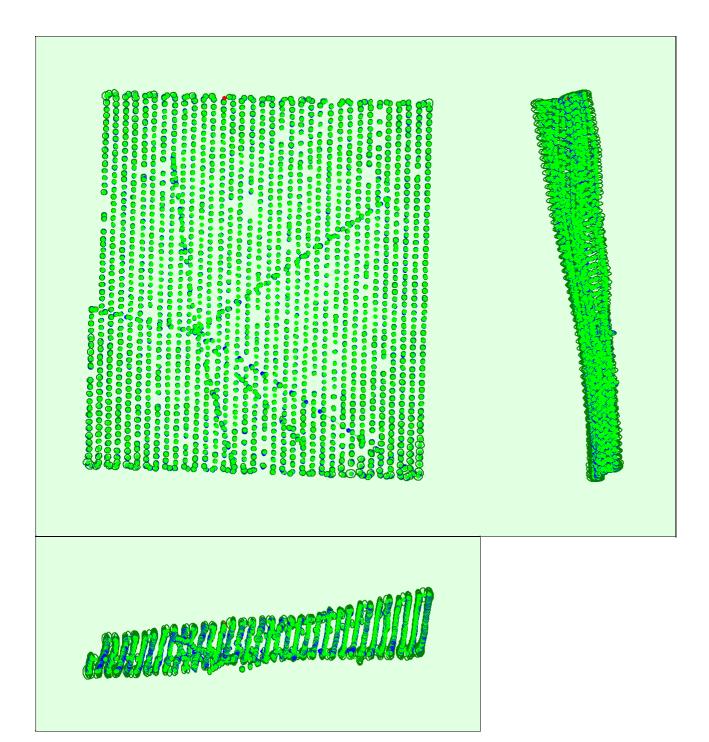### Initial Image Positions

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

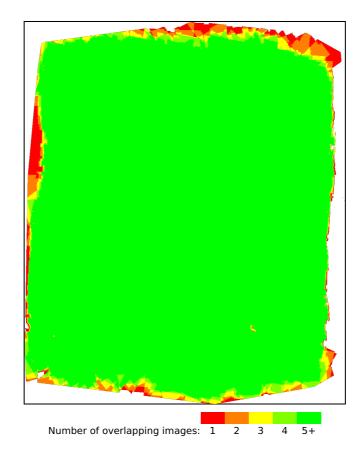|	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.076	0.078	0.153	0.038	0.038	0.014
Sigma	0.015	0.014	0.032	0.006	0.006	0.004

ⓘ Overlap

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

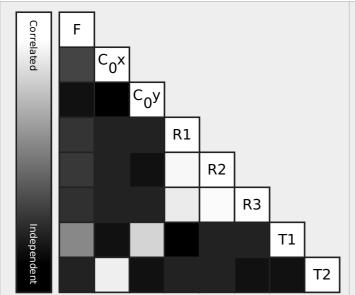|	
Number of 2D Keypoint Observations for Bundle Block Adjustment	8441853
Number of 3D Points for Bundle Block Adjustment	2367767
Mean Reprojection Error [pixels]	0.180

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	1446.108 [pixel] 5.423 [mm]	653.934 [pixel] 2.452 [mm]	494.994 [pixel] 1.856 [mm]	-0.096	0.142	-0.012	0.000	-0.000
Uncertainties (Sigma)	0.233 [pixel] 0.001 [mm]	0.159 [pixel] 0.001 [mm]	0.120 [pixel] 0.000 [mm]	0.001	0.008	0.017	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.
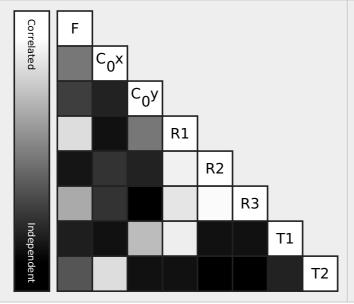

The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the 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	1443.038 [pixel] 5.411 [mm]	655.966 [pixel] 2.460 [mm]	481.314 [pixel] 1.805 [mm]	-0.098	0.131	0.008	0.000	0.000
Uncertainties (Sigma)	0.225 [pixel] 0.001 [mm]	0.050 [pixel] 0.000 [mm]	0.040 [pixel] 0.000 [mm]	0.000	0.002	0.005	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	1447.908 [pixel] 5.430 [mm]	653.248 [pixel] 2.450 [mm]	494.197 [pixel] 1.853 [mm]	-0.096	0.106	0.050	-0.000	-0.000
Uncertainties (Sigma)	0.234 [pixel] 0.001 [mm]	0.164 [pixel] 0.001 [mm]	0.124 [pixel] 0.000 [mm]	0.001	0.008	0.018	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.
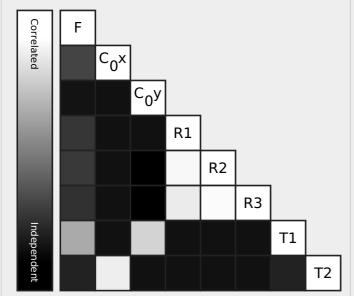
Internal Camera Parameters

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	1448.470 [pixel] 5.432 [mm]	661.737 [pixel] 2.482 [mm]	483.018 [pixel] 1.811 [mm]	-0.099	0.110	0.045	0.000	-0.000
Uncertainties (Sigma)	0.235 [pixel] 0.001 [mm]	0.171 [pixel] 0.001 [mm]	0.129 [pixel] 0.000 [mm]	0.001	0.008	0.019	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.
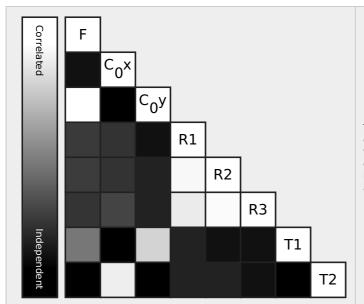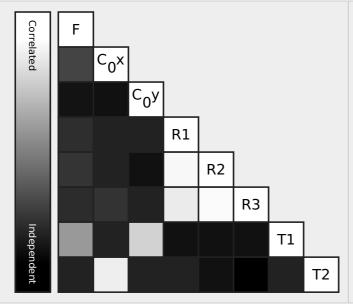
Internal Camera Parameters

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	1446.273 [pixel] 5.424 [mm]	657.109 [pixel] 2.464 [mm]	494.942 [pixel] 1.856 [mm]	-0.098	0.123	0.017	0.000	-0.000
Uncertainties (Sigma)	0.232 [pixel] 0.001 [mm]	0.146 [pixel] 0.001 [mm]	0.111 [pixel] 0.000 [mm]	0.001	0.007	0.016	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.

Camera Rig «MicaSense 5 band» Relatives. Images: 10625

	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	-0.101	0.087	-0.374
Uncertainties (sigma)				0.005	0.007	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	0.041	0.061	-0.063
Uncertainties (sigma)				0.005	0.007	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	-0.164	-0.179	0.120
Uncertainties (sigma)				0.005	0.007	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	-0.089	-0.604	-0.321
Uncertainties (sigma)				0.005	0.006	0.000

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7022	2764
Min	5537	322
Max	9523	6303
Mean	7116	2829

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6625	2242
Min	5699	402
Max	8627	5026
Mean	6691	2256

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6888	2834
Min	5537	575
Max	9300	5761
Mean	7019	2938

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6892	2281

Min	5787	390
Max	8967	4984
Mean	6959	2269

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7874	2859
Min	6873	322
Max	9523	6189
Mean	7950	2833

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	7772	2841
Min	6628	477
Max	9413	6303
Mean	7811	2879

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)	31 / 214 / 3635	21 / 79 / 2537	41 / 273 / 3081	20 / 101 / 1544	23 / 139 / 2027
RedEdge_5.5_1280x960 (Green)		32 / 131 / 4901	20 / 74 / 2301	14 / 58 / 2358	21 / 85 / 3129
RedEdge_5.5_1280x960 (Red)			38 / 254 / 3827	20 / 101 / 1453	25 / 139 / 1926
RedEdge_5.5_1280x960 (NIR)				38 / 313 / 4693	36 / 254 / 3464
RedEdge_5.5_1280x960 (Red edge)					29 / 225 / 4144

❓ 3D Points from 2D Keypoint Matches ⓘ

	Number of 3D Points Observed
In 2 Images	1360796
In 3 Images	413756
In 4 Images	198947
In 5 Images	108421
In 6 Images	68649
In 7 Images	45883
In 8 Images	32801
In 9 Images	24319
In 10 Images	18961
In 11 Images	15033
In 12 Images	11992
In 13 Images	9559
In 14 Images	7991
In 15 Images	6545
In 16 Images	5487
In 17 Images	4559
In 18 Images	3836
In 19 Images	3374
In 20 Images	2979
In 21 Images	2497
In 22 Images	2132
In 23 Images	1967
In 24 Images	1698

In 25 Images	1430
In 26 Images	1339
In 27 Images	1190
In 28 Images	1068
In 29 Images	965
In 30 Images	857
In 31 Images	806
In 32 Images	730
In 33 Images	687
In 34 Images	575
In 35 Images	531
In 36 Images	470
In 37 Images	422
In 38 Images	400
In 39 Images	398
In 40 Images	366
In 41 Images	280
In 42 Images	279
In 43 Images	246
In 44 Images	224
In 45 Images	186
In 46 Images	194
In 47 Images	159
In 48 Images	143
In 49 Images	117
In 50 Images	131
In 51 Images	104
In 52 Images	100
In 53 Images	97
In 54 Images	87
In 55 Images	80
In 56 Images	80
In 57 Images	75
In 58 Images	63
In 59 Images	45
In 60 Images	43
In 61 Images	41
In 62 Images	50
In 63 Images	45
In 64 Images	21
In 65 Images	29
In 66 Images	26
In 67 Images	23
In 68 Images	22
In 69 Images	25
In 70 Images	33
In 71 Images	22
In 72 Images	17
In 73 Images	23
In 74 Images	15
In 75 Images	19
In 76 Images	8
In 77 Images	7
In 78 Images	17
In 79 Images	7
In 80 Images	12
In 81 Images	9
In 82 Images	5
In 83 Images	11

In 84 Images	8	
In 85 Images	1	
In 86 Images	9	
In 87 Images	7	
In 88 Images	3	
In 89 Images	2	
In 90 Images	7	
In 91 Images	5	
In 92 Images	8	
In 93 Images	5	
In 94 Images	1	
In 95 Images	5	
In 96 Images	3	
In 97 Images	1	
In 98 Images	4	
In 99 Images	1	
In 100 Images	4	
In 101 Images	2	
In 102 Images	2	
In 103 Images	1	
In 104 Images	2	
In 106 Images	3	
In 107 Images	1	
In 108 Images	1	
In 109 Images	2	
In 110 Images	3	
In 111 Images	1	
In 112 Images	3	
In 113 Images	1	
In 114 Images	4	
In 115 Images	1	
In 116 Images	4	
In 117 Images	2	
In 118 Images	2	
In 119 Images	1	
In 121 Images	2	
In 122 Images	1	
In 123 Images	2	
In 124 Images	3	
In 125 Images	1	
In 126 Images	1	
In 128 Images	1	
In 129 Images	1	
In 131 Images	1	
In 132 Images	1	
In 133 Images	1	
In 137 Images	1	
In 138 Images	1	
In 139 Images	1	
In 143 Images	2	
In 144 Images	1	

❓ 2D Keypoint Matches

Number of matches

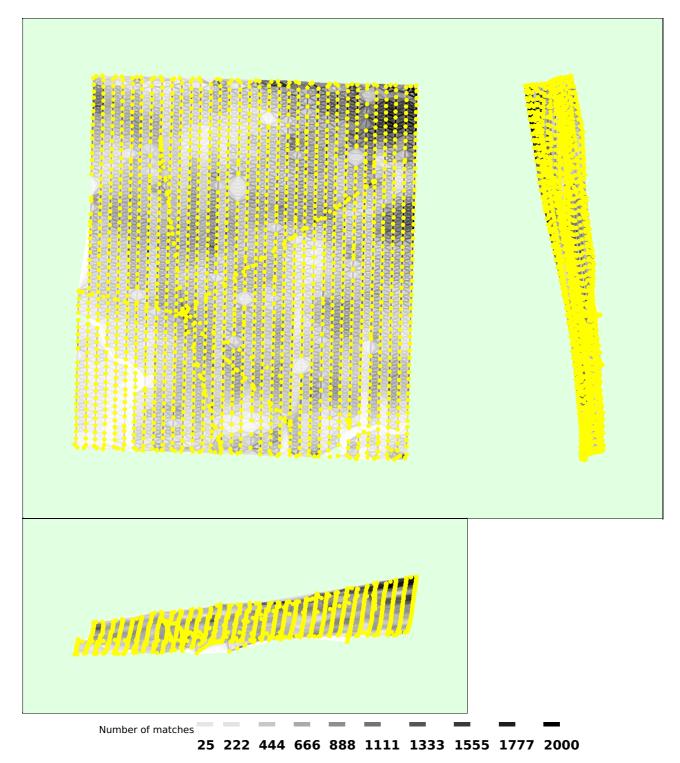|									
25	222	444	666	888	1111	1333	1555	1777	2000

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	0.01	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	0.09	0.00	0.00

-3.00	0.00	49.00	46.61	47.48
0.00	3.00	50.90	53.14	52.51
3.00	6.00	0.00	0.25	0.00
6.00	9.00	0.00	0.00	0.00
9.00	12.00	0.00	0.00	0.01
12.00	15.00	0.00	0.00	0.00
15.00	-	0.00	0.01	0.00
Mean [m]		0.010555	-0.007990	-0.003748
Sigma [m]		0.583198	0.752441	0.560825
RMS Error [m]		0.583294	0.752483	0.560838

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]	99.99	99.99	100.00
[-2.00, 2.00]	99.99	99.99	100.00
[-3.00, 3.00]	99.99	99.99	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: 1
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:11s
Time for Point Cloud Classification	01m:01s
Time for 3D Textured Mesh Generation	10m:14s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	11170348
Average Density (per m^3)	6.31

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (8.16 [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 (8.16 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Index Calculator: Index Values	Polygon Shapefile [cm/grid]: 400
Time for DSM Generation	48s
Time for Orthomosaic Generation	42m:24s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	52m:32s
Time for Index Map Generation	40s

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 | ✓ |