# Quality Report

Generated with Pix4Dmapper Pro version 3.2.10 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 | mallowsbay_rgb |
| Processed | 2017-07-09 15:28:28 |
| Camera Model Name(s) | CanonPowerShotS110_5.2-26.0mm_5.2_4000x3000 (RGB) |
| Average Ground Sampling Distance (GSD) | 3.51 cm / 1.38 in |
| Area Covered | 0.3778 $km^2$ / 37.7775 ha / 0.1459 sq. mi. / 93.3985 acres |
| Time for Initial Processing (without report) | 12m:24s |

## Quality Check

| | | |
|---|---|---|
| **Images** | median of 8126 keypoints per image | ⚠ |
| **Dataset** | 359 out of 521 images calibrated (68%), all images enabled, 3 blocks | ⚠ |
| **Camera Optimization** | 0.24% relative difference between initial and optimized internal camera parameters | ✓ |
| **Matching** | median of 719.671 matches per calibrated image | ⚠ |
| **Georeferencing** | yes, no 3D GCP | ⚠ |

## Preview

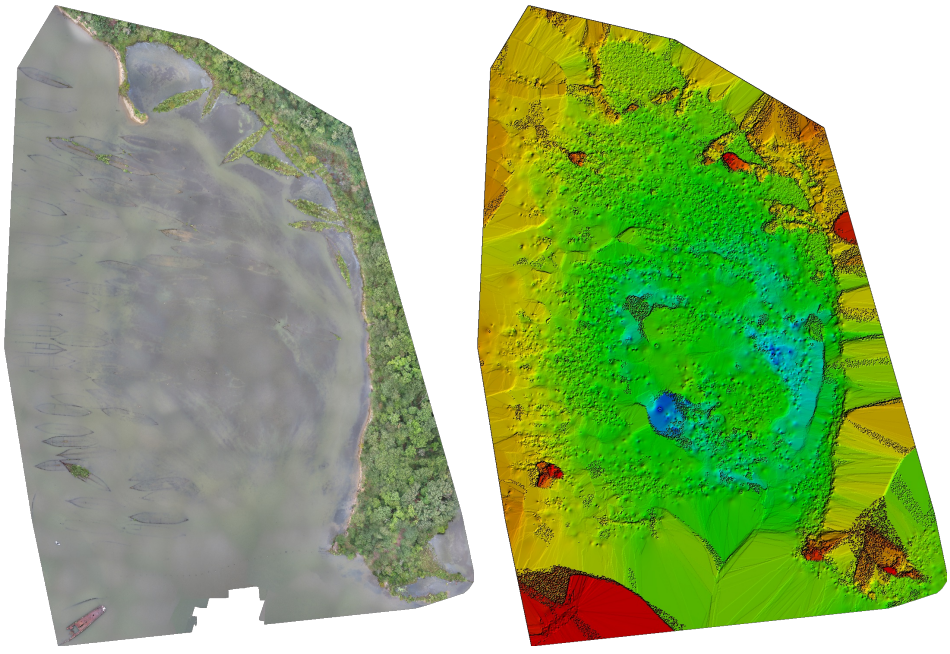


**Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.**

# Calibration Details

| | |
|---|---|
| Number of Calibrated Images | 359 out of 521 |
| Number of Geolocated Images | 521 out of 521 |

## Initial Image Positions

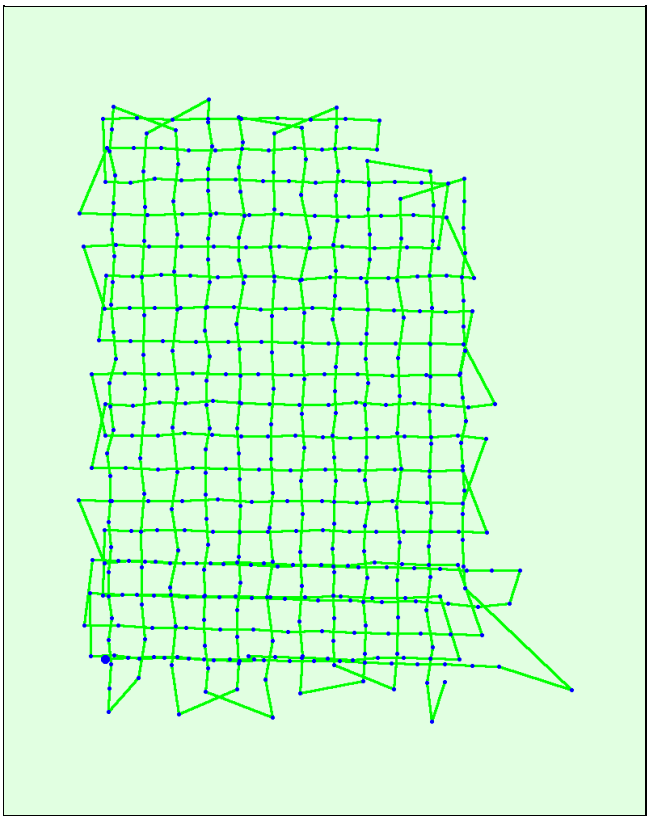


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

## Computed Image/GCPs/Manual Tie Points Positions

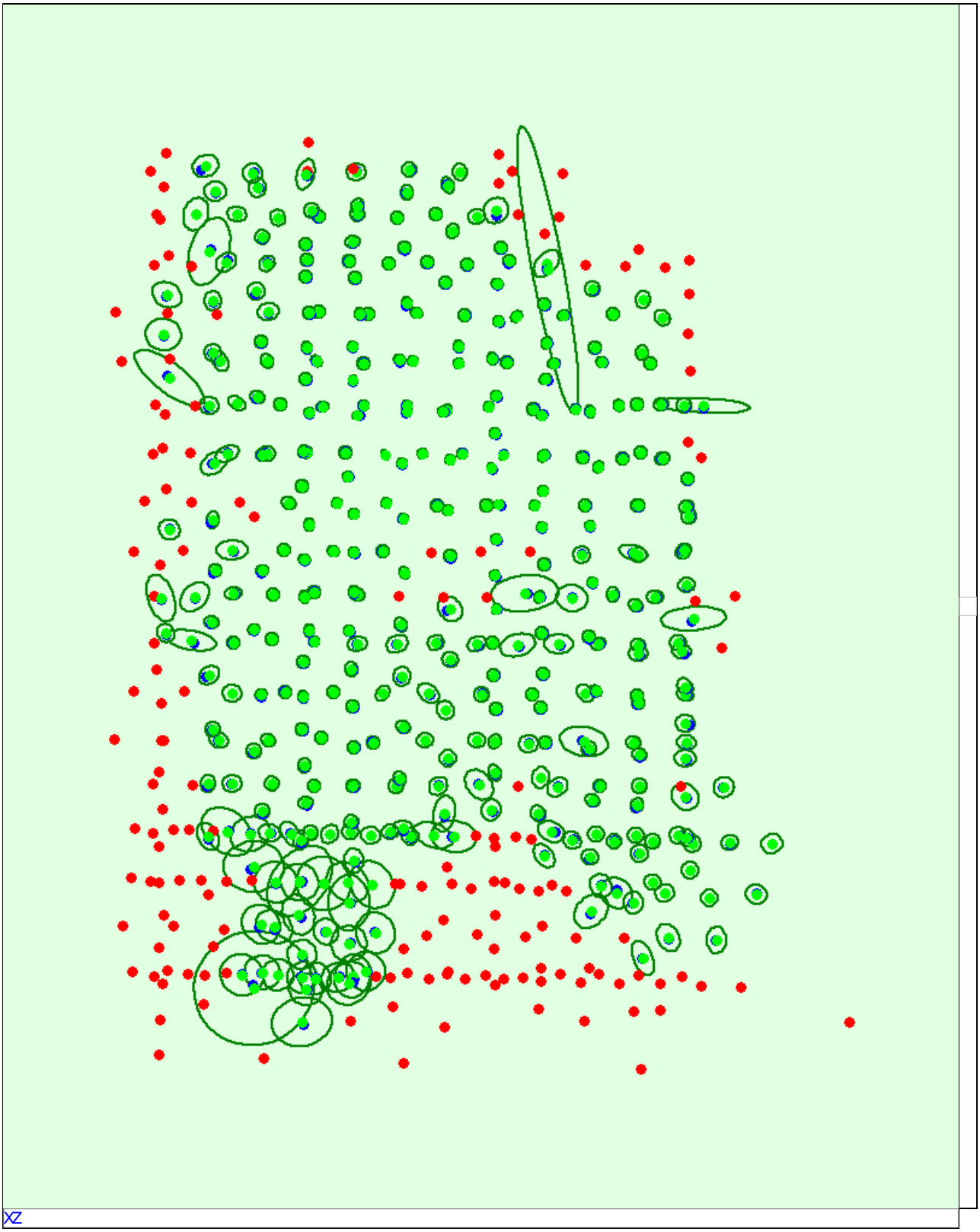



**Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane). Red dots indicate 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 | 0.956 | 0.947 | 1.150 | 0.535 | 0.555 | 0.255 |
| Sigma | 0.640 | 0.904 | 0.745 | 0.556 | 0.571 | 0.322 |

### Overlap

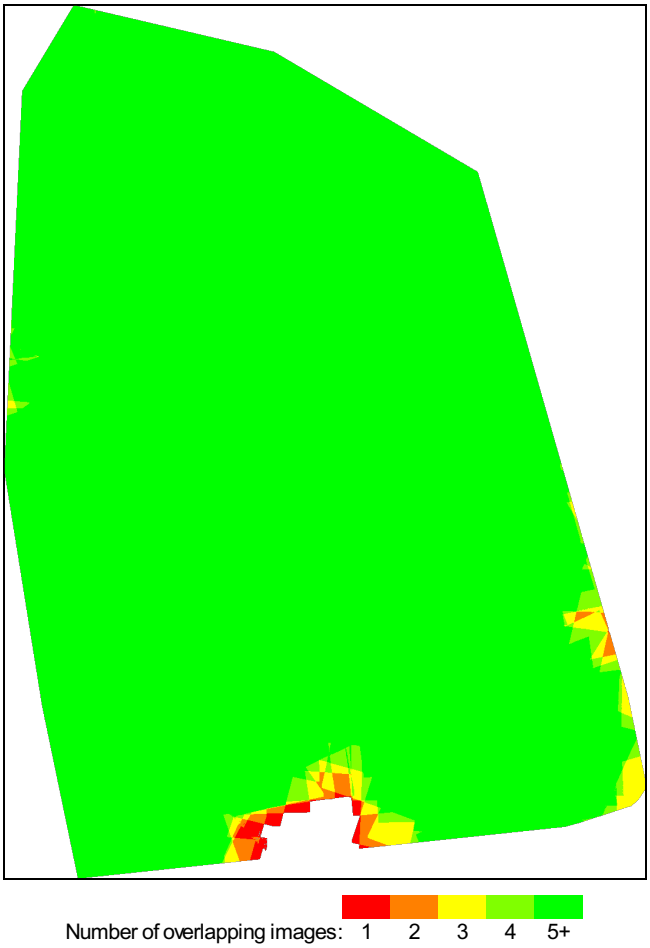



**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

# Bundle Block Adjustment Details

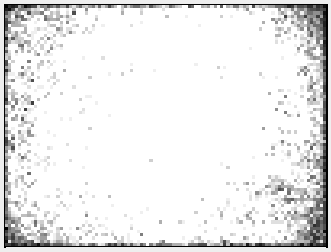
| | |
|---|---|
| Number of 2D Keypoint Observations for Bundle Block Adjustment | 334296 |
| Number of 3D Points for Bundle Block Adjustment | 122778 |
| Mean Reprojection Error [pixels] | 0.179 |

### Internal Camera Parameters

**CanonPowerShotS110_5.2-26.0mm_5.2_4000x3000 (RGB). Sensor Dimensions: 7.440 [mm] x 5.580 [mm]**

**EXIF ID: CanonPowerShotS110_5.2_4000x3000**

| | Focal Length | Principal Point x | Principal Point y | R1 | R2 | R3 | T1 | T2 |
|---|---|---|---|---|---|---|---|---|
| Initial Values | 2883.887 [pixel]<br>5.364 [mm] | 2000.000 [pixel]<br>3.720 [mm] | 1500.000 [pixel]<br>2.790 [mm] | -0.013 | -0.066 | 0.049 | -0.001 | 0.001 |
| Optimized Values | 2876.782 [pixel]<br>5.351 [mm] | 1996.296 [pixel]<br>3.713 [mm] | 1470.159 [pixel]<br>2.734 [mm] | -0.039 | -0.020 | 0.019 | -0.002 | 0.000 |
| Uncertainties (Sigma) | 9.318 [pixel]<br>0.017 [mm] | 1.986 [pixel]<br>0.004 [mm] | 2.574 [pixel]<br>0.005 [mm] | 0.002 | 0.007 | 0.006 | 0.000 | 0.000 |



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.

## 2D Keypoints Table

| | Number of 2D Keypoints per Image | Number of Matched 2D Keypoints per Image |
|---|---|---|
| Median | 8126 | 720 |
| Min | 5800 | 37 |
| Max | 15586 | 3879 |
| Mean | 9076 | 931 |

## 3D Points from 2D Keypoint Matches

| | Number of 3D Points Observed |
|---|---|
| In 2 Images | 84240 |
| In 3 Images | 19735 |
| In 4 Images | 7956 |
| In 5 Images | 4067 |
| In 6 Images | 2312 |
| In 7 Images | 1463 |
| In 8 Images | 879 |
| In 9 Images | 618 |
| In 10 Images | 460 |
| In 11 Images | 342 |
| In 12 Images | 273 |
| In 13 Images | 177 |
| In 14 Images | 125 |
| In 15 Images | 71 |
| In 16 Images | 38 |
| In 17 Images | 16 |
| In 18 Images | 3 |
| In 19 Images | 3 |

## 2D Keypoint Matches

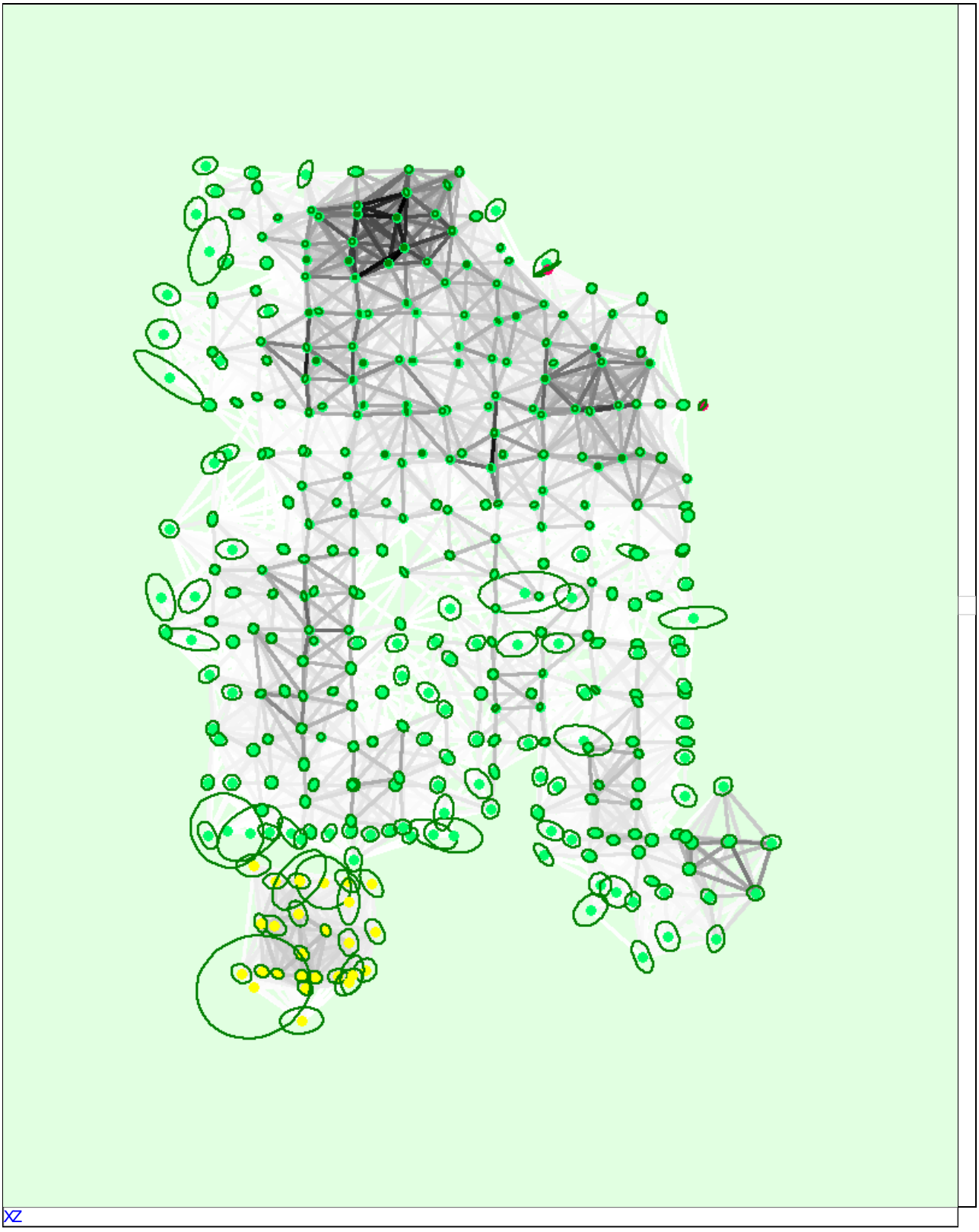



**Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty 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 | 0.723 | 0.688 | 0.740 | 0.453 | 0.448 | 0.179 |
| Sigma | 0.639 | 0.549 | 0.447 | 0.344 | 0.359 | 0.159 |

# Geolocation Details

### Absolute Geolocation Variance

| Min Error [m] | Max Error [m] | Geolocation Error X [%] | Geolocation Error Y [%] | Geolocation Error Z [%] |
|---|---|---|---|---|
| - | -10.83 | 0.00 | 0.00 | 0.00 |
| -10.83 | -8.66 | 0.00 | 0.00 | 0.00 |
| -8.66 | -6.50 | 0.00 | 0.00 | 0.00 |
| -6.50 | -4.33 | 0.00 | 0.28 | 0.00 |
| -4.33 | -2.17 | 1.95 | 3.62 | 1.39 |
| -2.17 | 0.00 | 43.45 | 62.95 | 38.72 |
| 0.00 | 2.17 | 53.20 | 32.31 | 55.99 |
| 2.17 | 4.33 | 1.39 | 0.84 | 3.90 |
| 4.33 | 6.50 | 0.00 | 0.00 | 0.00 |
| 6.50 | 8.66 | 0.00 | 0.00 | 0.00 |
| 8.66 | 10.83 | 0.00 | 0.00 | 0.00 |
| 10.83 | - | 0.00 | 0.00 | 0.00 |
| **Mean [m]** | | 0.068213 | -0.416441 | 0.263673 |
| **Sigma [m]** | | 0.926586 | 0.983389 | 1.077838 |
| **RMS Error [m]** | | 0.929093 | 1.067931 | 1.109621 |

**Min Error and Max Error represent geolocation error intervalsbetween -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 intial 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] | 98.33 | 97.49 | 99.16 |
| [-2.00, 2.00] | 99.44 | 100.00 | 100.00 |
| [-3.00, 3.00] | 100.00 | 100.00 | 100.00 |
| **Mean of Geolocation Accuracy [m]** | 4.003571 | 4.003571 | 4.017162 |
| **Sigma of Geolocation Accuracy [m]** | 2.235284 | 2.235284 | 1.641233 |

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

| Geolocation Orientational Variance | RMS [degree] |
|---|---|
| Omega | 4.459 |
| Phi | 4.437 |
| Kappa | 5.449 |

**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) i7-6800K CPU @ 3.40GHz<br>RAM: 64GB<br>GPU: unknown graphics card (Driver: unknown) |
| Operating System | Windows 10 Enterprise, 64-bit |

### Coordinate Systems

| | |
|---|---|
| Image Coordinate System | WGS84 |
| Output Coordinate System | WGS84 / UTM zone 18N |

### Processing Options

| | |
|---|---|
| Detected Template | No Template Available |
| Keypoints Image Scale | Custom, Image Scale: 0.5 |
| Advanced: Matching Image Pairs | Aerial Grid or Corridor |
| Advanced: Matching Strategy | Use Geometrically Verified Matching: yes |
| Advanced: Keypoint Extraction | Targeted Number of Keypoints: Automatic |
| Advanced: Calibration | Calibration Method: Alternative<br>Internal Parameters Optimization: All<br>External Parameters Optimization: All<br>Rematch: Auto, no<br>Bundle Adjustment: Classic |

# 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 |
| Advanced: 3D Textured Mesh Settings | Sample Density Divider: 1 |
| Advanced: Matching Window Size | 7x7 pixels |
| Advanced: Image Groups | group1 |
| Advanced: Use Processing Area | yes |
| Advanced: Use Annotations | yes |
| Advanced: Limit Camera Depth Automatically | no |
| Time for Point Cloud Densification | 15m:57s |
| Time for 3D Textured Mesh Generation | 07m:40s |

### Results

| | |
|---|---|
| Number of Generated Tiles | 1 |
| Number of 3D Densified Points | 10124935 |
| Average Density (per $m^3$) | 56.96 |

# DSM, Orthomosaic and Index Details

### Processing Options

| | |
|---|---|
| DSM and Orthomosaic Resolution | 1 x GSD (3.51 [cm/pixel]) |
| DSM Filters | Noise Filtering: yes<br>Surface Smoothing: yes, Type: Sharp |
| Raster DSM | Generated: yes<br>Method: Inverse Distance Weighting<br>Merge Tiles: yes |
| Orthomosaic | Generated: yes<br>Merge Tiles: yes<br>GeoTIFF Without Transparency: yes<br>Google Maps Tiles and KML: yes |
| Time for DSM Generation | 13m:20s |
| Time for Orthomosaic Generation | 32m:14s |