

# Quality Report



Generated with Pix4Denterprise version 4.3.31

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

**?** Help to analyze the results in the Quality Report

**i** Additional information about the sections

**💡** Click [here](#) for additional tips to analyze the Quality Report

## Summary



Project	eldo_4k_2
Processed	2019-01-08 07:46:34
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), FC350_3.6_4000x3000 (RGB)
Rig name(s)	«MicaSense 5 band_merge_eldo_4k_2_re»
Average Ground Sampling Distance (GSD)	7.74 cm / 3.05 in
Area Covered	0.000 km <sup>2</sup> / 0.0000 ha / 0.00 sq. mi. / 0.0001 acres
Time for Initial Processing (without report)	2d:10h:22m:52s

## Quality Check



<b>?</b> <b>Images</b>	median of 7157 keypoints per image	<b>⚠</b>
<b>?</b> <b>Dataset</b>	12352 out of 12357 images calibrated (99%), 25 images disabled	<b>✓</b>
<b>?</b> <b>Camera Optimization</b>	0.97% relative difference between initial and optimized internal camera parameters	<b>✓</b>
<b>?</b> <b>Matching</b>	median of 3554.39 matches per calibrated image	<b>✓</b>
<b>?</b> <b>Georeferencing</b>	yes, no 3D GCP	<b>⚠</b>

## Preview



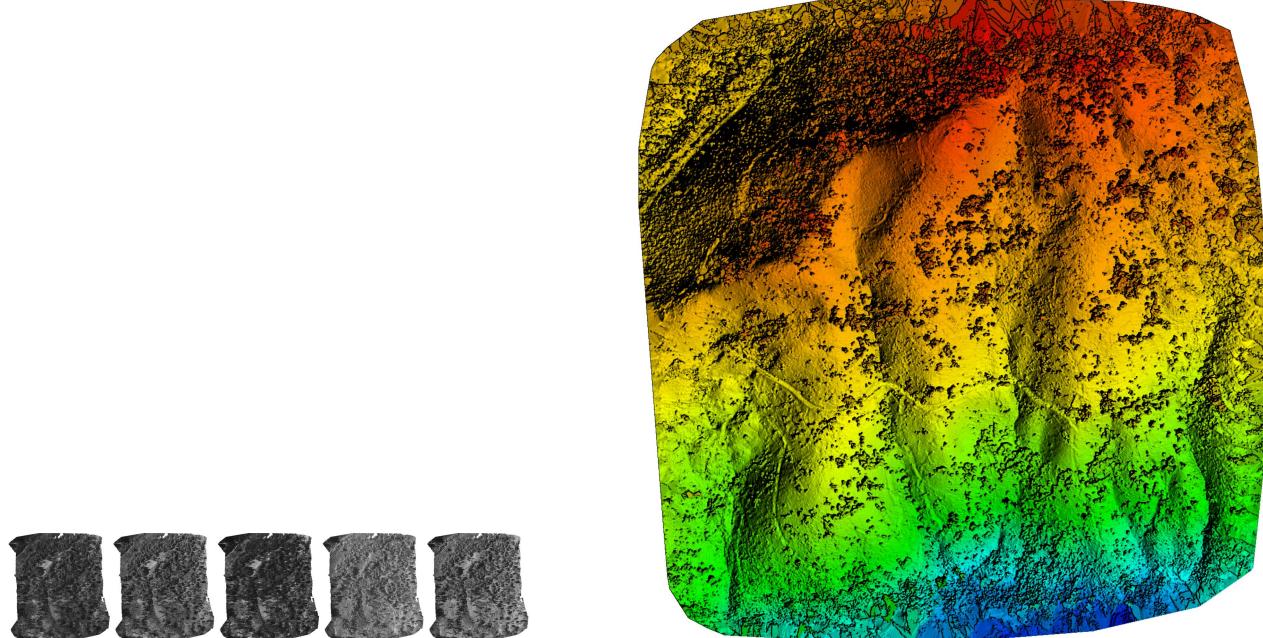


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

## Calibration Details



Number of Calibrated Images	12352 out of 12382
Number of Geolocated Images	12382 out of 12382

### Initial Image Positions

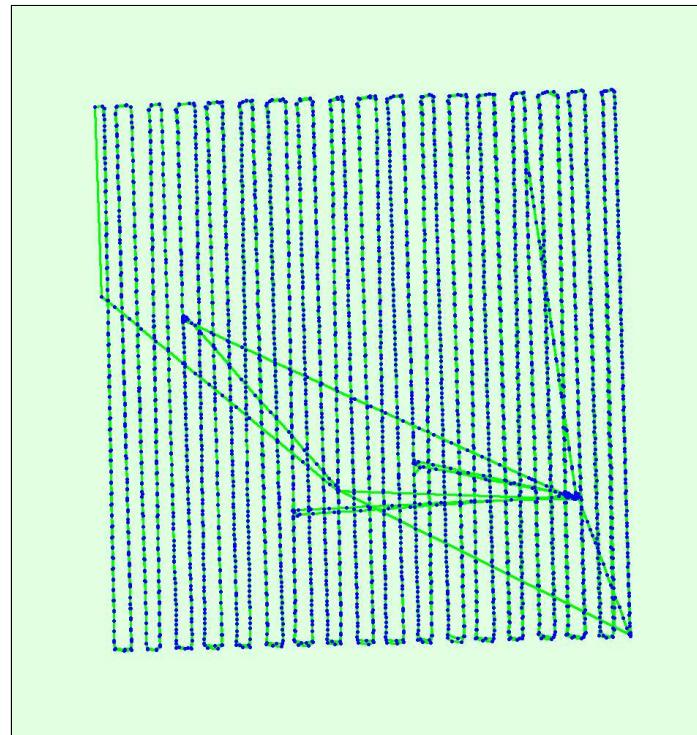
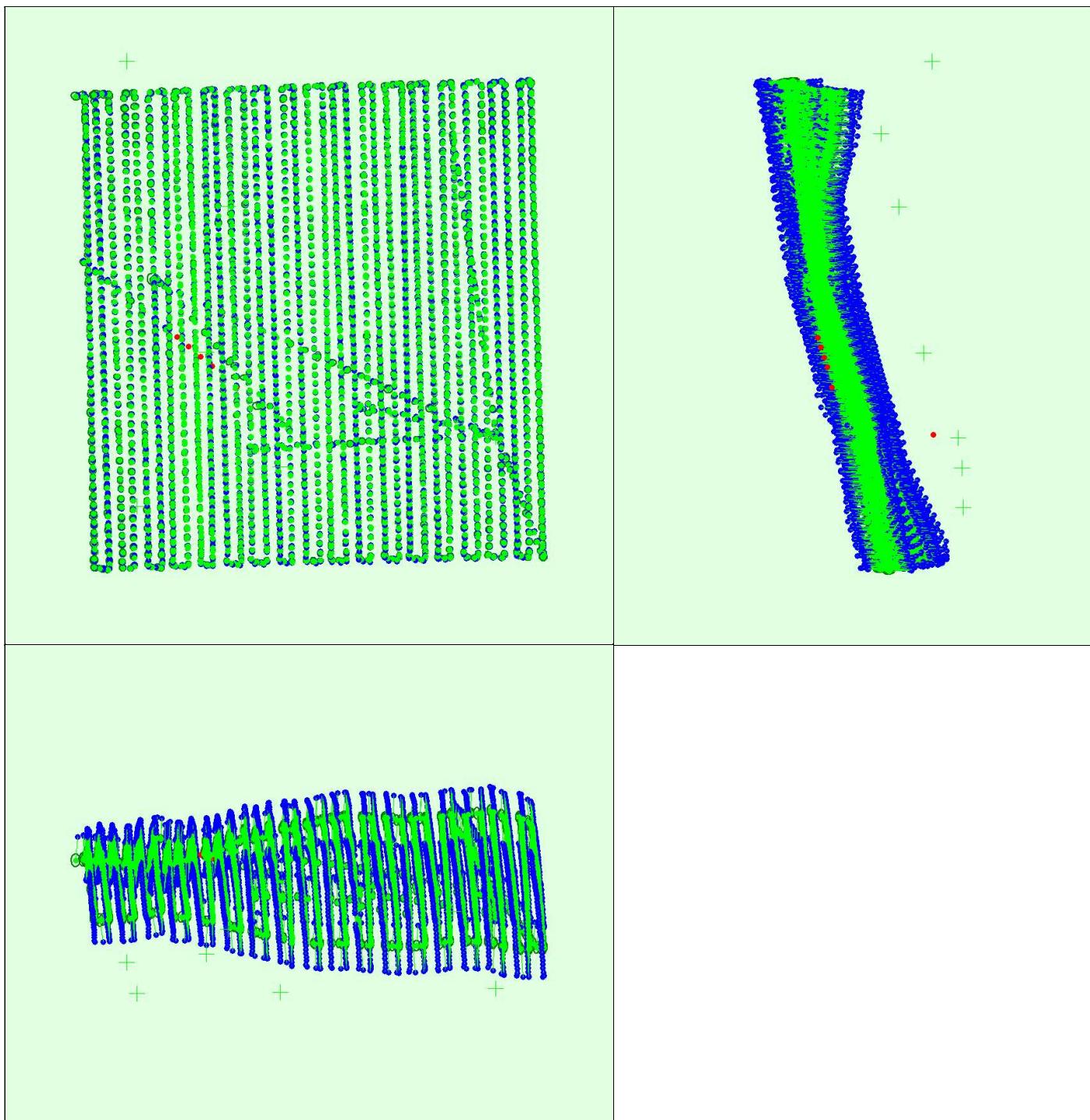


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

### Computed Image/GCPs/Manual Tie Points Positions





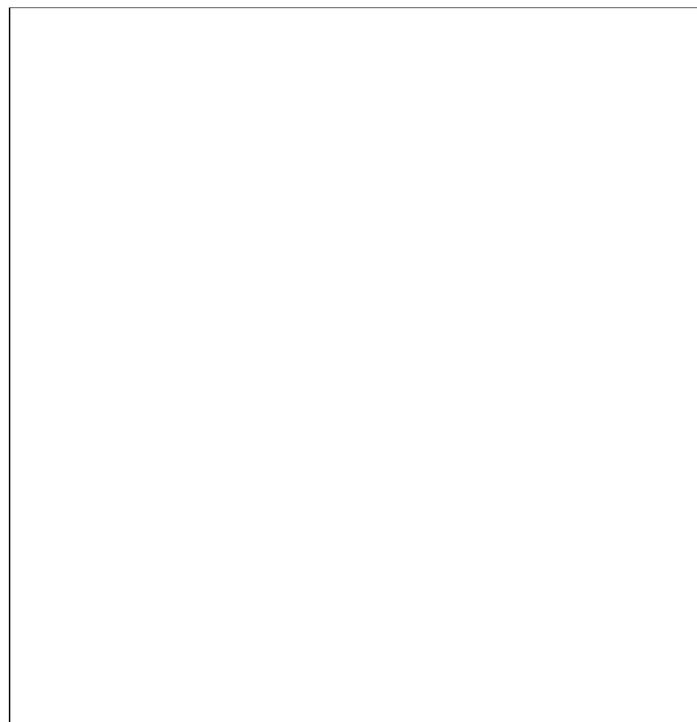
Uncertainty ellipses 50x magnified

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	0.060	0.062	0.109	0.025	0.024	0.011
Sigma	0.011	0.012	0.019	0.006	0.005	0.003

 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	21747198
Number of 3D Points for Bundle Block Adjustment	5871475
Mean Reprojection Error [pixels]	0.172

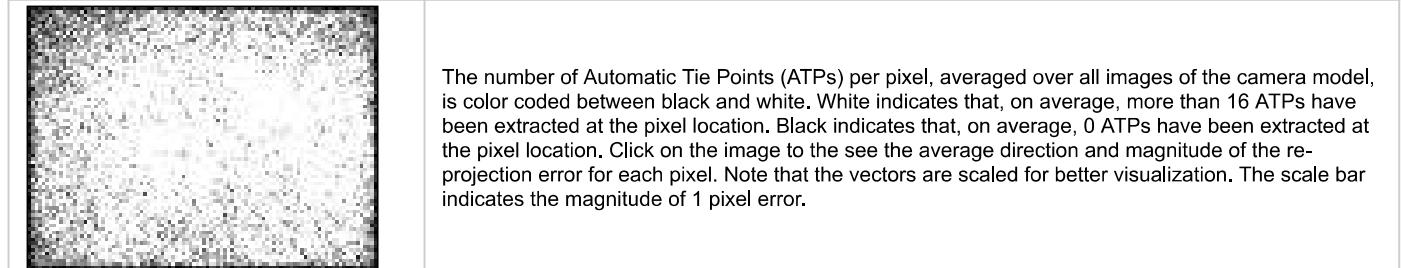
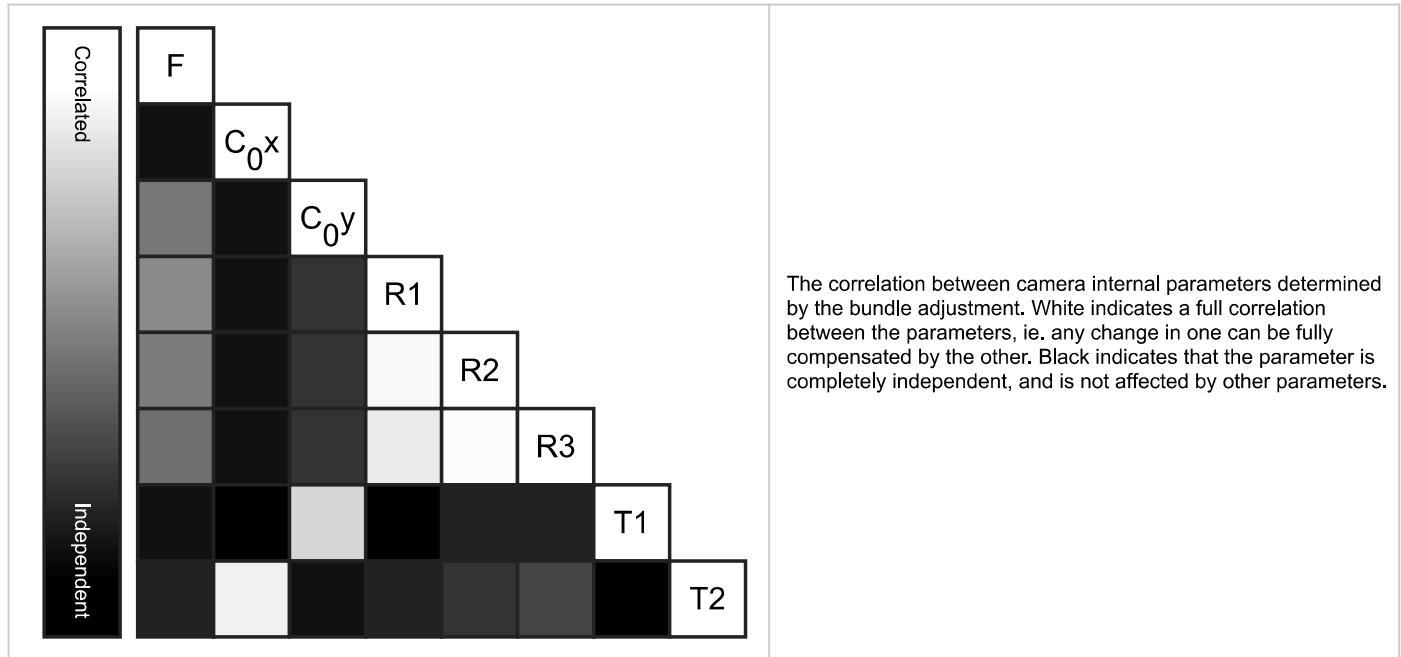
## Internal Camera Parameters

### 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	1449.587 [pixel] 5.436 [mm]	653.769 [pixel] 2.452 [mm]	495.196 [pixel] 1.857 [mm]	-0.100	0.204	-0.175	0.000	-0.001
Uncertainties (Sigma)	0.155 [pixel] 0.001 [mm]	0.235 [pixel] 0.001 [mm]	0.175 [pixel] 0.001 [mm]	0.002	0.012	0.026	0.000	0.000



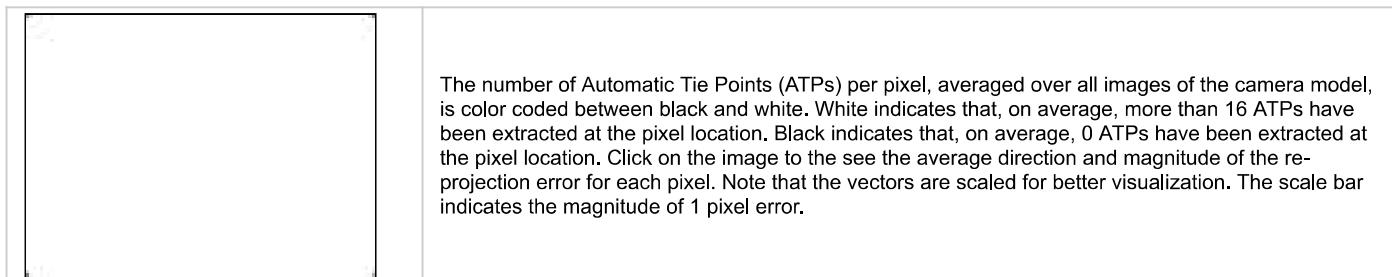
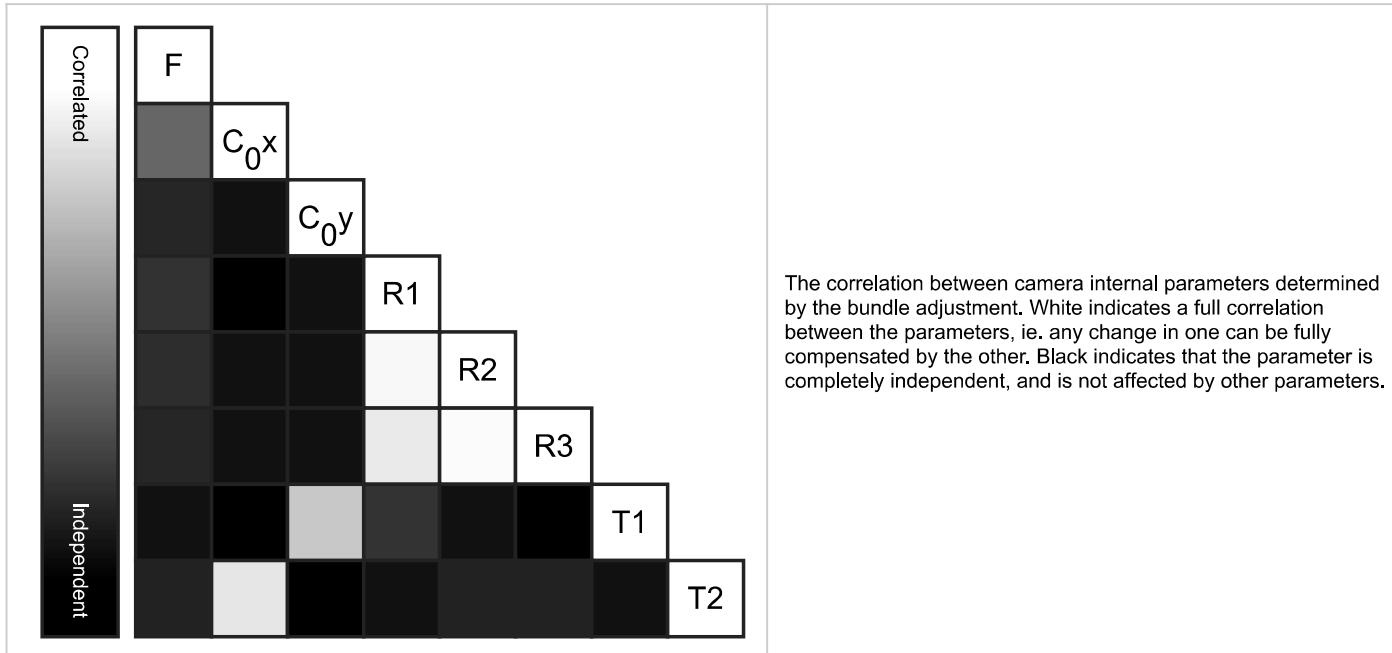
## Internal Camera Parameters

### 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	1446.313 [pixel] 5.424 [mm]	655.910 [pixel] 2.460 [mm]	481.056 [pixel] 1.804 [mm]	-0.098	0.167	-0.090	0.000	0.000
Uncertainties (Sigma)	0.129 [pixel] 0.000 [mm]	0.068 [pixel] 0.000 [mm]	0.053 [pixel] 0.000 [mm]	0.000	0.003	0.007	0.000	0.000



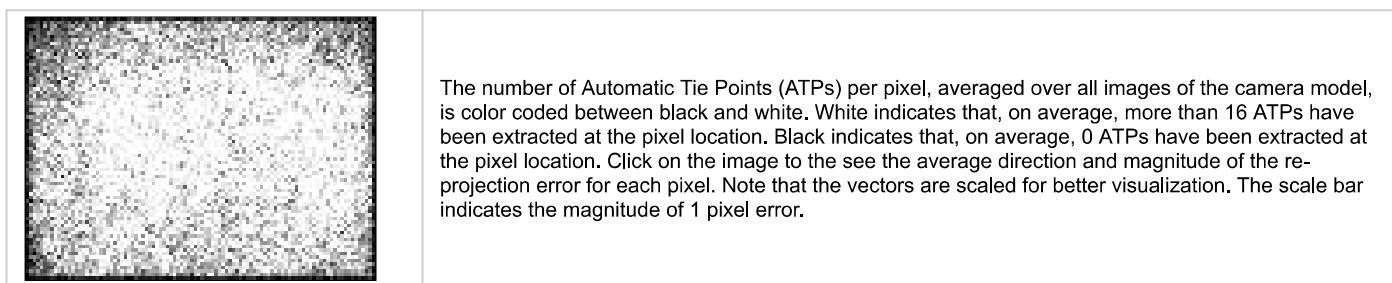
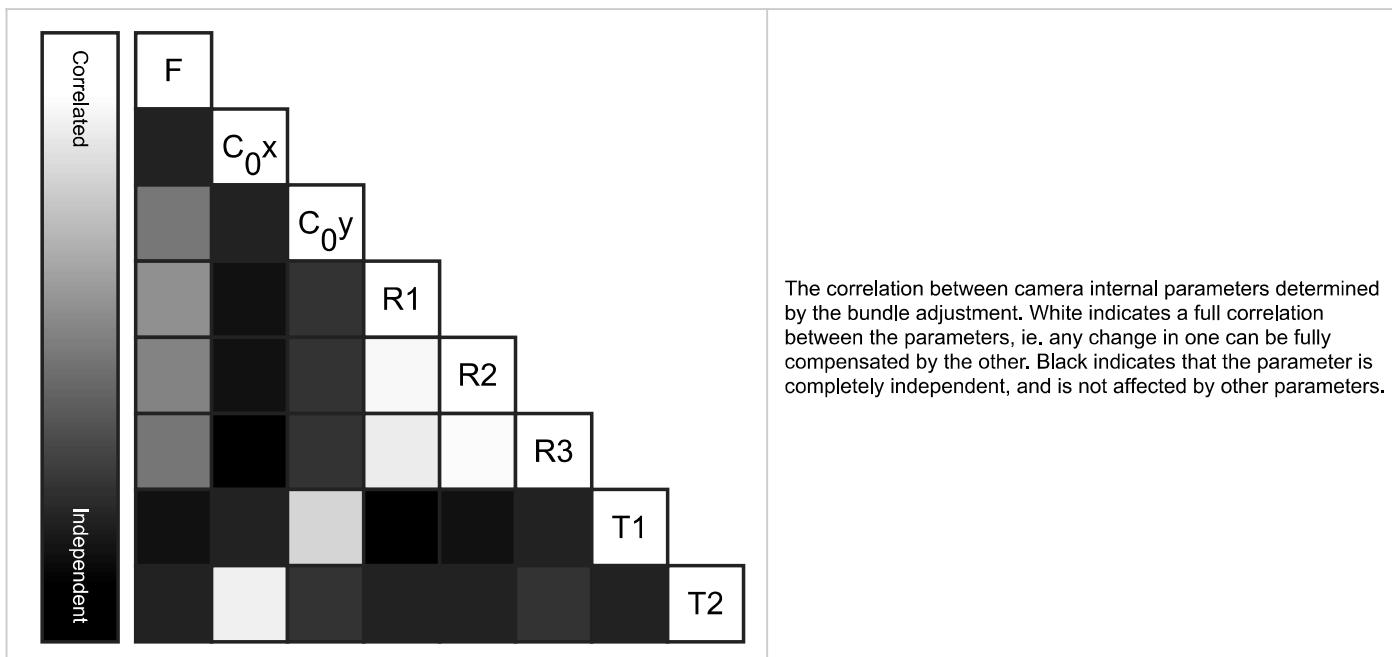
## ⓘ Internal Camera Parameters

📄 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	1451.405 [pixel] 5.443 [mm]	652.994 [pixel] 2.449 [mm]	493.872 [pixel] 1.852 [mm]	-0.100	0.165	-0.104	-0.000	-0.000
Uncertainties (Sigma)	0.160 [pixel] 0.001 [mm]	0.257 [pixel] 0.001 [mm]	0.191 [pixel] 0.001 [mm]	0.002	0.013	0.030	0.000	0.000



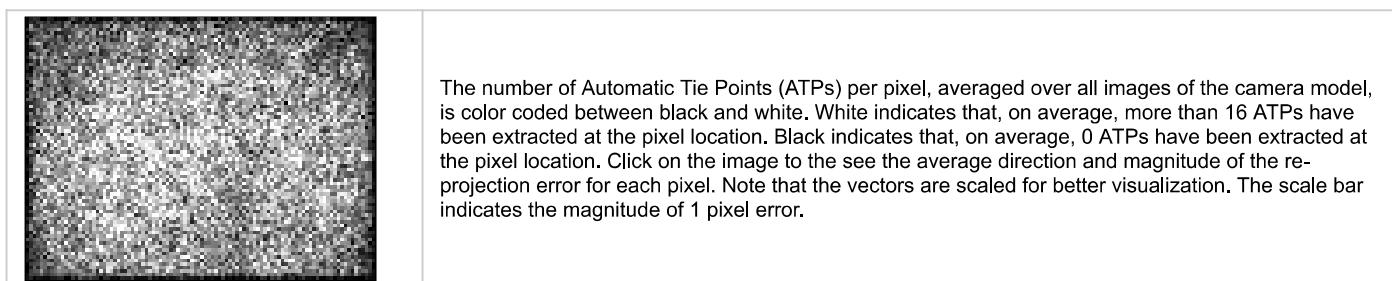
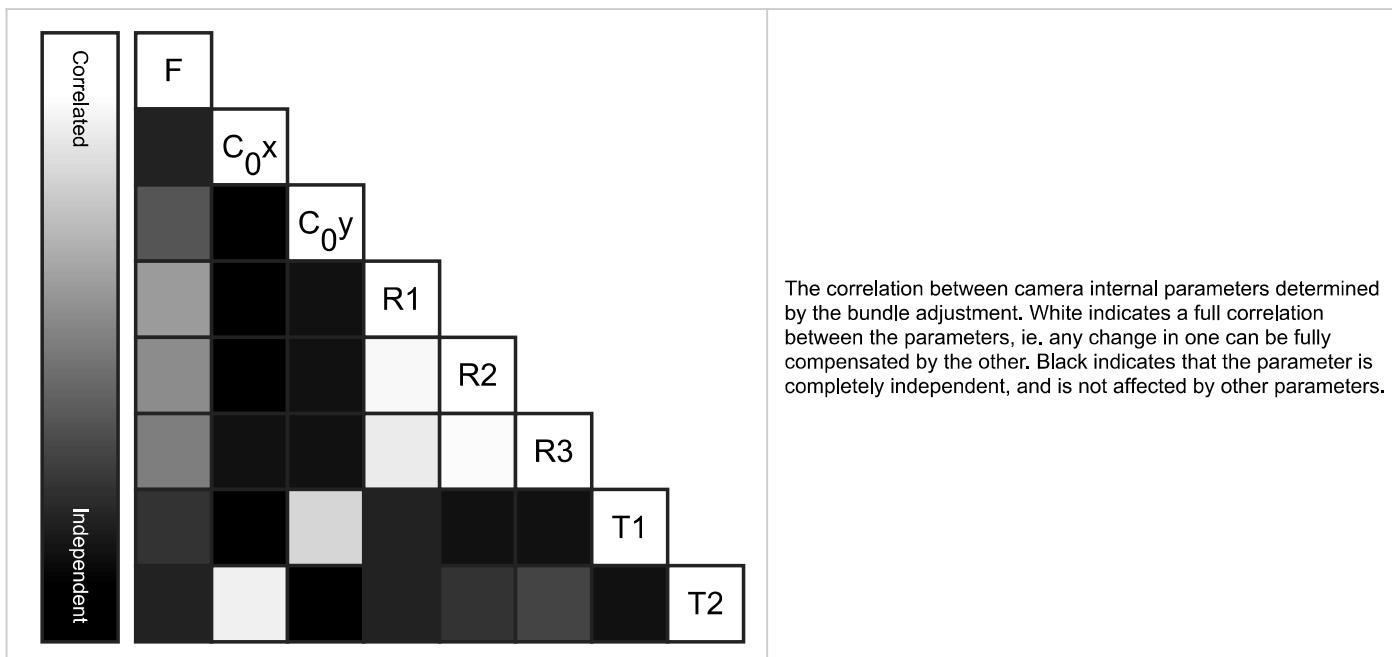
## Internal Camera Parameters

### 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	1451.982 [pixel] 5.445 [mm]	661.202 [pixel] 2.480 [mm]	481.795 [pixel] 1.807 [mm]	-0.103	0.175	-0.109	-0.000	-0.001
Uncertainties (Sigma)	0.168 [pixel] 0.001 [mm]	0.288 [pixel] 0.001 [mm]	0.217 [pixel] 0.001 [mm]	0.002	0.014	0.032	0.000	0.000



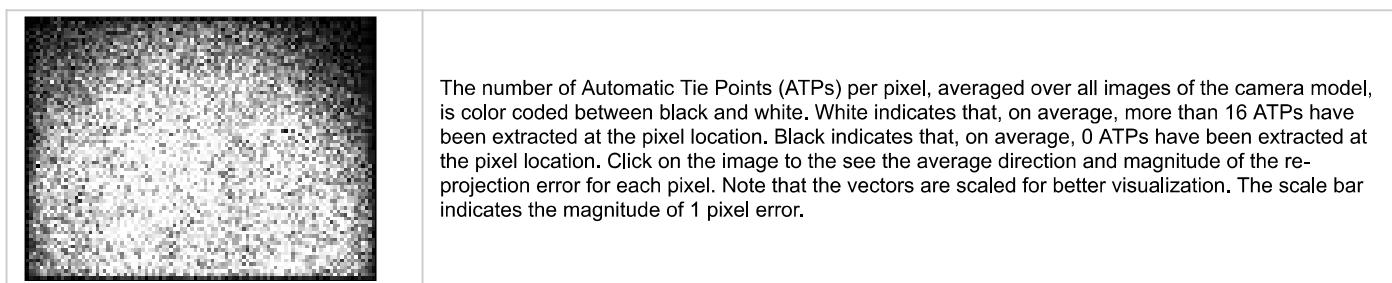
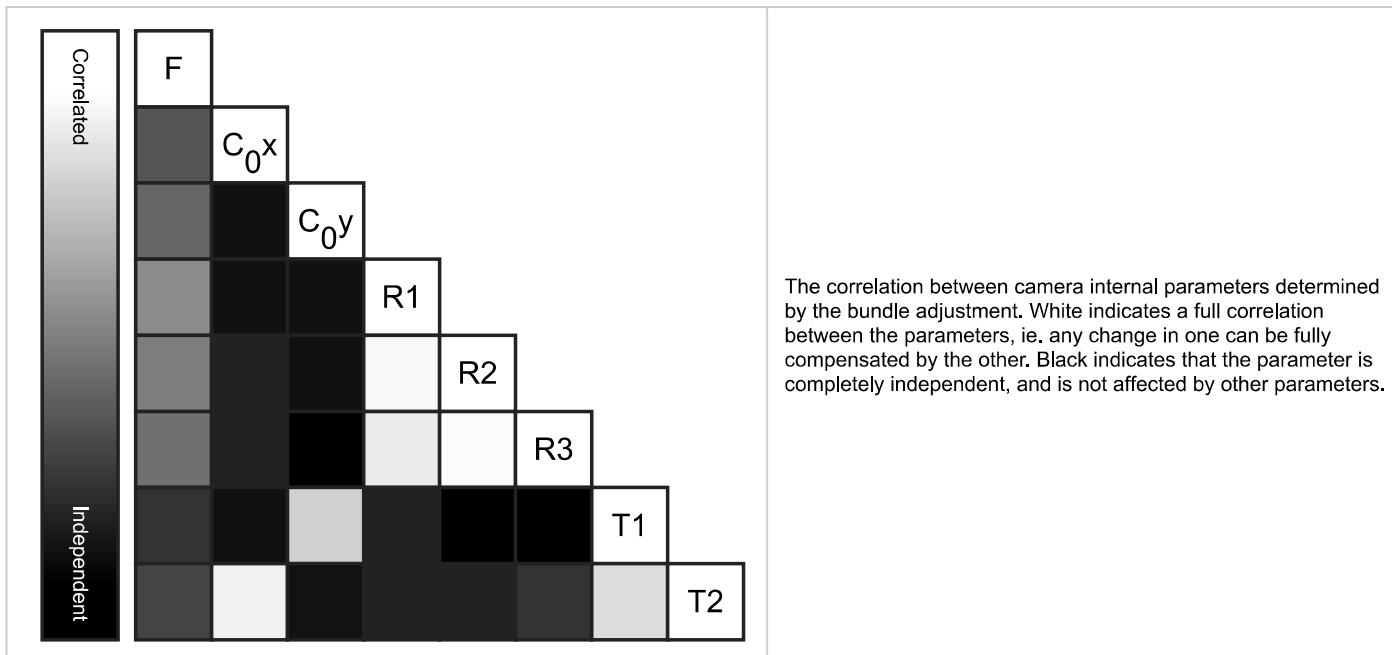
## Internal Camera Parameters

### 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	1449.785 [pixel] 5.437 [mm]	653.178 [pixel] 2.449 [mm]	492.832 [pixel] 1.848 [mm]	-0.105	0.202	-0.175	-0.000	-0.001
Uncertainties (Sigma)	0.156 [pixel] 0.001 [mm]	0.268 [pixel] 0.001 [mm]	0.198 [pixel] 0.001 [mm]	0.002	0.013	0.032	0.000	0.000



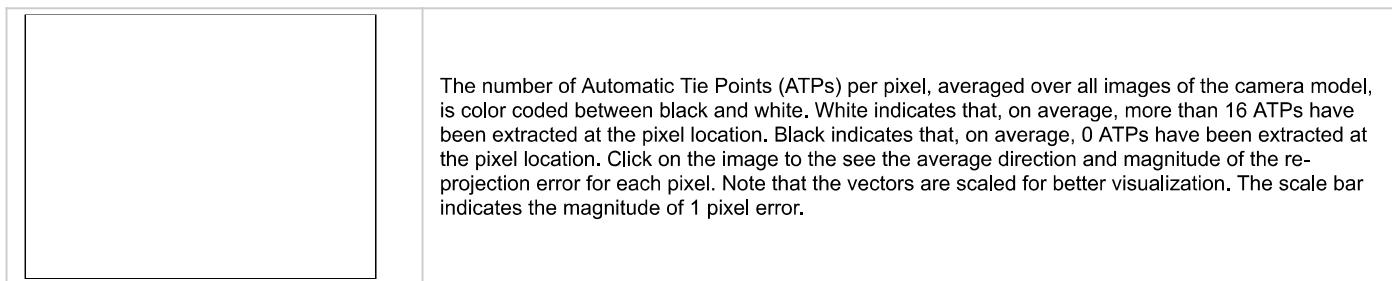
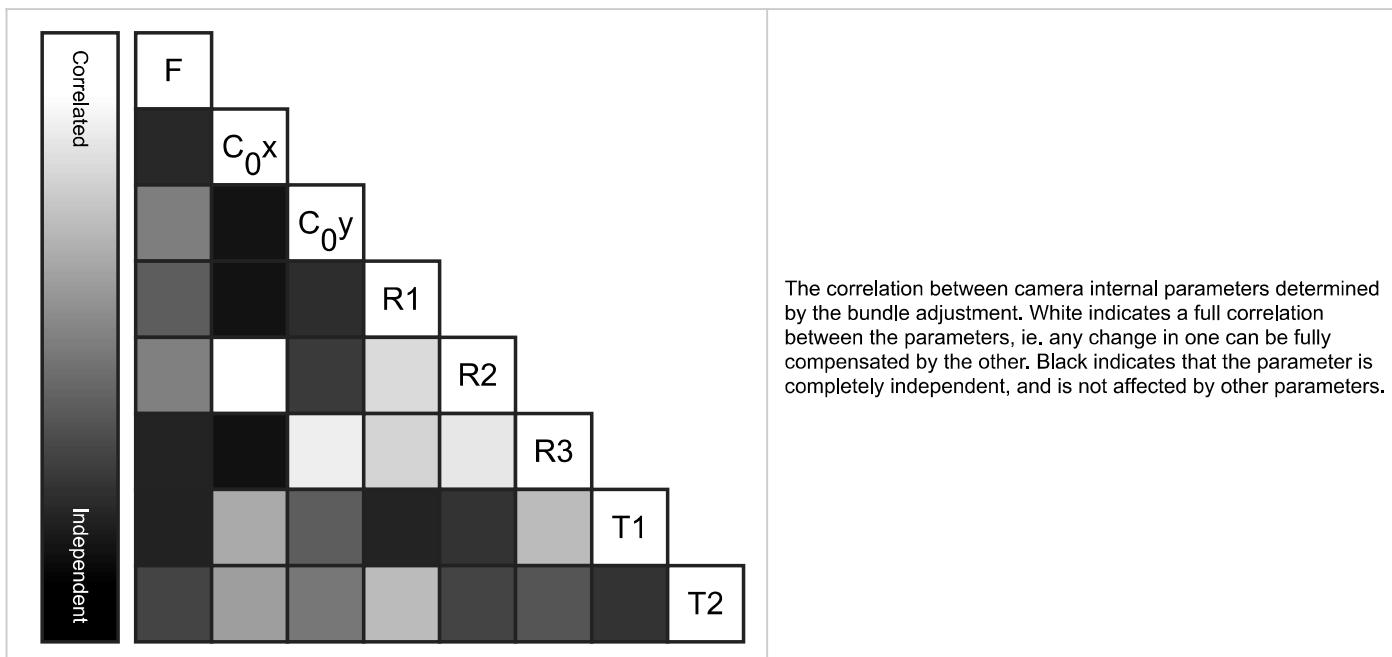
## ⓘ Internal Camera Parameters

### 📄 FC350\_3.6\_4000x3000 (RGB). Sensor Dimensions: 6.317 [mm] x 4.738 [mm]



EXIF ID: FC350\_3.6\_4000x3000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	2285.722 [pixel] 3.610 [mm]	2000.006 [pixel] 3.159 [mm]	1500.003 [pixel] 2.369 [mm]	-0.130	0.106	-0.016	-0.000	0.000
Optimized Values	2287.490 [pixel] 3.613 [mm]	1986.161 [pixel] 3.137 [mm]	1503.788 [pixel] 2.375 [mm]	-0.126	0.107	-0.015	0.001	0.000
Uncertainties (Sigma)	0.203 [pixel] 0.000 [mm]	0.017 [pixel] 0.000 [mm]	0.016 [pixel] 0.000 [mm]	0.000	0.000	0.000	0.000	0.000



### Camera Rig «MicaSense 5 band\_merge\_eldo\_4k\_2\_re» Relatives. Images: 10480



	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	-0.124	0.097	-0.374
Uncertainties (sigma)				0.007	0.010	0.001
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	0.026	0.053	-0.063
Uncertainties (sigma)				0.008	0.011	0.001
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	-0.138	-0.173	0.118
Uncertainties (sigma)				0.009	0.012	0.001
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	-0.030	-0.739	-0.306
Uncertainties (sigma)				0.008	0.011	0.001

### 2D Keypoints Table



	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7157	3554

Min	5323	61
Max	73633	19415
Mean	26140	4519

**2D Keypoints Table for Camera RedEdge\_5.5\_1280x960 (Blue)**

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6137	776
Min	5323	155
Max	8073	2089
Mean	6227	841

**2D Keypoints Table for Camera RedEdge\_5.5\_1280x960 (Green)**

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6680	1334
Min	5462	61
Max	8538	3574
Mean	6697	1437

**2D Keypoints Table for Camera RedEdge\_5.5\_1280x960 (Red)**

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6406	700
Min	5530	109
Max	8317	2437
Mean	6483	823

**2D Keypoints Table for Camera RedEdge\_5.5\_1280x960 (NIR)**

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7371	616
Min	6203	71
Max	8864	2501
Mean	7381	732

**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	7103	551
Min	5858	86
Max	8470	1503
Mean	7103	619

**2D Keypoints Table for Camera FC350\_3.6\_4000x3000 (RGB)**

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	56911	8885
Min	44040	2817
Max	73633	19415
Mean	56497	9645

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

	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)	FC350_3.6_4000x3000 (RGB)
RedEdge_5.5_1280x960 (Blue)	16 / 76 / 1297	10 / 39 / 917	18 / 93 / 792	8 / 29 / 397	9 / 42 / 613	4 / 15 / 373
RedEdge_5.5_1280x960 (Green)		14 / 61 / 2576	9 / 33 / 862	7 / 23 / 541	10 / 36 / 881	6 / 23 / 1004
RedEdge_5.5_1280x960 (Red)			14 / 74 / 1637	7 / 26 / 430	9 / 36 / 645	4 / 13 / 306
RedEdge_5.5_1280x960 (NIR)				13 / 71 / 1774	10 / 51 / 552	4 / 11 / 183
RedEdge_5.5_1280x960 (Red edge)					10 / 48 / 1165	4 / 15 / 240
FC350_3.6_4000x3000 (RGB)						19 / 116 / 11401

### 3D Points from 2D Keypoint Matches



	Number of 3D Points Observed
In 2 Images	3087885
In 3 Images	1092086
In 4 Images	549819
In 5 Images	322195
In 6 Images	206059
In 7 Images	139449
In 8 Images	98880
In 9 Images	72689
In 10 Images	55563
In 11 Images	43015
In 12 Images	34031
In 13 Images	26819
In 14 Images	21322
In 15 Images	17558
In 16 Images	14342
In 17 Images	11766
In 18 Images	10139
In 19 Images	8522
In 20 Images	7367
In 21 Images	6229
In 22 Images	5458
In 23 Images	4560
In 24 Images	3976
In 25 Images	3479
In 26 Images	3057
In 27 Images	2605
In 28 Images	2320
In 29 Images	2014
In 30 Images	1805
In 31 Images	1501
In 32 Images	1377
In 33 Images	1221
In 34 Images	1193
In 35 Images	962
In 36 Images	954
In 37 Images	780
In 38 Images	711

In 39 Images	664
In 40 Images	604
In 41 Images	535
In 42 Images	473
In 43 Images	441
In 44 Images	424
In 45 Images	345
In 46 Images	356
In 47 Images	271
In 48 Images	252
In 49 Images	255
In 50 Images	255
In 51 Images	222
In 52 Images	208
In 53 Images	153
In 54 Images	170
In 55 Images	142
In 56 Images	144
In 57 Images	130
In 58 Images	140
In 59 Images	117
In 60 Images	85
In 61 Images	72
In 62 Images	100
In 63 Images	84
In 64 Images	82
In 65 Images	66
In 66 Images	66
In 67 Images	57
In 68 Images	63
In 69 Images	64
In 70 Images	48
In 71 Images	41
In 72 Images	42
In 73 Images	32
In 74 Images	34
In 75 Images	48
In 76 Images	31
In 77 Images	39
In 78 Images	34
In 79 Images	24
In 80 Images	32
In 81 Images	19
In 82 Images	16
In 83 Images	23
In 84 Images	14
In 85 Images	23
In 86 Images	23
In 87 Images	9
In 88 Images	15
In 89 Images	10
In 90 Images	7
In 91 Images	7

In 92 Images	7
In 93 Images	9
In 94 Images	14
In 95 Images	12
In 96 Images	3
In 97 Images	11
In 98 Images	10
In 99 Images	3
In 100 Images	3
In 101 Images	5
In 102 Images	3
In 103 Images	4
In 104 Images	4
In 105 Images	5
In 106 Images	4
In 107 Images	4
In 108 Images	7
In 109 Images	5
In 110 Images	3
In 111 Images	1
In 112 Images	3
In 113 Images	4
In 114 Images	1
In 115 Images	2
In 116 Images	4
In 117 Images	1
In 119 Images	3
In 120 Images	1
In 121 Images	1
In 122 Images	1
In 123 Images	2
In 124 Images	2
In 125 Images	3
In 127 Images	1
In 128 Images	2
In 130 Images	1
In 132 Images	1
In 138 Images	1
In 143 Images	1
In 149 Images	1
In 151 Images	1
In 153 Images	1
In 159 Images	1

 **2D Keypoint Matches**

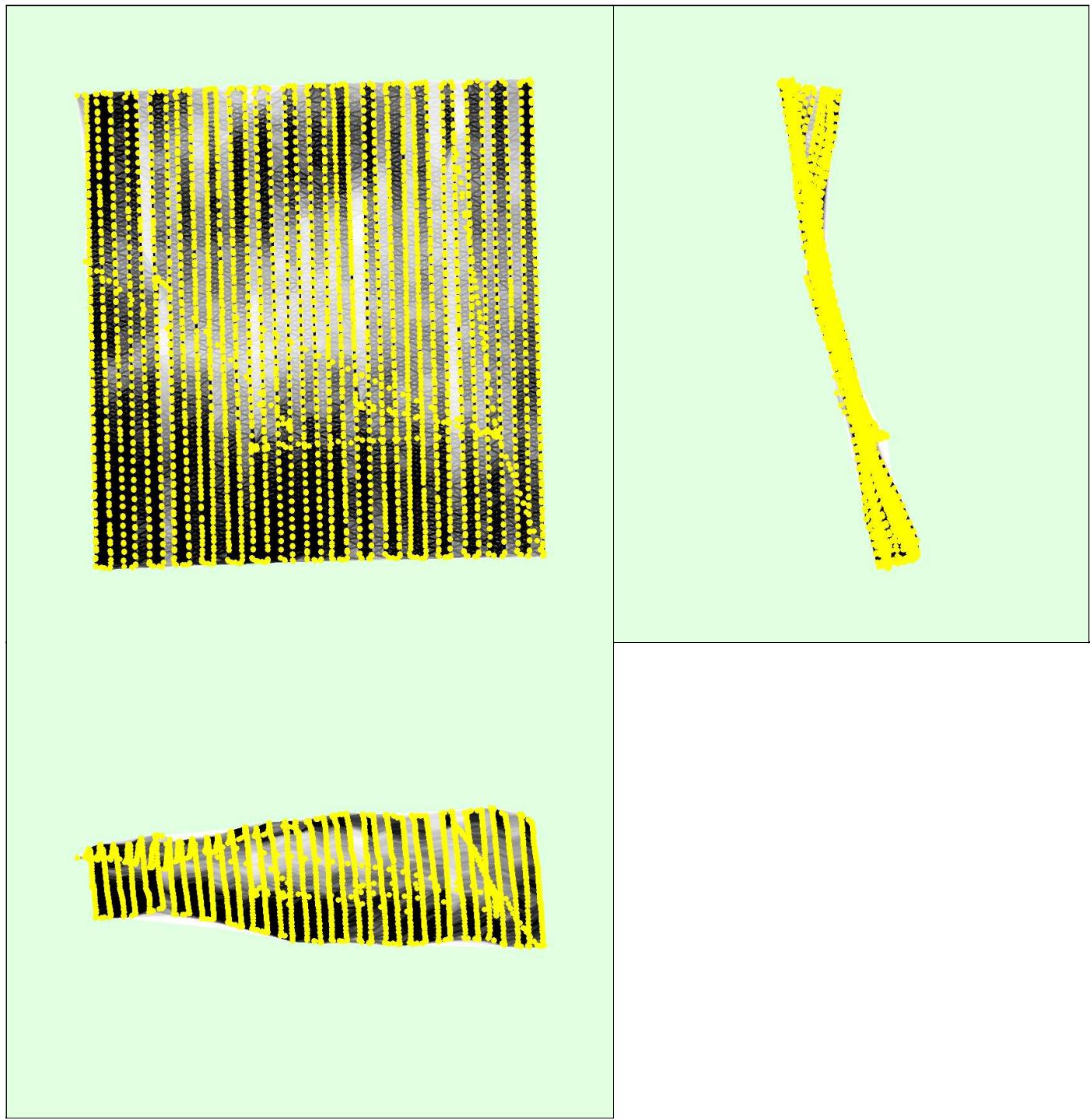


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

### ⓘ Manual Tie Points



MTP Name	Projection Error [pixel]	Verified/Marked
mtp1	1.761	51 / 51
mtp2	1.028	27 / 27
mtp3	0.865	55 / 55
mtp4	0.714	63 / 63
mtp5	1.256	55 / 55

ntp6	1.219	37 / 37
ntp9	1.513	38 / 38

Projection errors for manual tie points. The last column counts the number of images where the manual tie point has been automatically verified vs. manually marked.

## 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	15.20
-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	0.02	0.00
-6.00	-3.00	0.00	3.08	0.00
-3.00	0.00	37.67	34.63	0.00
0.00	3.00	62.02	60.48	0.00
3.00	6.00	0.31	1.78	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	84.80
<b>Mean [m]</b>		0.122250	0.464754	19.265908
<b>Sigma [m]</b>		0.554550	1.527538	21.639777
<b>RMS Error [m]</b>		0.567865	1.596674	28.973353

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	99.27	0.00
[-2.00, 2.00]	100.00	100.00	0.00
[-3.00, 3.00]	100.00	100.00	78.62
<b>Mean of Geolocation Accuracy [m]</b>	5.000000	5.000000	10.000000
<b>Sigma of Geolocation Accuracy [m]</b>	0.000000	0.000000	0.000000

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

Geolocation Orientational Variance	RMS [degree]
Omega	0.762
Phi	0.823
Kappa	4.835

Geolocation RMS error of the orientation angles given by the difference between the initial and computed image orientation angles.

## 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 4.15.0-1029-aws x86_64

**Coordinate Systems**

Image Coordinate System	WGS 84 (EGM 96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 10N (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: Auto, no
Rig «MicaSense 5 band_merge_eldo_4k_2_re» 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, group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	02h:32m:18s
Time for Point Cloud Classification	09m:18s
Time for 3D Textured Mesh Generation	53m:22s

**Results**

Number of Processed Clusters	2
Number of Generated Tiles	5
Number of 3D Densified Points	94527066
Average Density (per m <sup>3</sup> )	19.79

**DSM, Orthomosaic and Index Details**

**Processing Options**

DSM and Orthomosaic Resolution	1 x GSD (7.74 [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
Raster DTM	Generated: yes Merge Tiles: yes
DTM Resolution	5 x GSD (7.74 [cm/pixel])
Radiometric calibration with reflectance target	yes
Index Calculator: Reflectance Map	Generated: yes Resolution: 1 x GSD (7.74 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Time for DSM Generation	10m:18s
Time for Orthomosaic Generation	05h:08m:08s
Time for DTM Generation	57s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	08h:06m:24s
Time for Index Map Generation	01m:55s

**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	✓
FC350_3.6_4000x3000	Red Green Blue	No Correction	n/a