

Quality Report



Generated with Pix4Denterprise version 4.5.2
Preview



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	DuetM_Corn
Processed	2021-02-17 18:32:37
Camera Model Name(s)	Sequoia_4.0_1280x960 (Green), Sequoia_4.0_1280x960 (Red), Sequoia_4.0_1280x960 (Red edge), Sequoia_4.0_1280x960 (NIR)
Rig name(s)	«Sequoia»
Average Ground Sampling Distance (GSD)	24.28 cm / 9.56 in
Area Covered	2.744 km ² / 274.4328 ha / 1.06 sq. mi. / 678.4891 acres
Time for Initial Processing (without report)	08m:41s

Quality Check



Images	median of 10000 keypoints per image	
Dataset	2048 out of 2048 images calibrated (100%), 12 images disabled	
Camera Optimization	0.03% relative difference between initial and optimized internal camera parameters	
Matching	median of 2950.63 matches per calibrated image	
Georeferencing	yes, no 3D GCP	

Preview

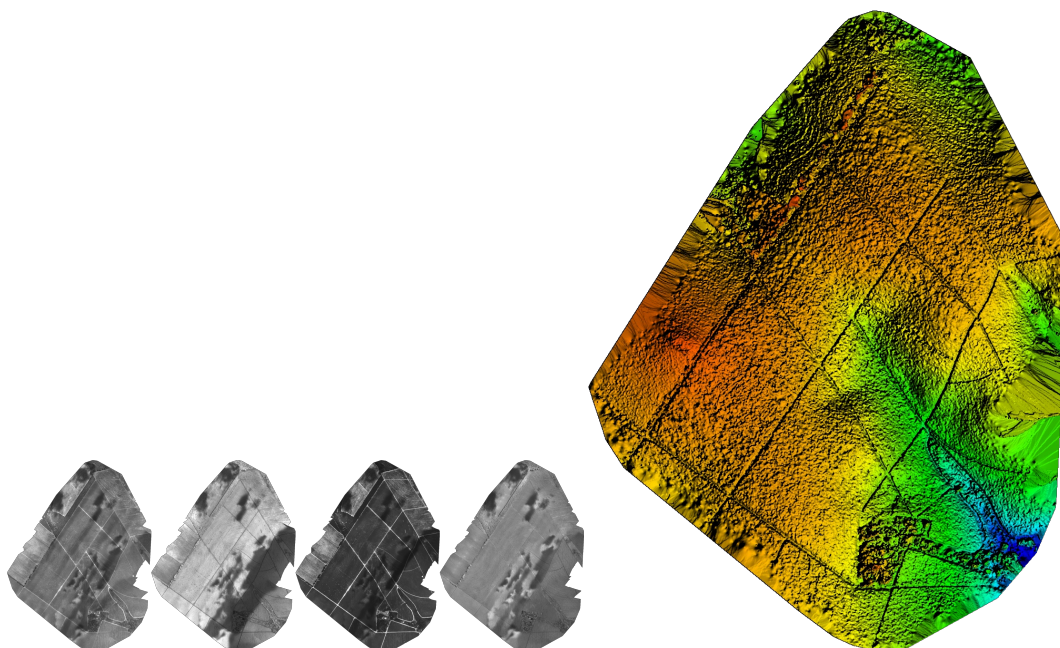


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details



Number of Calibrated Images	2048 out of 2060
Number of Geolocated Images	2060 out of 2060

? Initial Image Positions

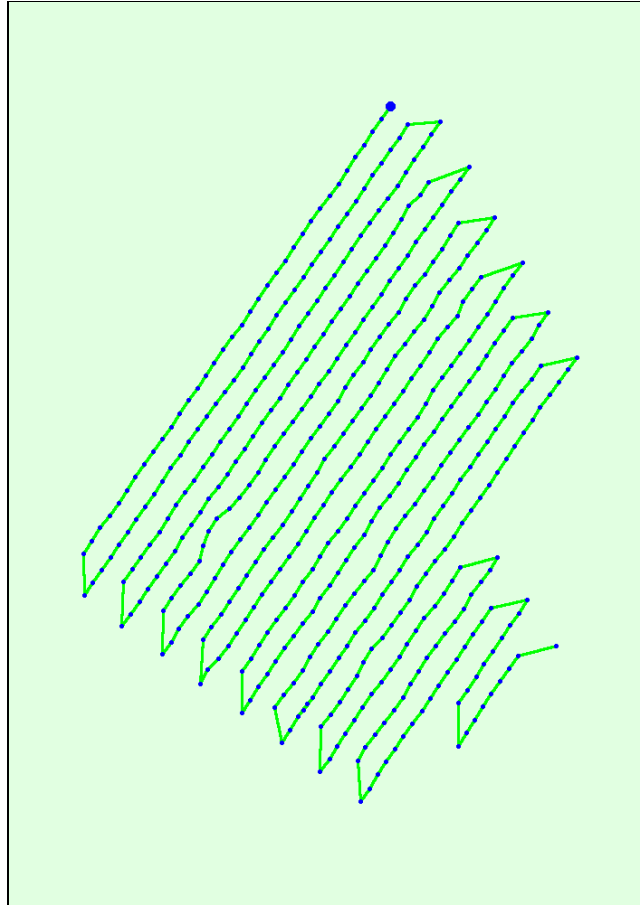
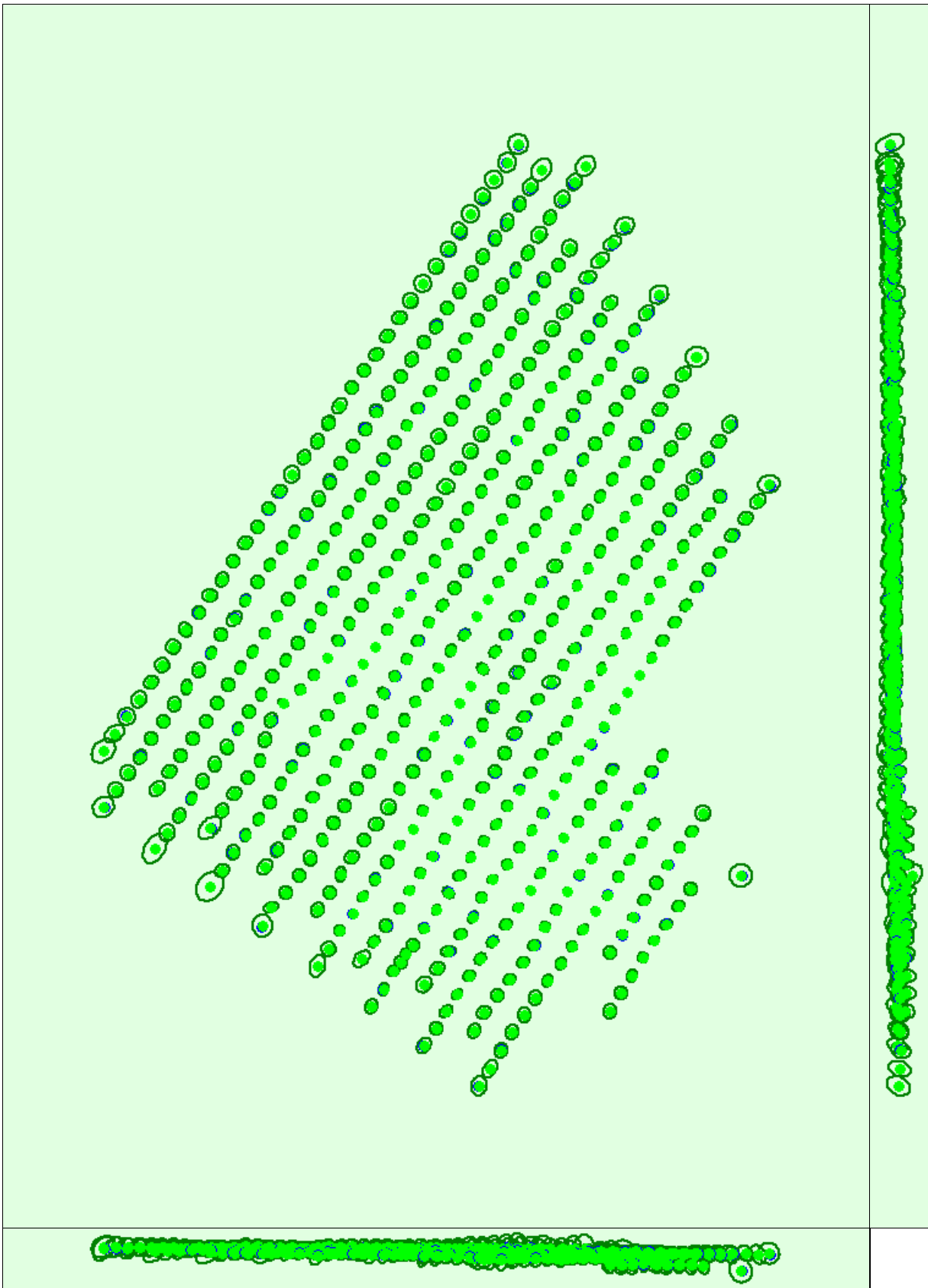


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

? Computed Image/GCPs/Manual Tie Points Positions





Uncertainty ellipses 100x 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.

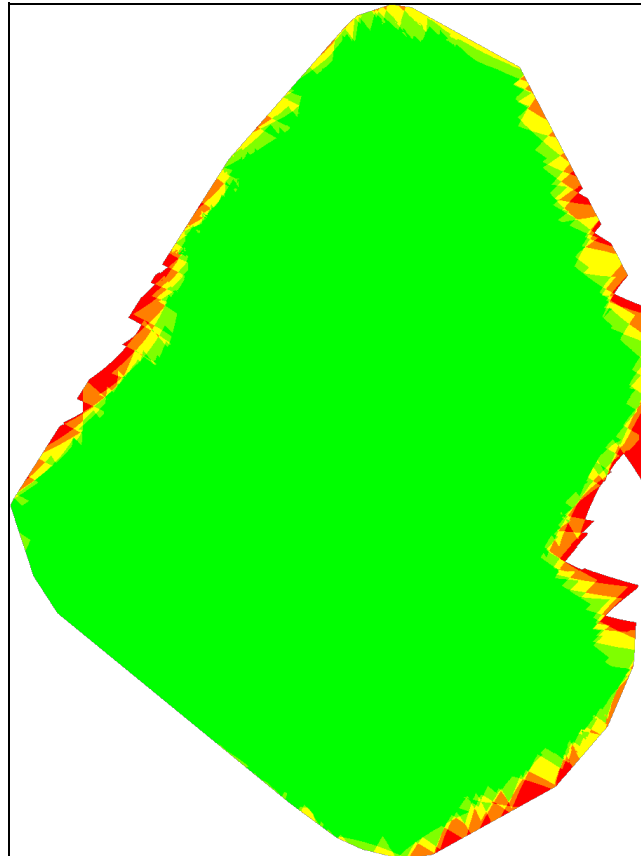
? Absolute camera position and orientation uncertainties



	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.139	0.143	0.154	0.035	0.031	0.014

Sigma	0.030	0.032	0.035	0.009	0.007	0.004
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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	2047831
Number of 3D Points for Bundle Block Adjustment	772434
Mean Reprojection Error [pixels]	0.259

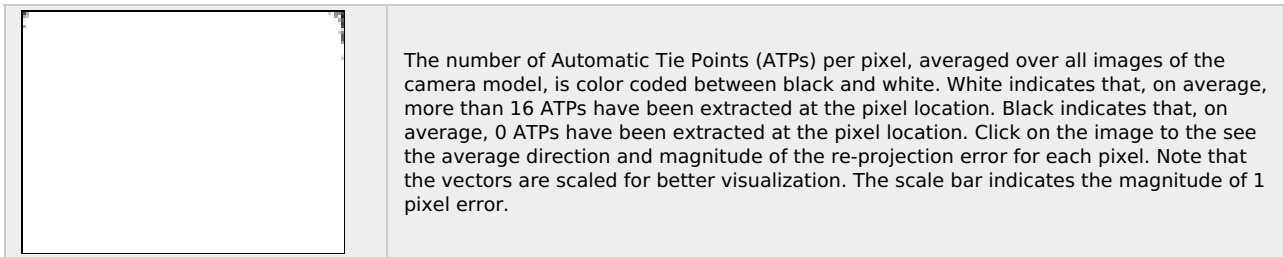
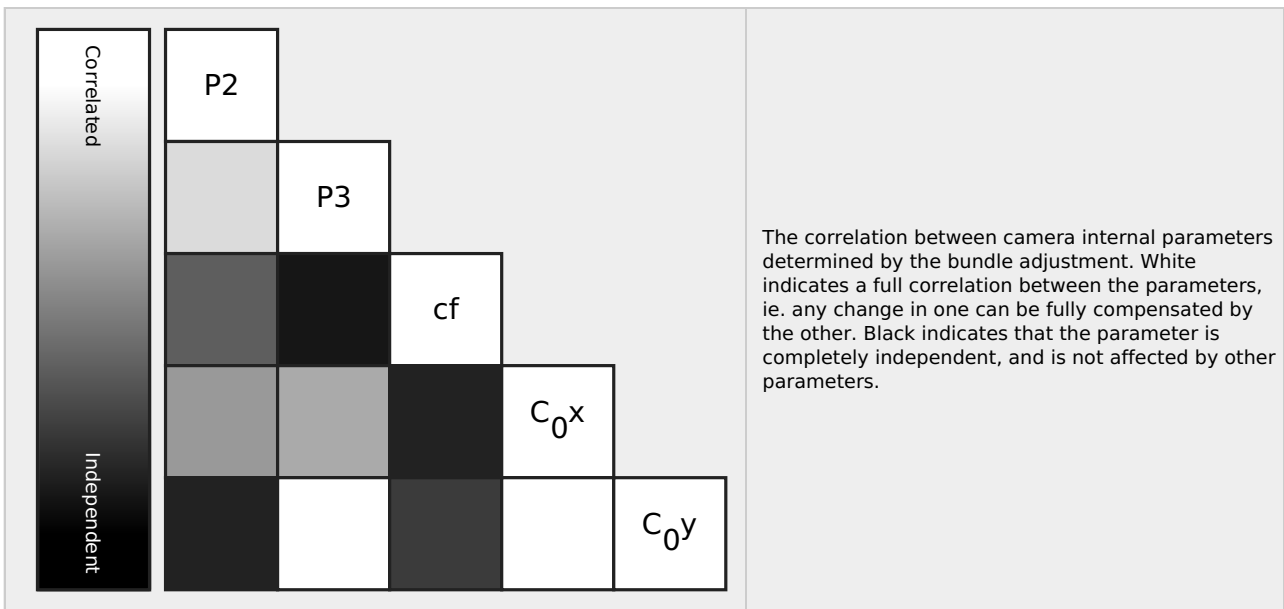
Internal Camera Parameters

Sequoia_4.0_1280x960 (Green). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]



EXIF ID: Sequoia_4.0_1280x960

	Poly[0]	Poly[1]	Poly[2]	Poly[3]	Poly[4]	c	d	e	f	Principal Point x	Principal Point y
Initial Values	0.000000	1.000000	0.010470	-0.139006	0.000000	1661.22	0.00	0.00	1661.22	614.95	467.73
Optimized Values	0.000000	1.000000	0.010202	-0.146923	0.000000	1665.92	0.00	0.00	1665.92	616.99	467.76
Uncertainties (Sigma)			0.000345	0.000604		0.35	0.00	0.00	0.35	0.07	0.07



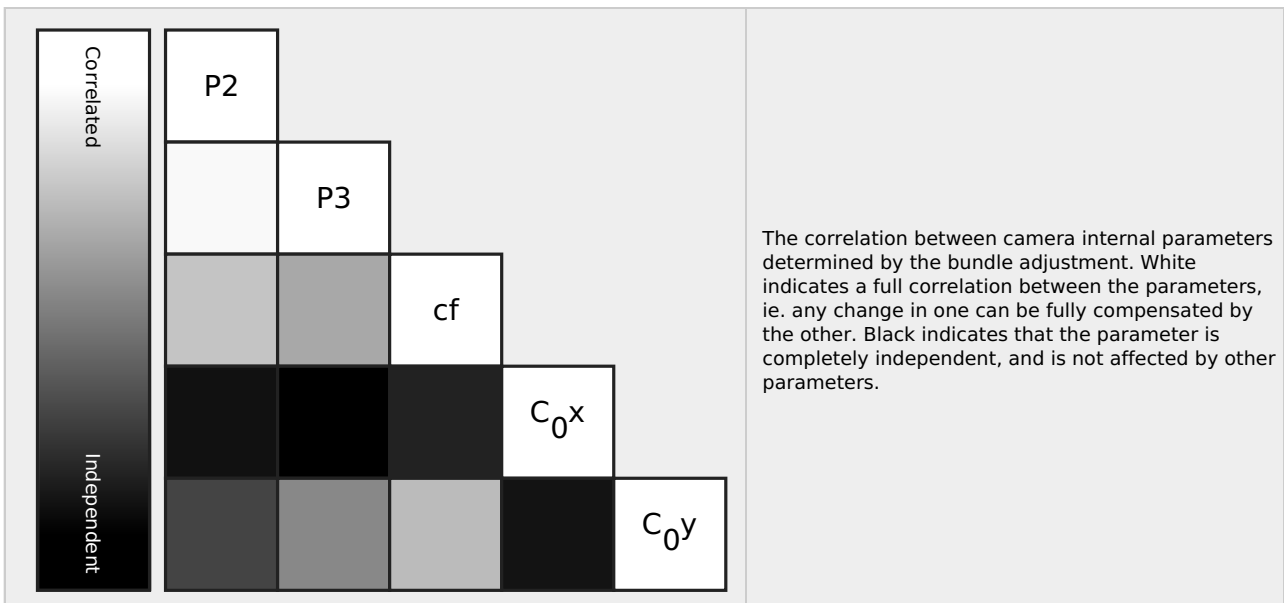
Internal Camera Parameters

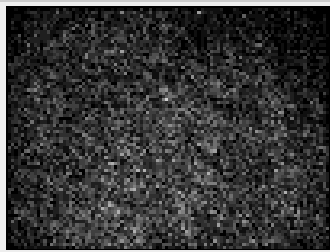
Sequoia_4.0_1280x960 (Red). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]



EXIF ID: Sequoia_4.0_1280x960

	Poly[0]	Poly[1]	Poly[2]	Poly[3]	Poly[4]	c	d	e	f	Principal Point x	Principal Point y
Initial Values	0.000000	1.000000	0.012488	-0.144114	0.000000	1658.43	0.00	0.00	1658.43	646.94	461.58
Optimized Values	0.000000	1.000000	0.005292	-0.139781	0.000000	1664.63	0.00	0.00	1664.63	649.44	462.58
Uncertainties (Sigma)			0.001648	0.002752		0.53	0.00	0.00	0.53	0.30	0.28





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 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.

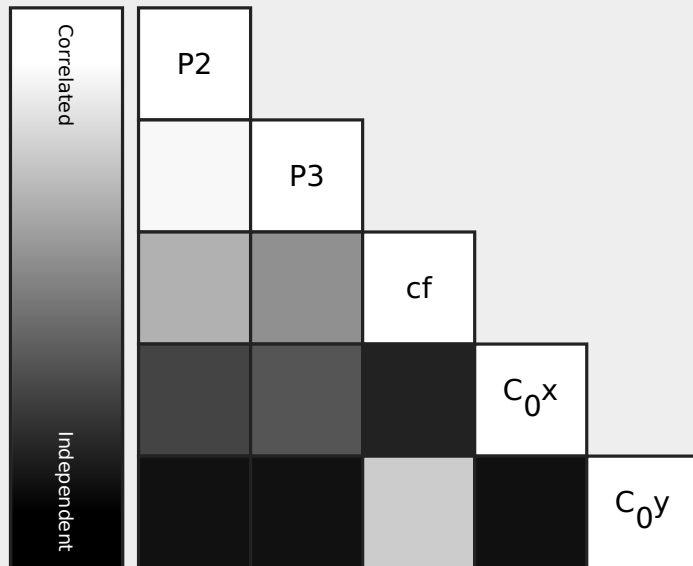
Internal Camera Parameters

Sequoia_4.0_1280x960 (Red edge). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

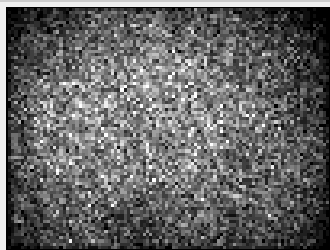


EXIF ID: Sequoia_4.0_1280x960

	Poly[0]	Poly[1]	Poly[2]	Poly[3]	Poly[4]	c	d	e	f	Principal Point x	Principal Point y
Initial Values	0.000000	1.000000	0.009679	-0.141984	0.000000	1657.87	0.00	0.00	1657.87	625.65	502.77
Optimized Values	0.000000	1.000000	0.013172	-0.154709	0.000000	1660.53	0.00	0.00	1660.53	624.41	503.81
Uncertainties (Sigma)			0.001323	0.002258		0.46	0.00	0.00	0.46	0.24	0.21



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 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.

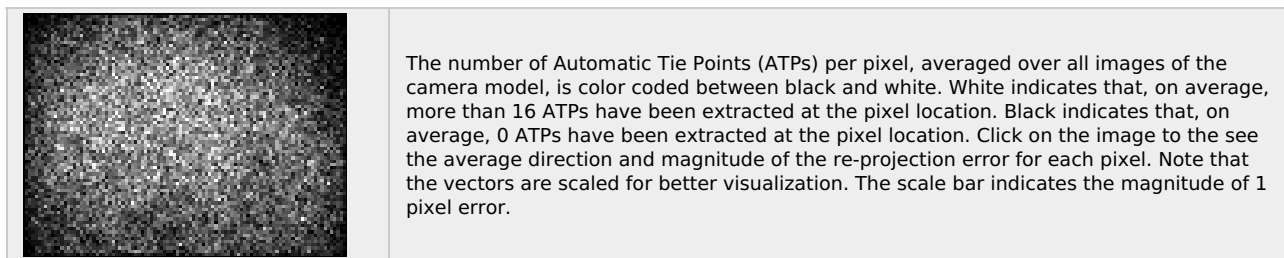
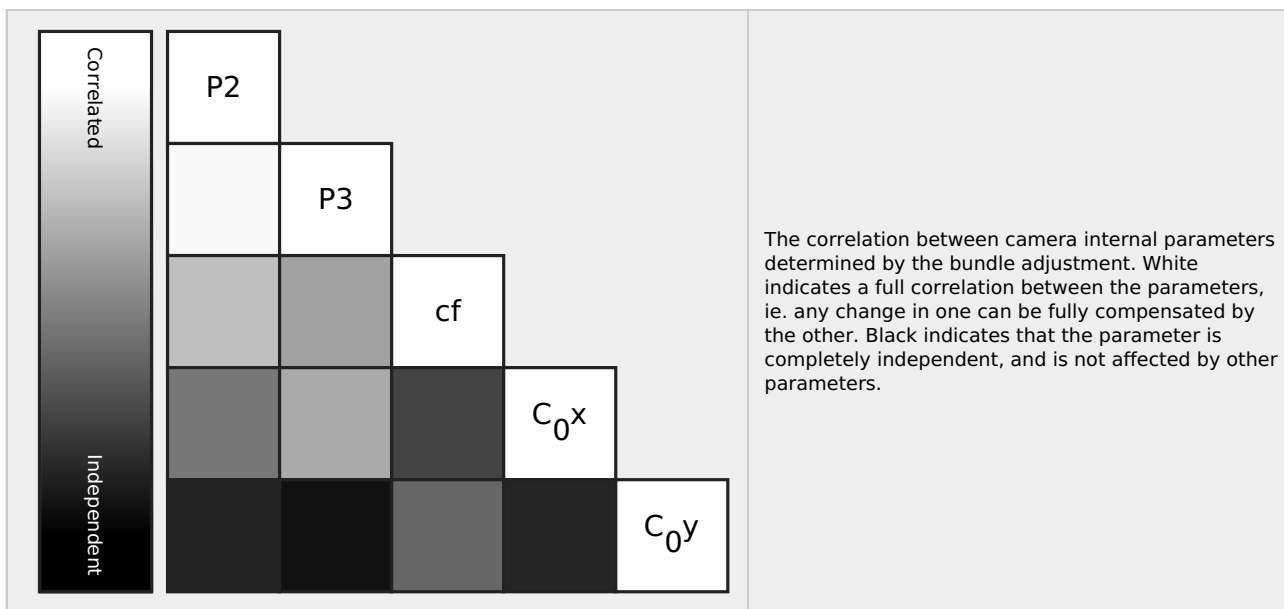
Internal Camera Parameters

Sequoia_4.0_1280x960 (NIR). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]



EXIF ID: Sequoia_4.0_1280x960

	Poly[0]	Poly[1]	Poly[2]	Poly[3]	Poly[4]	c	d	e	f	Principal Point x	Principal Point y
Initial Values	0.000000	1.000000	0.017795	-0.154935	0.000000	1655.62	0.00	0.00	1655.62	651.39	502.72
Optimized Values	0.000000	1.000000	0.010286	-0.149596	0.000000	1660.12	0.00	0.00	1660.12	650.90	502.96
Uncertainties (Sigma)			0.001580	0.002695		0.51	0.00	0.00	0.51	0.30	0.26



🔍 Camera Rig «Sequoia» Relatives. Images: 2048



	Transl X [m]	Transl Y [m]	Transl Z [m]	Rot X [degree]	Rot Y [degree]	Rot Z [degree]
Sequoia_4.0_1280x960 (Green)	Reference Camera					
Sequoia_4.0_1280x960 (Red)						
Initial Values	0.000	-0.015	0.000	-0.175	0.005	-0.020
Optimized values	0.000	-0.015	0.000	-0.193	0.010	-0.024
Uncertainties (sigma)				0.016	0.017	0.002
Sequoia_4.0_1280x960 (Red edge)						
Initial Values	0.015	0.000	0.000	0.129	-0.370	-0.046
Optimized values	0.015	0.000	0.000	0.083	-0.508	-0.036
Uncertainties (sigma)				0.012	0.014	0.001
Sequoia_4.0_1280x960 (NIR)						
Initial Values	0.015	-0.015	0.000	-0.300	-0.337	-0.092
Optimized values	0.015	-0.015	0.000	-0.322	-0.407	-0.090
Uncertainties (sigma)				0.015	0.017	0.002

🔍 2D Keypoints Table



	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	2951
Min	8321	413
Max	10000	6228
Mean	9868	3066

2D Keypoints Table for Camera Sequoia_4.0_1280x960 (Green)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	3124
Min	8364	784
Max	10000	6228
Mean	9871	3291

2D Keypoints Table for Camera Sequoia_4.0_1280x960 (Red)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	1321
Min	8321	442
Max	10000	4293
Mean	9599	1615

2D Keypoints Table for Camera Sequoia_4.0_1280x960 (Red edge)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	2590
Min	9813	413
Max	10000	5559
Mean	9996	2678

2D Keypoints Table for Camera Sequoia_4.0_1280x960 (NIR)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	2537
Min	9603	729
Max	10000	5518
Mean	9987	2684

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

	Sequoia_4.0_1... (Green)	Sequoia_4.0_128... (Red)	Sequoia_4....(Red edge)	Sequoia_4.0_128... (NIR)
Sequoia_4.0_1280x960 (Green)	28 / 155 / 3259	8 / 22 / 504	7 / 25 / 423	4 / 12 / 813
Sequoia_4.0_1280x960 (Red)		287 / 763 / 2729	4 / 11 / 42	3 / 5 / 18
Sequoia_4.0_1280x960 (Red edge)			103 / 1224 / 3832	48 / 140 / 2476
Sequoia_4.0_1280x960 (NIR)				550 / 1523 / 4157

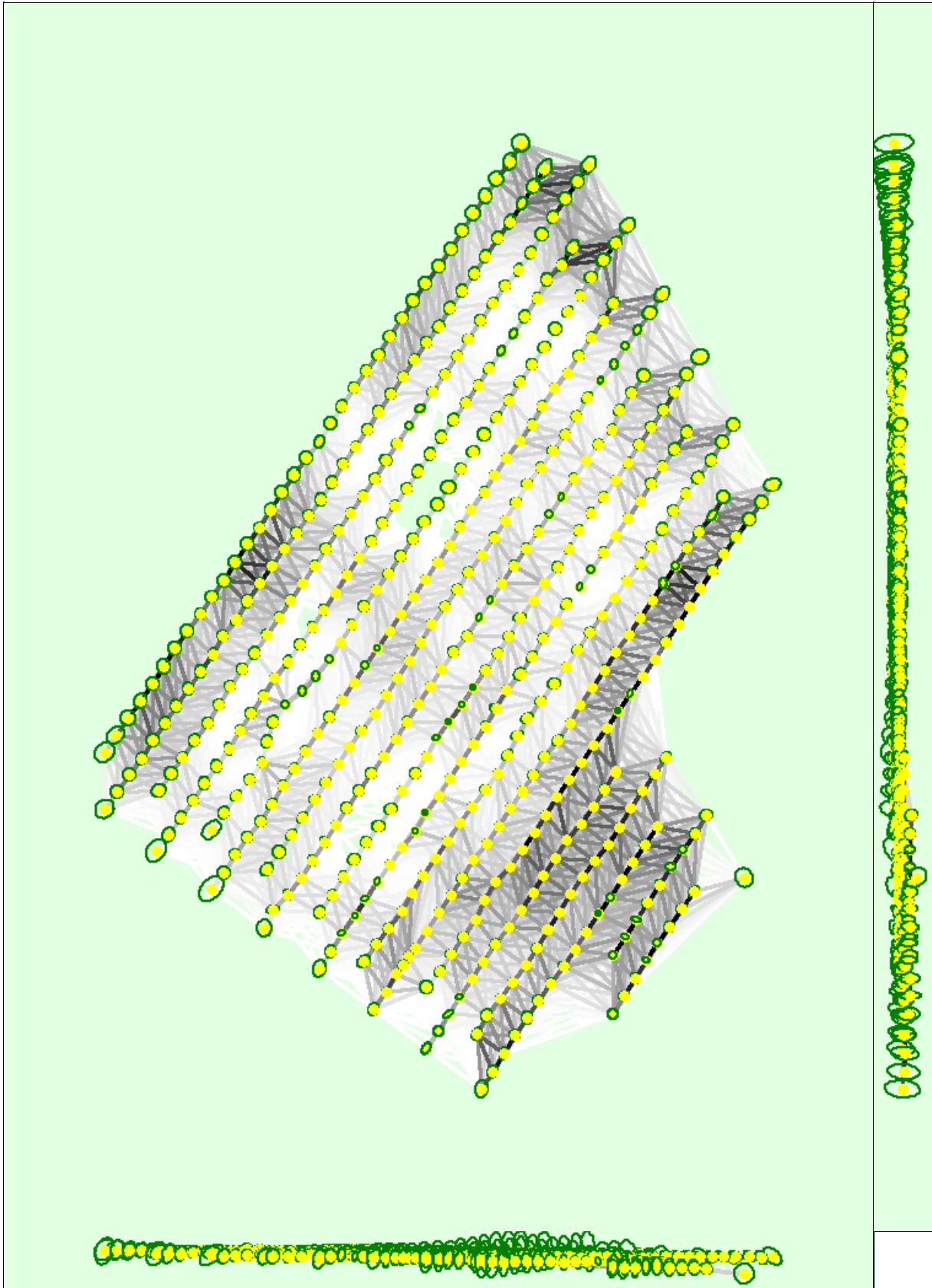
3D Points from 2D Keypoint Matches



	Number of 3D Points Observed
In 2 Images	532208
In 3 Images	129404
In 4 Images	52670
In 5 Images	24129
In 6 Images	13085
In 7 Images	7744
In 8 Images	4761
In 9 Images	2925
In 10 Images	1800
In 11 Images	1211
In 12 Images	776
In 13 Images	551
In 14 Images	362
In 15 Images	245
In 16 Images	167
In 17 Images	129
In 18 Images	89
In 19 Images	54
In 20 Images	33
In 21 Images	37
In 22 Images	15

In 23 Images	17
In 24 Images	8
In 25 Images	5
In 26 Images	5
In 27 Images	3
In 29 Images	1

2D Keypoint Matches



Uncertainty ellipses 100x magnified

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. Dark green ellipses indicate the relative camera position uncertainty of the bundle block adjustment result.

Relative camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.108	0.112	0.139	0.034	0.033	0.012
Sigma	0.027	0.030	0.063	0.011	0.011	0.004

Geolocation Details

Absolute Geolocation Variance

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-2.87	0.00	0.00	0.00
-2.87	-2.30	0.00	0.00	0.00
-2.30	-1.72	0.00	0.00	0.00
-1.72	-1.15	0.39	0.20	0.20
-1.15	-0.57	8.15	1.86	6.93
-0.57	0.00	40.23	50.44	40.82
0.00	0.57	41.21	44.92	45.95
0.57	1.15	9.62	2.39	5.52
1.15	1.72	0.39	0.00	0.59
1.72	2.30	0.00	0.20	0.00
2.30	2.87	0.00	0.00	0.00
2.87	-	0.00	0.00	0.00
Mean [m]		0.009279	-0.001709	0.000011
Sigma [m]		0.448728	0.307203	0.379943
RMS Error [m]		0.448824	0.307207	0.379943

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]	99.41	99.61	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]	1.194594	1.194594	1.785955
Sigma of Geolocation Accuracy [m]	0.026119	0.026119	0.041349

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

Geolocation Orientational Variance	RMS [degree]
Omega	10.118
Phi	7.337
Kappa	54.127

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 5.4.0-1037-aws x86_64

Coordinate Systems



Image Coordinate System	WGS 84 (EGM 96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 22S (EGM 96 Geoid)

Processing Options



Detected Template	cloud-ag-multispectral-1*
Keypoints Image Scale	Full, Image Scale: 2
Advanced: Matching Image Pairs	Aerial Grid or Corridor
Advanced: Matching Strategy	Use Geometrically Verified Matching: yes
Advanced: Keypoint Extraction	Targeted Number of Keypoints: Custom, Number of Keypoints: 10000
Advanced: Calibration	Calibration Method: Alternative Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Custom, yes
Rig «Sequoia» 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	Low (Fast)
Minimum Number of Matches	3
3D Textured Mesh Generation	no
LOD	Generated: no
Advanced: Image Groups	Green, NIR, Red, Red edge
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	55s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	NA

Results



Number of Generated Tiles	1
Number of 3D Densified Points	1162781
Average Density (per m ³)	0.09

DSM, Orthomosaic and Index Details



Processing Options



DSM and Orthomosaic Resolution	1 x GSD (24.3 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Radiometric calibration with reflectance target	yes
Index Calculator: Reflectance Map	Generated: yes Resolution: 1 x GSD (24.3 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Index Calculator: Index Values	Polygon Shapefile [cm/grid]: 400
Time for DSM Generation	00s
Time for Orthomosaic Generation	00s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	15m:37s
Time for Index Map Generation	44s

Camera Radiometric Correction



Camera Name	Band	Radiometric Correction Type	Reflectance target
Sequoia_4.0_1280x960	Green	Camera, Sun Irradiance and Sun Angle	✓
Sequoia_4.0_1280x960	Red	Camera, Sun Irradiance and Sun Angle	✓
Sequoia_4.0_1280x960	Red edge	Camera, Sun Irradiance and Sun Angle	✓
Sequoia_4.0_1280x960	NIR	Camera, Sun Irradiance and Sun Angle	✓