

# Quality Report



Generated with PIX4Dmapper version 4.8.1 Preview



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## Summary



|  |   |
|--|---|
| Project                                | M1-Páty_szeptember_v2   |
| Processed                              | 2022-10-03 11:24:02   |
| Camera Model Name(s)                   | FC6310R_8.8_5472x3648 (RGB)(1), FC6310R_8.8_5472x3648 (RGB)(2)    |
| Average Ground Sampling Distance (GSD) | 1.80 cm / 0.71 in   |
| Area Covered                           | 0.374 km <sup>2</sup> / 37.4278 ha / 0.14 sq. mi. / 92.5341 acres |

## Quality Check



|                            |  |  |
|----------------------------|--|--|
| <b>Images</b>              | median of 53708 keypoints per image  |  |
| <b>Dataset</b>             | 1037 out of 1037 images calibrated (100%), all images enabled                      |  |
| <b>Camera Optimization</b> | 0.71% relative difference between initial and optimized internal camera parameters |  |
| <b>Matching</b>            | median of 16063.7 matches per calibrated image                                     |  |
| <b>Georeferencing</b>      | yes, 2 GCPs (2 3D), mean RMS error = 0.494 m                                       |  |

## Preview

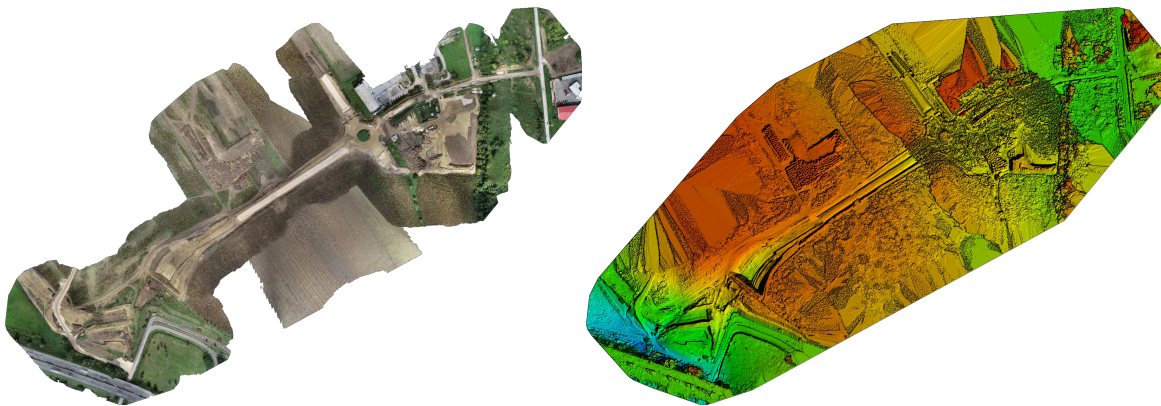


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

## Calibration Details



|                             |                  |
|-----------------------------|------------------|
| Number of Calibrated Images | 1037 out of 1037 |
| Number of Geolocated Images | 1037 out of 1037 |

## Initial Image Positions



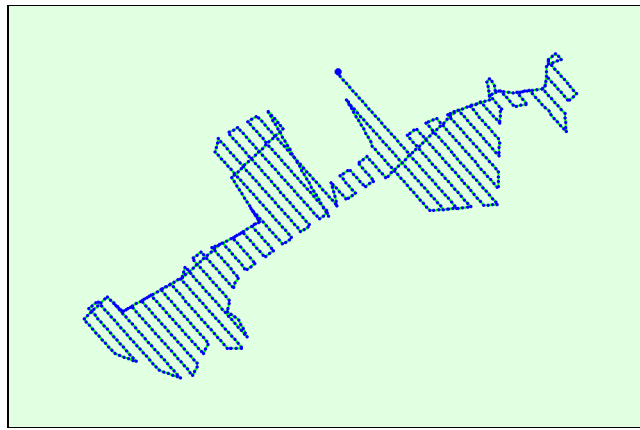


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

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

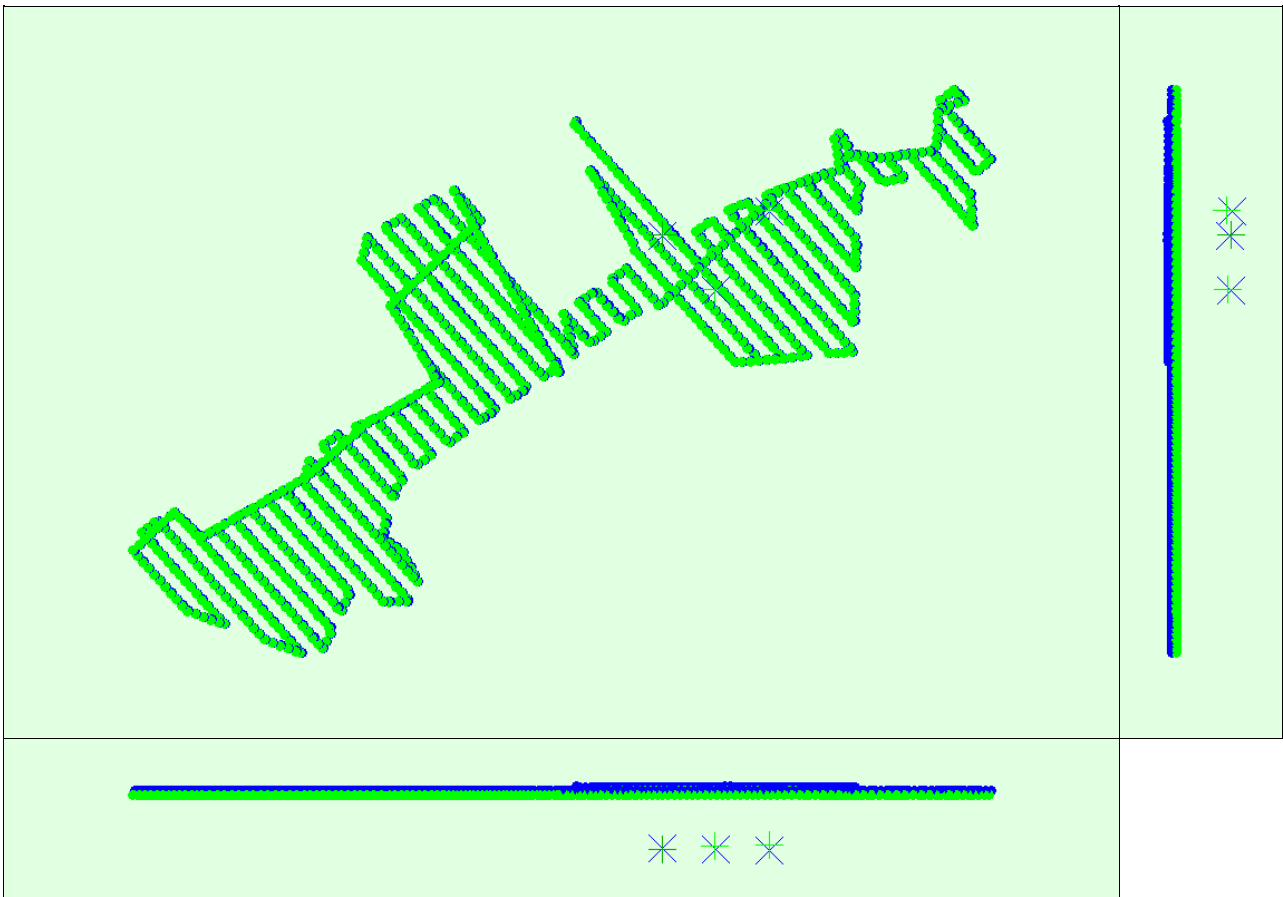


Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane).

**Overlap**



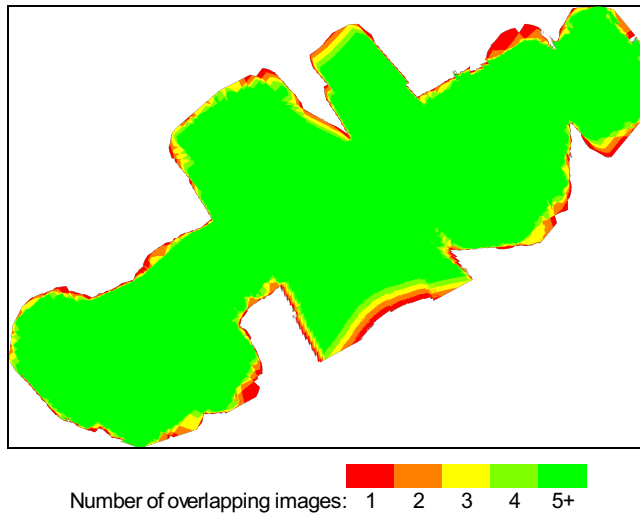


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic. Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

## Bundle Block Adjustment Details

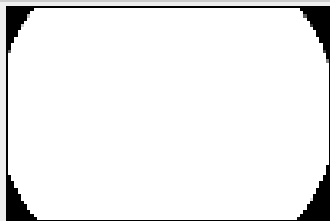
|  |          |
|--|----------|
| Number of 2D Keypoint Observations for Bundle Block Adjustment | 17708255 |
| Number of 3D Points for Bundle Block Adjustment                | 5218326  |
| Mean Reprojection Error [pixels]                               | 0.124    |

### Internal Camera Parameters

#### FC6310R\_8.8\_5472x3648 (RGB)(1). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]

EXIF ID: FC6310R\_8.8\_5472x3648

|                  | Focal Length                   | Principal Point x              | Principal Point y              | R1     | R2    | R3     | T1     | T2     |
|------------------|--------------------------------|--------------------------------|--------------------------------|--------|-------|--------|--------|--------|
| Initial Values   | 3658.300 [pixel]<br>8.580 [mm] | 2722.500 [pixel]<br>6.385 [mm] | 1835.100 [pixel]<br>4.304 [mm] | -0.269 | 0.112 | -0.033 | 0.000  | -0.001 |
| Optimized Values | 3666.520 [pixel]<br>8.599 [mm] | 2705.144 [pixel]<br>6.344 [mm] | 1802.884 [pixel]<br>4.228 [mm] | -0.277 | 0.121 | -0.035 | -0.000 | 0.000  |



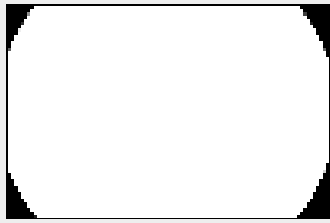
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to 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

#### FC6310R\_8.8\_5472x3648 (RGB)(2). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]

EXIF ID: FC6310R\_8.8\_5472x3648

|                  | Focal Length                   | Principal Point x              | Principal Point y              | R1     | R2    | R3     | T1     | T2     |
|------------------|--------------------------------|--------------------------------|--------------------------------|--------|-------|--------|--------|--------|
| Initial Values   | 3658.300 [pixel]<br>8.580 [mm] | 2722.500 [pixel]<br>6.385 [mm] | 1835.100 [pixel]<br>4.304 [mm] | -0.269 | 0.112 | -0.033 | 0.000  | -0.001 |
| Optimized Values | 3702.247 [pixel]<br>8.683 [mm] | 2705.970 [pixel]<br>6.346 [mm] | 1802.181 [pixel]<br>4.227 [mm] | -0.282 | 0.126 | -0.037 | -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 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 | 53708                            | 16064                                    |
| Mn     | 37632                            | 392                                      |
| Max    | 83372                            | 35679                                    |
| Mean   | 54378                            | 17076                                    |

### 2D Keypoints Table for Camera FC6310R\_8.8\_5472x3648 (RGB)(1)

|        | Number of 2D Keypoints per Image | Number of Matched 2D Keypoints per Image |
|--------|----------------------------------|--|
| Median | 55626                            | 25162                                    |
| Mn     | 37632                            | 6419                                     |
| Max    | 83372                            | 35679                                    |
| Mean   | 57579                            | 24506                                    |

### 2D Keypoints Table for Camera FC6310R\_8.8\_5472x3648 (RGB)(2)

|        | Number of 2D Keypoints per Image | Number of Matched 2D Keypoints per Image |
|--------|----------------------------------|--|
| Median | 53495                            | 14654                                    |
| Mn     | 37717                            | 392                                      |
| Max    | 79180                            | 30423                                    |
| Mean   | 53440                            | 14899                                    |

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

|                                | FC6310R_8.8_...(RGB)(1) | FC6310R_8.8_...(RGB)(2) |
|--------------------------------|-------------------------|-------------------------|
| FC6310R_8.8_5472x3648 (RGB)(1) | 619 / 2137 / 28514      |                         |
| FC6310R_8.8_5472x3648 (RGB)(2) |                         | 243 / 956 / 17083       |

## ? 3D Points from 2D Keypoint Matches



|              | Number of 3D Points Observed |
|--------------|------------------------------|
| In 2 Images  | 3012853                      |
| In 3 Images  | 933925                       |
| In 4 Images  | 431226                       |
| In 5 Images  | 243110                       |
| In 6 Images  | 152613                       |
| In 7 Images  | 103350                       |
| In 8 Images  | 69789                        |
| In 9 Images  | 51550                        |
| In 10 Images | 39503                        |
| In 11 Images | 31378                        |
| In 12 Images | 25222                        |
| In 13 Images | 20442                        |
| In 14 Images | 16452                        |
| In 15 Images | 13558                        |
| In 16 Images | 11691                        |
| In 17 Images | 9795                         |
| In 18 Images | 8142                         |
| In 19 Images | 7145                         |

|              |      |
|--------------|------|
| In 20 Images | 6070 |
| In 21 Images | 5144 |
| In 22 Images | 4209 |
| In 23 Images | 3523 |
| In 24 Images | 3038 |
| In 25 Images | 2566 |
| In 26 Images | 2119 |
| In 27 Images | 1806 |
| In 28 Images | 1527 |
| In 29 Images | 1298 |
| In 30 Images | 1087 |
| In 31 Images | 860  |
| In 32 Images | 720  |
| In 33 Images | 591  |
| In 34 Images | 477  |
| In 35 Images | 388  |
| In 36 Images | 278  |
| In 37 Images | 228  |
| In 38 Images | 169  |
| In 39 Images | 137  |
| In 40 Images | 121  |
| In 41 Images | 75   |
| In 42 Images | 48   |
| In 43 Images | 26   |
| In 44 Images | 28   |
| In 45 Images | 15   |
| In 46 Images | 12   |
| In 47 Images | 10   |
| In 48 Images | 5    |
| In 49 Images | 3    |
| In 50 Images | 4    |

## 2D Keypoint Matches

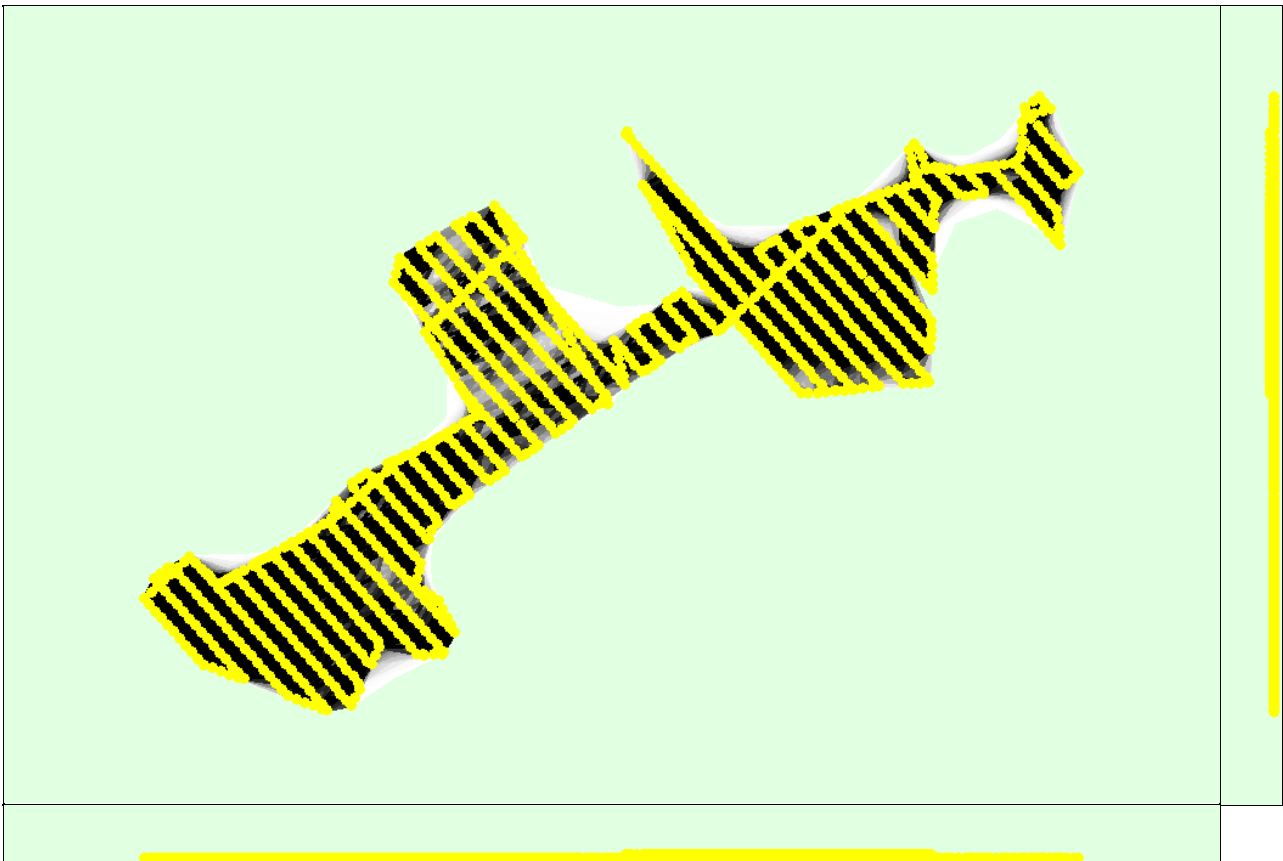




Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

## Geolocation Details

### Ground Control Points

| GCP Name             | Accuracy XYZ [m] | Error X [m] | Error Y [m] | Error Z [m] | Projection Error [pixel] | Verified/Marked |
|----------------------|------------------|-------------|-------------|-------------|--------------------------|-----------------|
| 5 (3D)               | 0.009/ 0.012     | -418682.977 | 93405.767   | 226751.413  | n/a                      | 0 / 37          |
| 11 (3D)              | 0.010/ 0.013     | -195600.542 | 92449.431   | 117460.433  | n/a                      | 0 / 30          |
| 7 (3D)               | 0.011/ 0.024     | 0.761       | -2.083      | -3.120      | 66.746                   | 9 / 10          |
| 6 (3D)               | 0.011/ 0.025     | -0.019      | -2.203      | 1.206       | 62.285                   | 3 / 6           |
| 8 (3D)               | 0.009/ 0.018     | 98583.641   | -104641.767 | 76842.314   | n/a                      | 0 / 7           |
| 9 (3D)               | 0.009/ 0.020     | 105005.640  | 1727.910    | 55195.763   | n/a                      | 0 / 21          |
| s1 (3D)              | 0.020/ 0.020     | 343.647     | -628.343    | 354.243     | n/a                      | 0 / 14          |
| s2 (3D)              | 0.020/ 0.020     | 0.276       | -2.346      | -5.337      | 62.299                   | 32 / 32         |
| <b>Mean [m]</b>      |                  | 0.518305    | -2.214826   | -4.228614   |                          |                 |
| <b>Sigma [m]</b>     |                  | 0.242746    | 0.131565    | 1.108204    |                          |                 |
| <b>RMS Error [m]</b> |                  | 0.572333    | 2.218730    | 4.371418    |                          |                 |

Localisation accuracy per GCP and mean errors in the three coordinate directions. The last column counts the number of calibrated images where the GCP has been automatically verified vs. manually marked.

### Absolute Geolocation Variance

| Min Error [m]        | Max Error [m] | Geolocation Error X [%] | Geolocation Error Y [%] | Geolocation Error Z [%] |
|----------------------|---------------|-------------------------|-------------------------|-------------------------|
| -                    | -0.06         | 0.00                    | 0.00                    | 0.00                    |
| -0.06                | -0.05         | 0.00                    | 0.00                    | 0.00                    |
| -0.05                | -0.04         | 0.00                    | 0.00                    | 0.00                    |
| -0.04                | -0.02         | 0.00                    | 0.00                    | 0.00                    |
| -0.02                | -0.01         | 0.00                    | 0.00                    | 0.00                    |
| -0.01                | 0.00          | 0.00                    | 0.00                    | 0.00                    |
| 0.00                 | 0.01          | 0.00                    | 0.00                    | 0.00                    |
| 0.01                 | 0.02          | 0.00                    | 0.00                    | 0.00                    |
| 0.02                 | 0.04          | 0.00                    | 0.00                    | 0.00                    |
| 0.04                 | 0.05          | 0.00                    | 0.00                    | 0.00                    |
| 0.05                 | 0.06          | 0.00                    | 0.00                    | 0.00                    |
| 0.06                 | -             | 100.00                  | 100.00                  | 100.00                  |
| <b>Mean [m]</b>      |               | 1.460167                | 0.314396                | 5.100975                |
| <b>Sigma [m]</b>     |               | 0.003708                | 0.003958                | 0.008235                |
| <b>RMS Error [m]</b> |               | 1.460172                | 0.314420                | 5.100981                |

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]              | 0.00         | 0.00         | 0.00         |
| [-2.00, 2.00]              | 0.00         | 0.00         | 0.00         |

|  |          |          |          |
|--|----------|----------|----------|
| [-3.00, 3.00]                            | 0.00     | 0.00     | 0.00     |
| <b>Mean of Geolocation Accuracy [m]</b>  | 0.010380 | 0.010380 | 0.019142 |
| <b>Sigma of Geolocation Accuracy [m]</b> | 0.000496 | 0.000496 | 0.001239 |

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

|                                    |              |
|------------------------------------|--------------|
| Geolocation Orientational Variance | RMS [degree] |
| Omega                              | 0.523        |
| Phi                                | 0.465        |
| Kappa                              | 2.506        |

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) i7-10750H CPU @ 2.60GHz<br>RAM: 16GB<br>GPU: Intel(R) UHD Graphics (Driver: 27.20.100.9664), NVIDIA GeForce RTX 3060 Laptop GPU (Driver: 30.0.14.7219) |
| Operating System | Windows 10 Pro, 64-bit  |

### Coordinate Systems



|                          |             |
|--------------------------|-------------|
| Image Coordinate System  | WGS 84      |
| Output Coordinate System | HD72 / EOVS |

### Processing Options



|                                |   |
|--------------------------------|---|
| Detected Template              | No Template Available   |
| Keypoints Image Scale          | Full, 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: Geolocation Based<br>Internal Parameters Optimization: All prior<br>External Parameters Optimization: All<br>Rematch: Auto, yes |