# Quality Report

Generated with Pix4Dmapper version 4.3.27

**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_1_x3 |
| Processed | 2018-10-04 08:40:02 |
| Camera Model Name(s) | FC350_3.6_4000x3000 (RGB) |
| Average Ground Sampling Distance (GSD) | 5.39 cm / 2.12 in |
| Area Covered | 0.700 $km^2$ / 69.9648 ha / 0.27 sq. mi. / 172.9763 acres |
| Time for Initial Processing (without report) | 20m:36s |

## Quality Check

| | | |
|---|---|---|
| **Images** | median of 11592 keypoints per image | ✓ |
| **Dataset** | 1311 out of 1316 images calibrated (99%), all images enabled | ✓ |
| **Camera Optimization** | 2.05% relative difference between initial and optimized internal camera parameters | ✓ |
| **Matching** | median of 1256.28 matches per calibrated image | ✓ |
| **Georeferencing** | yes, no 3D GCP | ⚠ |

## Preview

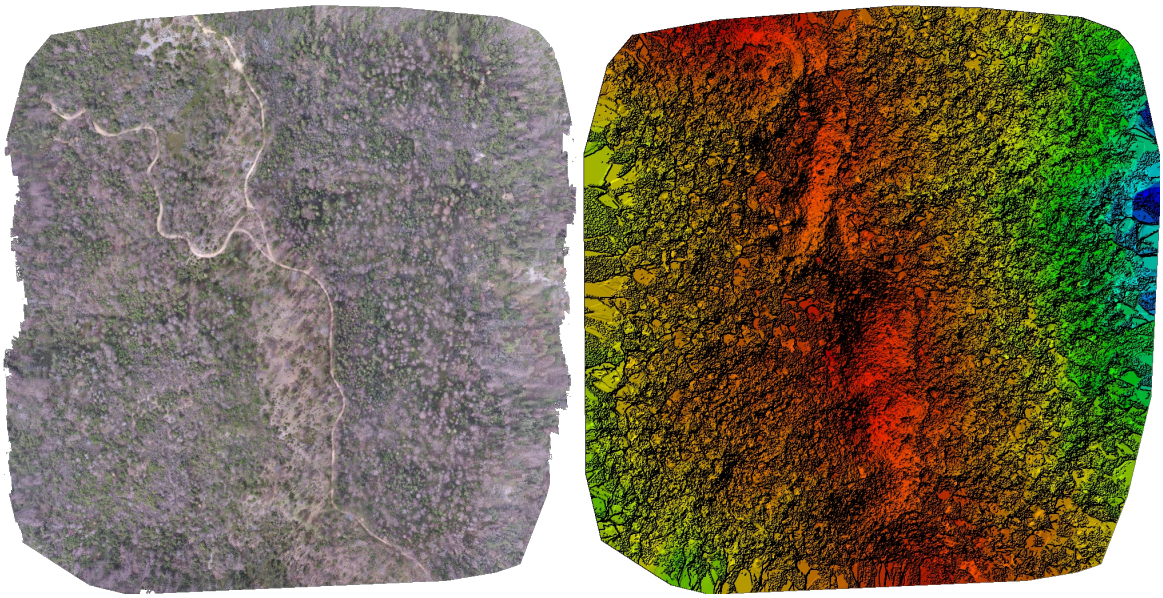


**Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.**

# Calibration Details

| | |
|---|---|
| Number of Calibrated Images | 1311 out of 1316 |
| Number of Geolocated Images | 1316 out of 1316 |

## Initial Image Positions

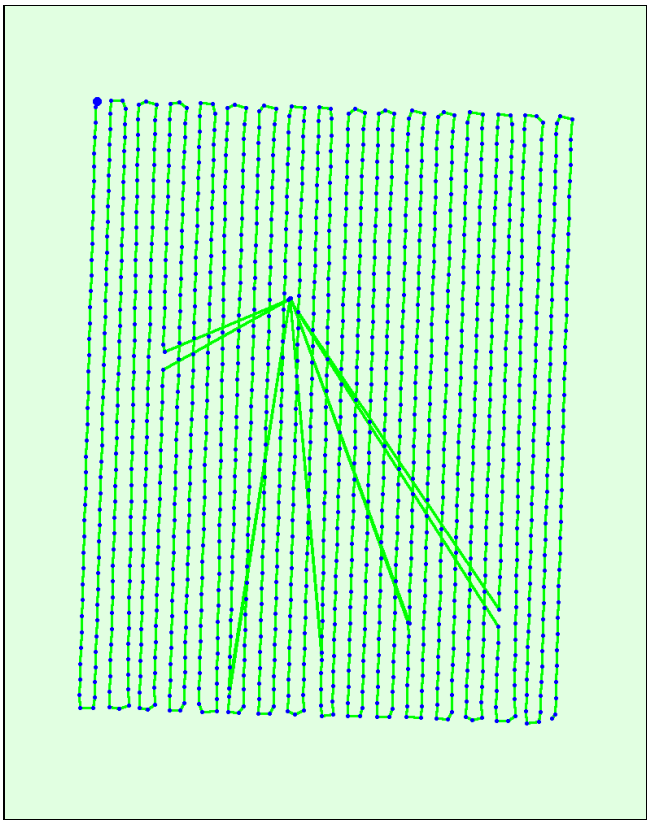
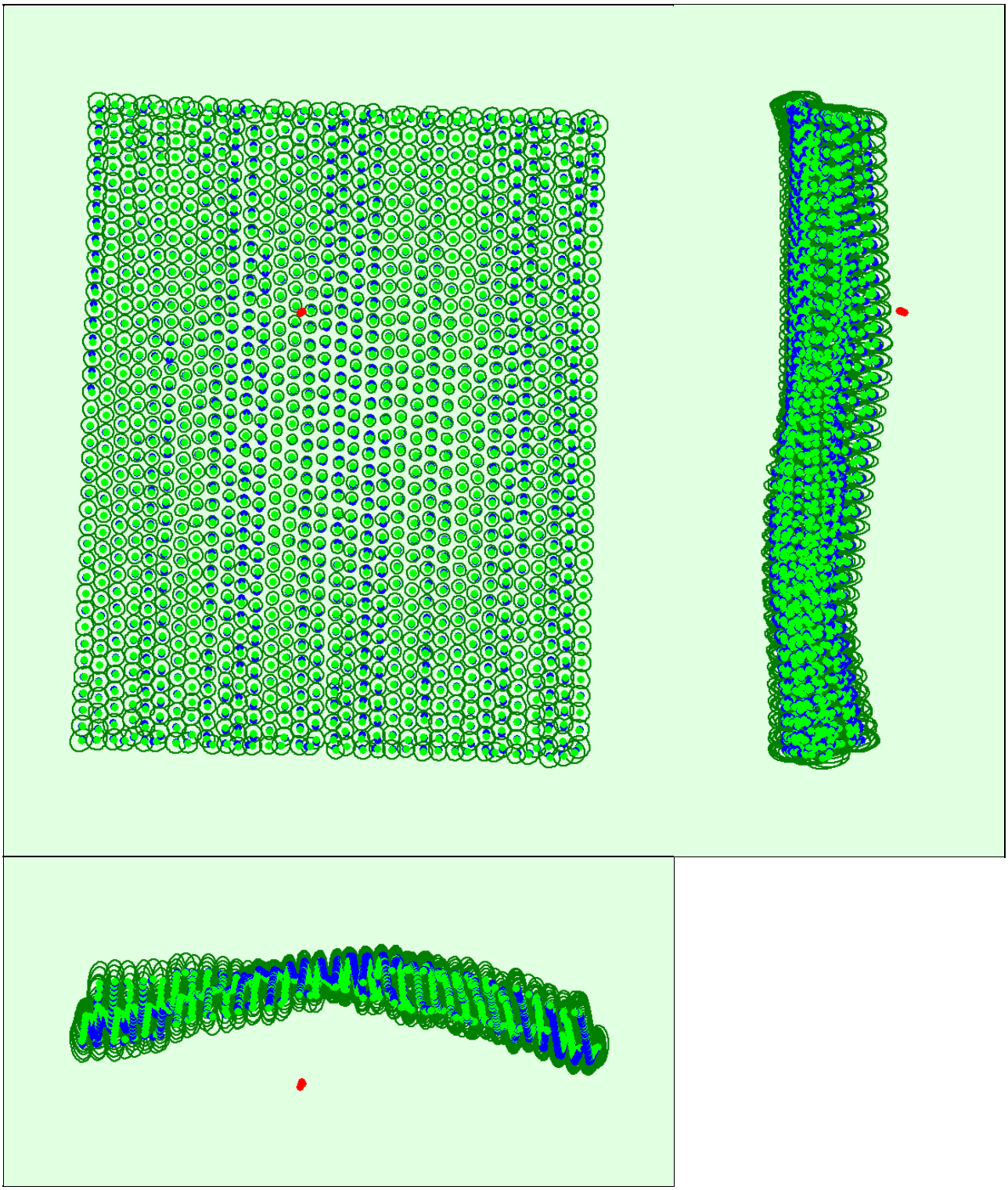


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

## 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 | 0.085 | 0.086 | 0.163 | 0.030 | 0.030 | 0.014 |
| Sigma | 0.013 | 0.013 | 0.026 | 0.003 | 0.002 | 0.001 |

## Overlap

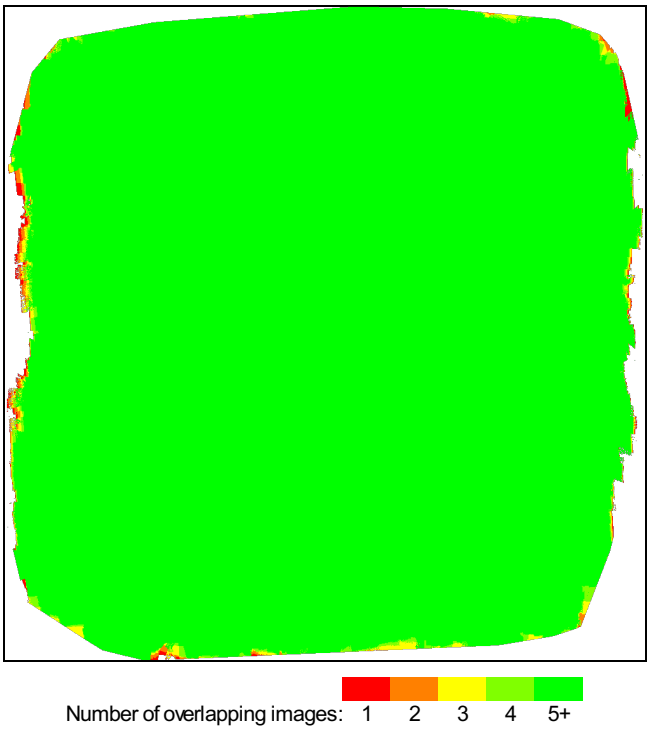



**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.**
**Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of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

# Bundle Block Adjustment Details

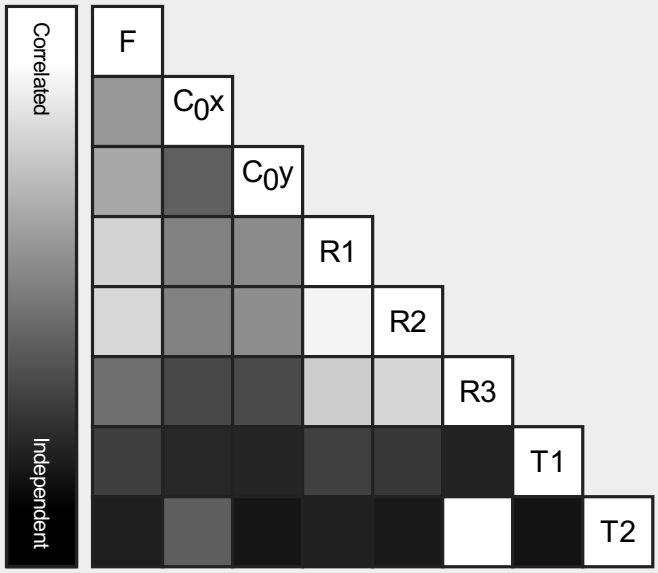
| | |
|---|---|
| Number of 2D Keypoint Observations for Bundle Block Adjustment | 1663641 |
| Number of 3D Points for Bundle Block Adjustment | 580869 |
| Mean Reprojection Error [pixels] | 0.119 |

### Internal Camera Parameters

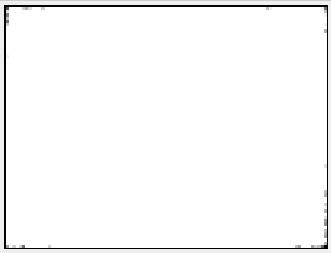
### FC350_3.6_4000x3000 (RGB). Sensor Dimensions: 6.317 [mm] x 4.738 [mm]

**EXIF ID: FC350_3.6_4000x3000**

| | Focal Length | Principal Point x | Principal Point y | R1 | R2 | R3 | T1 | T2 |
|---|---|---|---|---|---|---|---|---|
| Initial Values | 2285.722 [pixel]<br>3.610 [mm] | 2000.006 [pixel]<br>3.159 [mm] | 1500.003 [pixel]<br>2.369 [mm] | -0.130 | 0.106 | -0.016 | -0.000 | 0.000 |
| Optimized Values | 2332.644 [pixel]<br>3.684 [mm] | 1985.255 [pixel]<br>3.135 [mm] | 1503.213 [pixel]<br>2.374 [mm] | -0.130 | 0.113 | -0.015 | 0.001 | 0.000 |
| Uncertainties (Sigma) | 1.547 [pixel]<br>0.002 [mm] | 0.051 [pixel]<br>0.000 [mm] | 0.049 [pixel]<br>0.000 [mm] | 0.000 | 0.000 | 0.000 | 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.

### 2D Keypoints Table

| | Number of 2D Keypoints per Image | Number of Matched 2D Keypoints per Image |
|---|---|---|
| Median | 11592 | 1256 |
| Min | 10653 | 338 |
| Max | 14531 | 2787 |
| Mean | 11648 | 1269 |

### 3D Points from 2D Keypoint Matches

| | Number of 3D Points Observed |
|---|---|
| In 2 Images | 386214 |
| In 3 Images | 97732 |
| In 4 Images | 40030 |
| In 5 Images | 20027 |
| In 6 Images | 11439 |
| In 7 Images | 7314 |
| In 8 Images | 4556 |
| In 9 Images | 3242 |
| In 10 Images | 2228 |
| In 11 Images | 1643 |
| In 12 Images | 1227 |
| In 13 Images | 952 |
| In 14 Images | 735 |
| In 15 Images | 569 |
| In 16 Images | 508 |
| In 17 Images | 390 |
| In 18 Images | 296 |
| In 19 Images | 256 |
| In 20 Images | 210 |
| In 21 Images | 188 |
| In 22 Images | 145 |

| | |
|---|---|
| In 23 Images | 117 |
| In 24 Images | 101 |
| In 25 Images | 91 |
| In 26 Images | 80 |
| In 27 Images | 62 |
| In 28 Images | 64 |
| In 29 Images | 50 |
| In 30 Images | 29 |
| In 31 Images | 40 |
| In 32 Images | 38 |
| In 33 Images | 30 |
| In 34 Images | 34 |
| In 35 Images | 26 |
| In 36 Images | 22 |
| In 37 Images | 24 |
| In 38 Images | 10 |
| In 39 Images | 23 |
| In 40 Images | 12 |
| In 41 Images | 17 |
| In 42 Images | 13 |
| In 43 Images | 4 |
| In 44 Images | 10 |
| In 45 Images | 7 |
| In 46 Images | 10 |
| In 47 Images | 7 |
| In 48 Images | 6 |
| In 49 Images | 3 |
| In 50 Images | 8 |
| In 51 Images | 3 |
| In 52 Images | 1 |
| In 53 Images | 6 |
| In 54 Images | 3 |
| In 55 Images | 1 |
| In 56 Images | 1 |
| In 57 Images | 1 |
| In 58 Images | 3 |
| In 59 Images | 1 |
| In 60 Images | 2 |
| In 62 Images | 1 |
| In 65 Images | 2 |
| In 66 Images | 3 |
| In 70 Images | 1 |
| In 73 Images | 1 |

**2D Keypoint Matches**

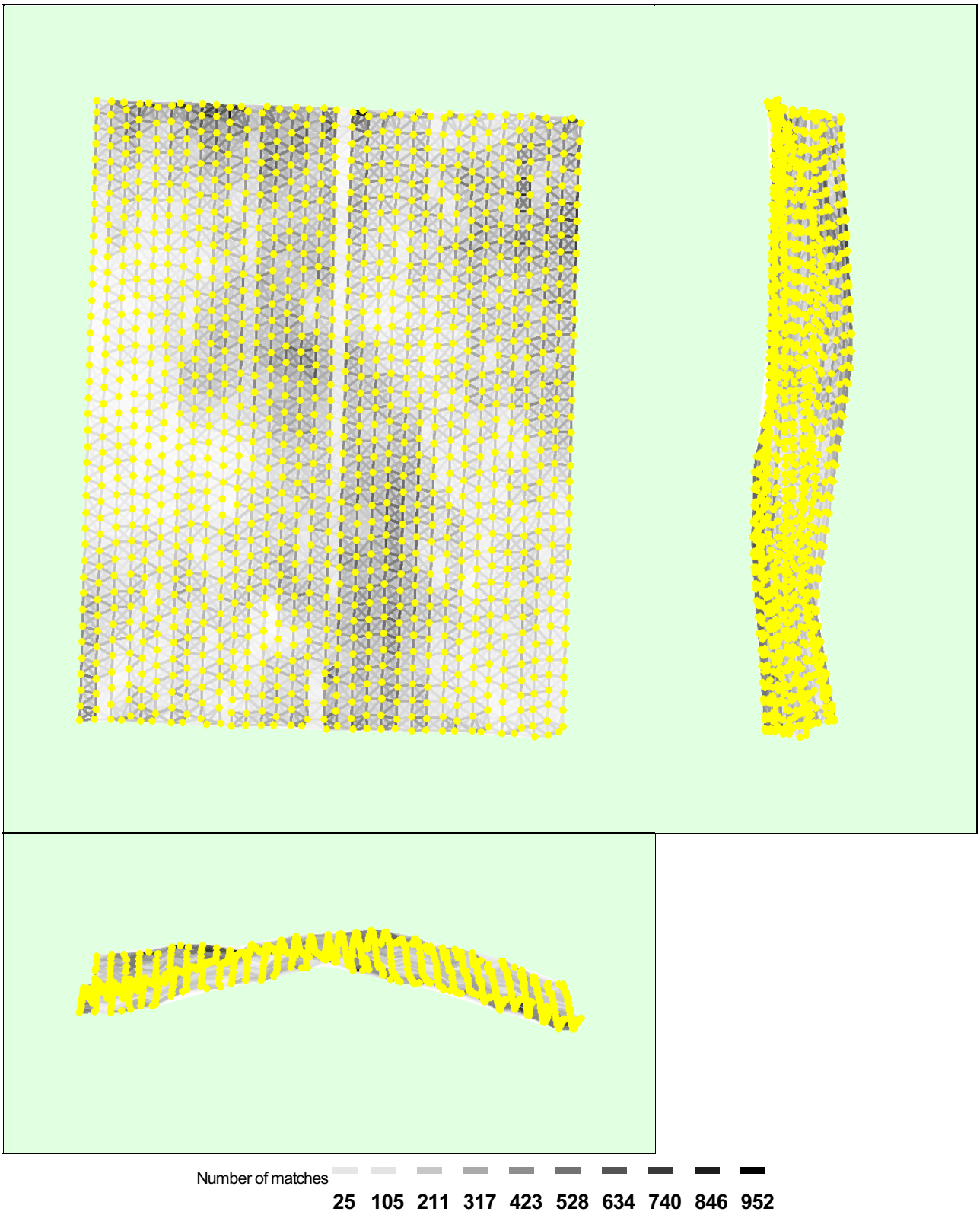



**Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.**

# 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 | 0.38 |
| -6.00 | -3.00 | 0.69 | 13.88 | 13.42 |
| -3.00 | 0.00 | 43.02 | 38.60 | 31.88 |
| 0.00 | 3.00 | 56.29 | 33.10 | 44.24 |
| 3.00 | 6.00 | 0.00 | 14.42 | 10.07 |
| 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]** | | -0.000000 | -0.000000 | 0.000000 |
| **Sigma [m]** | | 0.537917 | 2.485228 | 2.466805 |
| **RMS Error [m]** | | 0.537917 | 2.485228 | 2.466805 |

**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] | 100.00 | 97.25 | 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.**

| Geolocation Orientational Variance | RMS [degree] |
|---|---|
| Omega | 0.489 |
| Phi | 0.973 |
| Kappa | 5.254 |

**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) Core(TM) i7-8700K CPU @ 3.70GHz<br>RAM: 64GB<br>GPU: NVIDIA GeForce GTX 1080 Ti (Driver: 24.21.13.9882), Intel(R) UHD Graphics 630 (Driver: 22.20.16.4758) |
| Operating System | Windows 10 Education, 64-bit |

### Coordinate Systems

| | |
|---|---|
| Image Coordinate System | WGS 84 (EGM96 Geoid) |
| Output Coordinate System | WGS 84 / UTM zone 11N (EGM96 Geoid) |

### Processing Options

| | |
|---|---|
| Detected Template | RGB Local structure bark beetle severity* |
| Keypoints Image Scale | Custom, Image Scale: 0.5 |
| 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<br>Internal Parameters Optimization: All<br>External Parameters Optimization: All<br>Rematch: Auto, no |

# 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)<br>Color Balancing: no |
| LOD | Generated: no |
| Advanced: 3D Textured Mesh Settings | Sample Density Divider: 1 |
| Advanced: Image Groups | group1 |
| Advanced: Use Processing Area | yes |
| Advanced: Use Annotations | yes |
| Time for Point Cloud Densification | 04h:29m:10s |
| Time for Point Cloud Classification | NA |
| Time for 3D Textured Mesh Generation | 29m:10s |

### Results

| | |
|---|---|
| Number of Generated Tiles | 4 |
| Number of 3D Densified Points | 60440524 |
| Average Density (per $m^3$) | 20.02 |

# DSM, Orthomosaic and Index Details

### Processing Options

| | |
|---|---|
| DSM and Orthomosaic Resolution | 1 x GSD (5.39 [cm/pixel]) |
| DSM Filters | Noise Filtering: yes<br>Surface Smoothing: yes, Type: Sharp |
| Raster DSM | Generated: yes<br>Method: Triangulation<br>Merge Tiles: yes |
| Orthomosaic | Generated: yes<br>Merge Tiles: yes<br>GeoTIFF Without Transparency: no<br>Google Maps Tiles and KML: no |
| Time for DSM Generation | 03m:34s |
| Time for Orthomosaic Generation | 03h:09m:42s |
| Time for DTM Generation | 00s |
| Time for Contour Lines Generation | 00s |
| Time for Reflectance Map Generation | 00s |
| Time for Index Map Generation | 00s |