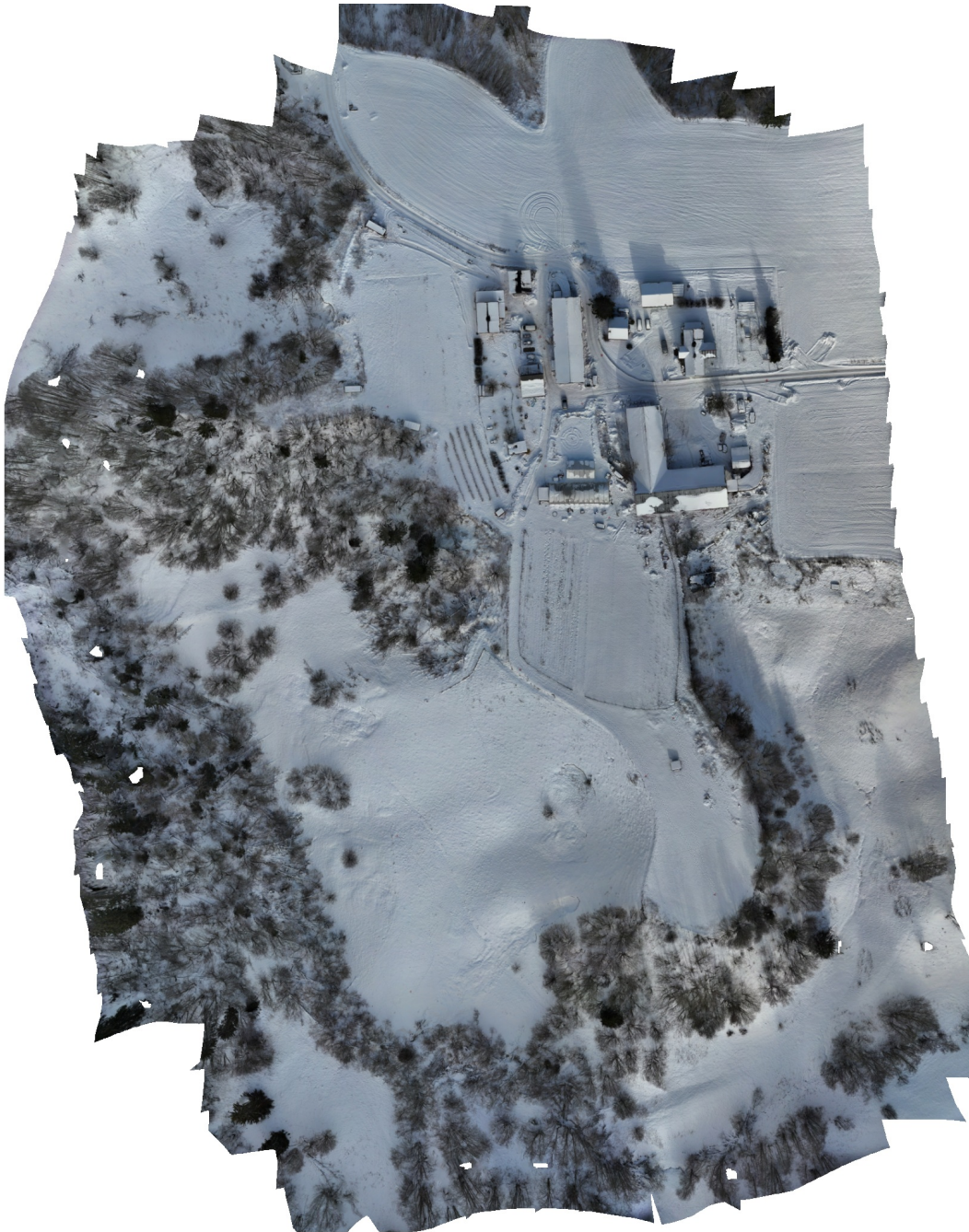


Sander 2026-02-19

DJI Matrice 4E
Flown by Luc Girod and Valérian Janquin
Kartverket NTRIP, 16 CPs
EUREF89 - UTM32N - NN2000
19 February 2026



Survey Data

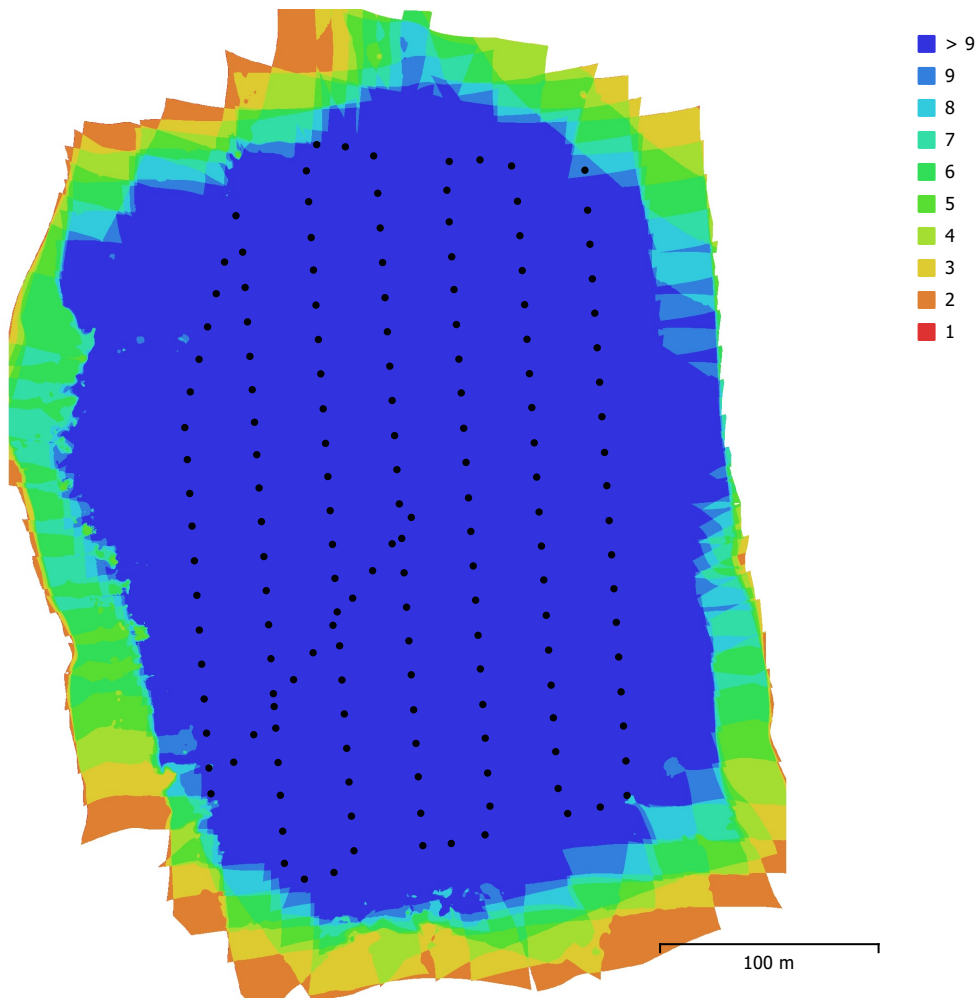


Fig. 1. Camera locations and image overlap.

| | | | |
|--------------------|-----------------------|---------------------|-----------|
| Number of images: | 156 | Camera stations: | 156 |
| Flying altitude: | 80.6 m | Tie points: | 86,828 |
| Ground resolution: | 2.17 cm/pix | Projections: | 634,707 |
| Coverage area: | 0.128 km ² | Reprojection error: | 0.987 pix |

| Camera Model | Resolution | Focal Length | Pixel Size | Precalibrated |
|---------------|-------------|--------------|---------------------|---------------|
| M4E (12.29mm) | 5280 x 3956 | 12.29 mm | 3.36 x 3.36 μ m | Yes |

Table 1. Cameras.

Camera Calibration

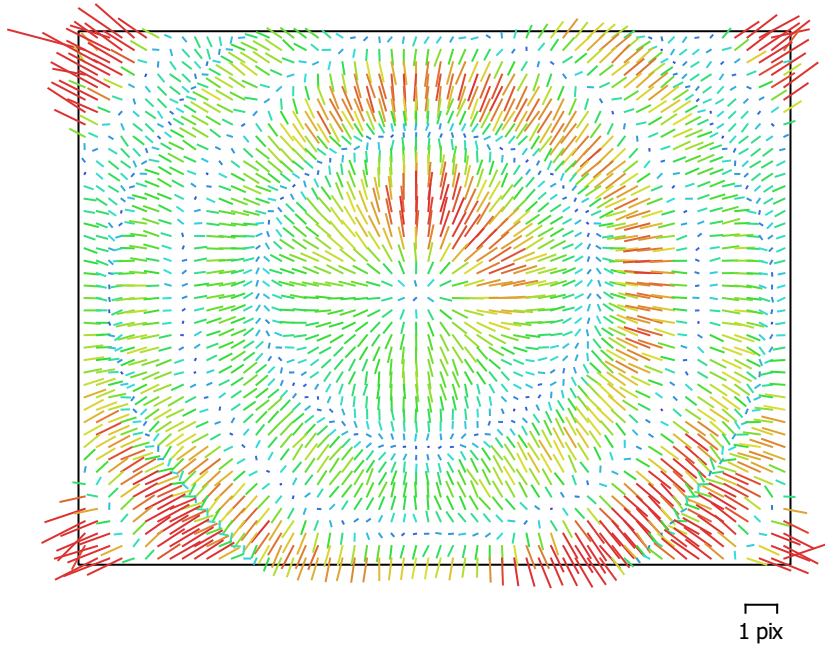


Fig. 2. Image residuals for M4E (12.29mm).

M4E (12.29mm)

156 images, precalibrated

| | | | |
|--------------|--------------------|-----------------|---|
| Type | Resolution | Focal Length | Pixel Size |
| Frame | 5280 x 3956 | 12.29 mm | 3.36 x 3.36 μm |

| | Value | Error | F | Cx | Cy | K1 | K2 | K3 | P1 | P2 |
|-----------|---------------------|---------|------|-------|-------|-------|-------|-------|-------|-------|
| F | 3721.6 | 0.077 | 1.00 | -0.02 | -0.11 | -0.19 | 0.08 | -0.12 | 0.02 | 0.01 |
| Cx | 18.4666 | 0.026 | | 1.00 | 0.01 | 0.02 | 0.00 | -0.00 | 0.13 | 0.01 |
| Cy | -18.2251 | 0.023 | | | 1.00 | -0.02 | 0.02 | -0.02 | -0.01 | 0.07 |
| K1 | -0.100034 | 2.8e-05 | | | | 1.00 | -0.93 | 0.87 | -0.01 | -0.08 |
| K2 | -0.0168252 | 7.3e-05 | | | | | 1.00 | -0.98 | -0.00 | 0.07 |
| K3 | -0.00634868 | 5.8e-05 | | | | | | 1.00 | 0.01 | -0.07 |
| P1 | -0.000326739 | 1.2e-06 | | | | | | | 1.00 | -0.00 |
| P2 | -0.000398967 | 1.2e-06 | | | | | | | | 1.00 |

Table 2. Calibration coefficients and correlation matrix.

Camera Locations

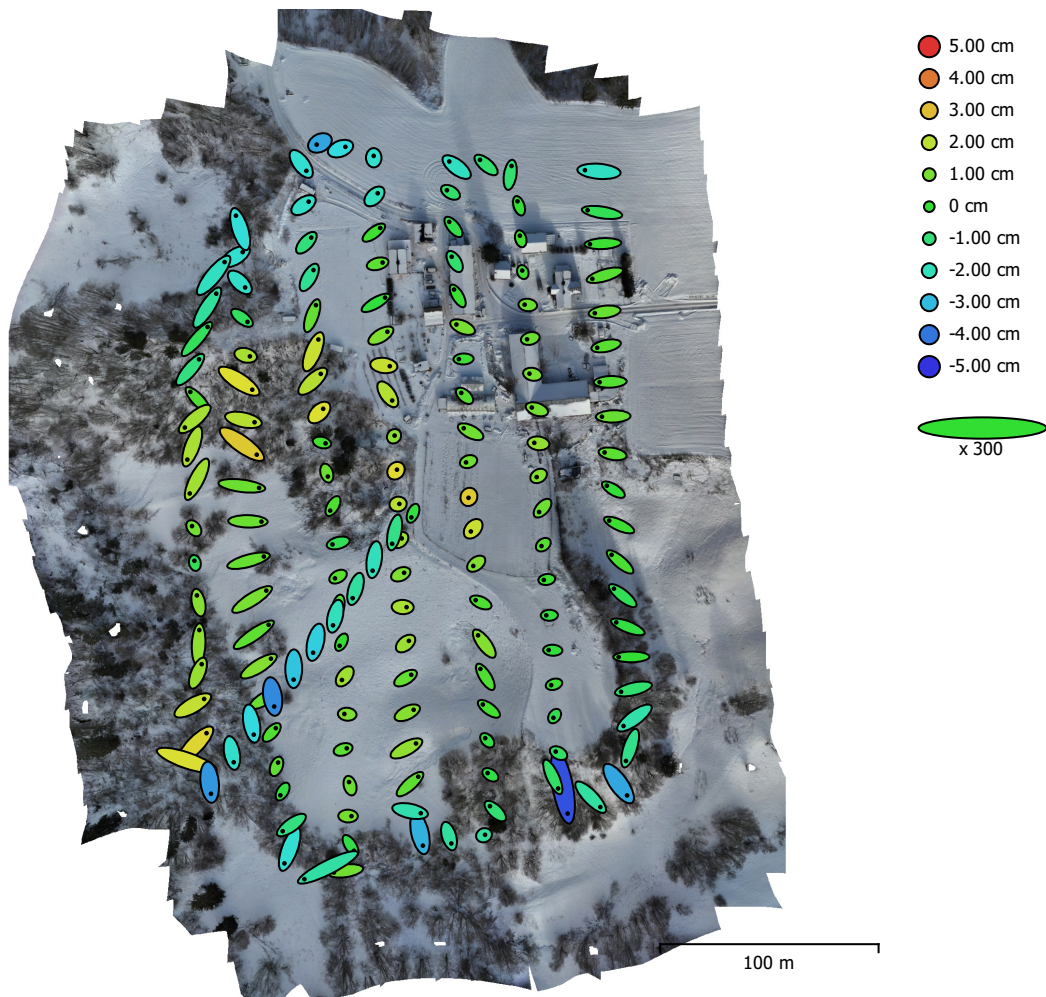


Fig. 3. Camera locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
 Estimated camera locations are marked with a black dot.

| X error (cm) | Y error (cm) | Z error (cm) | XY error (cm) | Total error (cm) |
|--------------|--------------|--------------|---------------|------------------|
| 2.21154 | 2.05009 | 1.51484 | 3.01559 | 3.37469 |

Table 3. Average camera location error.
 X - Easting, Y - Northing, Z - Altitude.

Ground Control Points

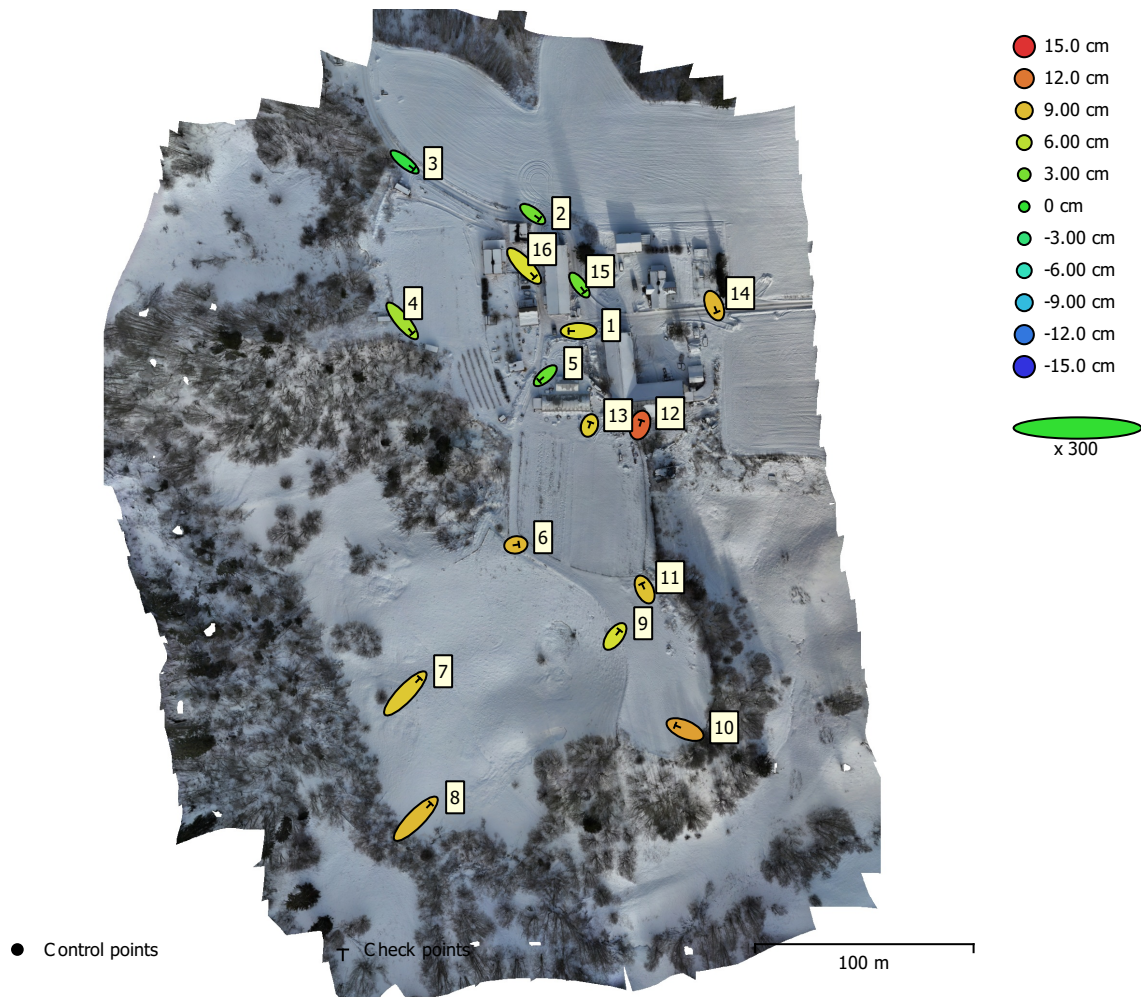


Fig. 4. GCP locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
 Estimated GCP locations are marked with a dot or crossing.

| Count | X error (cm) | Y error (cm) | Z error (cm) | XY error (cm) | Total (cm) |
|-------|--------------|--------------|--------------|---------------|------------|
| 16 | 2.54108 | 2.49102 | 7.71495 | 3.5584 | 8.49604 |

Table 4. Check points RMSE.

X - Easting, Y - Northing, Z - Altitude.

| Label | X error (cm) | Y error (cm) | Z error (cm) | Total (cm) | Image (pix) |
|--------------|---------------------|---------------------|---------------------|-------------------|--------------------|
| 1 | -3.05643 | -0.0184994 | 7.62307 | 8.21299 | 0.451 (5) |
| 2 | 2.11271 | -1.53952 | 2.79968 | 3.83038 | 0.731 (5) |
| 3 | 2.82978 | -2.21883 | -0.671446 | 3.6581 | 0.733 (6) |
| 4 | 3.15307 | -3.77775 | 4.95961 | 6.98649 | 0.461 (6) |
| 5 | -1.87295 | -1.62387 | 2.35061 | 3.41618 | 1.355 (7) |
| 6 | 0.92964 | 0.140746 | 9.24681 | 9.29449 | 0.777 (5) |
| 7 | 4.4624 | 4.66767 | 8.45764 | 10.641 | 0.768 (5) |
| 8 | 4.61178 | 4.65057 | 9.10978 | 11.2198 | 0.653 (9) |
| 9 | 1.47527 | 1.91277 | 7.11485 | 7.51373 | 0.719 (6) |
| 10 | -3.02486 | 1.29706 | 10.2517 | 10.767 | 0.456 (5) |
| 11 | -0.860111 | 1.78473 | 8.74423 | 8.96586 | 0.791 (5) |
| 12 | 0.445357 | 1.41599 | 12.9717 | 13.0564 | 0.753 (8) |
| 13 | 0.323928 | 0.95249 | 8.28503 | 8.34589 | 0.841 (6) |
| 14 | 0.845907 | -1.9759 | 9.25243 | 9.4988 | 0.831 (6) |
| 15 | 1.57526 | -2.10139 | 2.56162 | 3.66867 | 0.826 (6) |
| 16 | 3.23083 | -3.4478 | 7.38405 | 8.7664 | 0.601 (5) |
| Total | 2.54108 | 2.49102 | 7.71495 | 8.49604 | 0.774 |

Table 5. Check points.
X - Easting, Y - Northing, Z - Altitude.

Digital Elevation Model

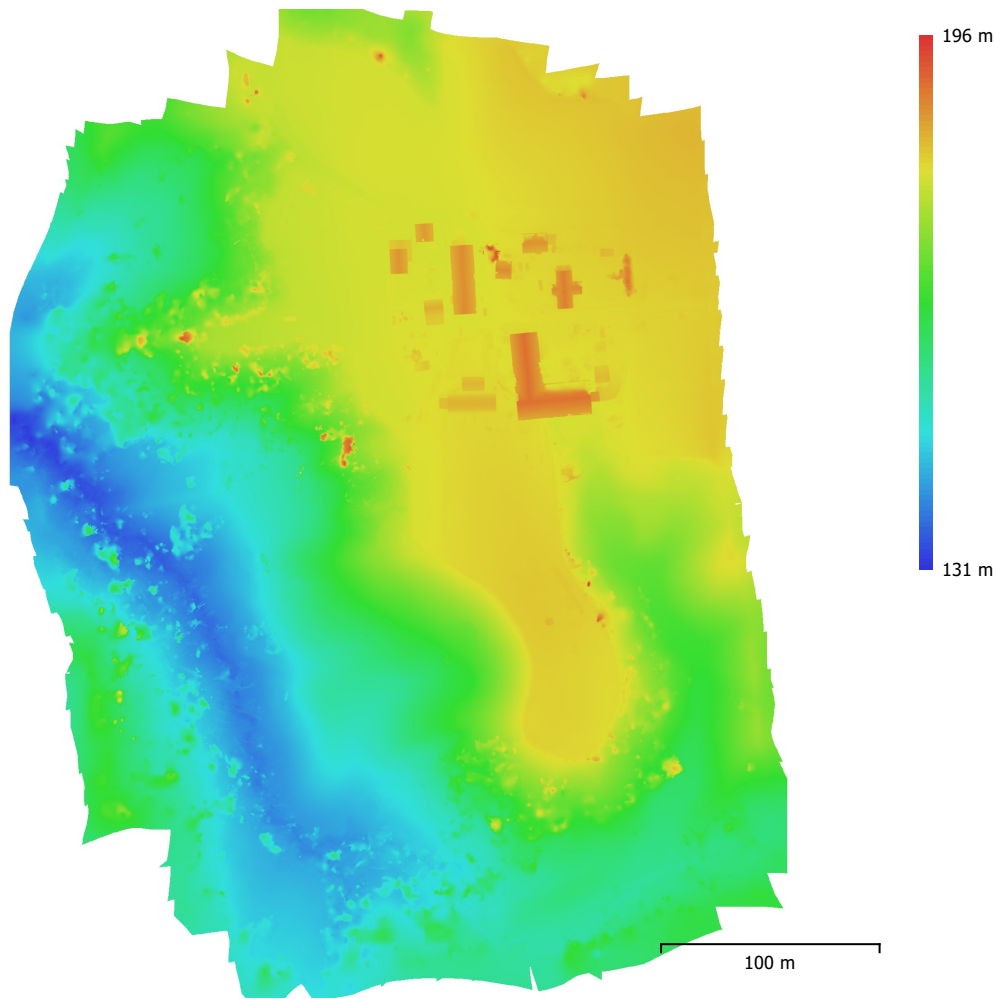


Fig. 5. Reconstructed digital elevation model.

Resolution: 5.00 cm/pix
Point density: 400 points/m²

Processing Parameters

General

| | |
|-------------------|--|
| Images | 156 |
| Aligned images | 156 |
| Markers | 16 |
| Coordinate system | ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972) |
| Rotation angles | Yaw, Pitch, Roll |

Tie Points

| | |
|--------------------------------|-------------------------|
| Points | 86,828 of 95,599 |
| RMS reprojection error | 0.280019 (0.986609 pix) |
| Max reprojection error | 1.01105 (57.422 pix) |
| Mean key point size | 3.27826 pix |
| Point colors | 3 bands, uint8 |
| Key points | No |
| Average tie point multiplicity | 7.77255 |

Alignment parameters

| | |
|-------------------------------|------------|
| Accuracy | High |
| Generic preselection | Yes |
| Reference preselection | Source |
| Key point limit | 40,000 |
| Key point limit per Mpx | 1,000 |
| Tie point limit | 4,000 |
| Exclude stationary tie points | Yes |
| Guided image matching | No |
| Adaptive camera model fitting | Yes |
| Matching time | 37 seconds |
| Matching memory usage | 464.22 MB |
| Alignment time | 17 seconds |
| Alignment memory usage | 75.28 MB |

Optimization parameters

| | |
|-------------------------------|--------------------------|
| Parameters | f, cx, cy, k1-k3, p1, p2 |
| Adaptive camera model fitting | No |
| Exclude corners | No |
| Optimization time | 1 seconds |
| Date created | 2026:02:19 14:29:42 |
| Software version | 2.2.1.20641 |
| File size | 41.94 MB |

Depth Maps

| | |
|---|---------------------|
| Count | 145 |
| Depth maps generation parameters | |
| Quality | High |
| Filtering mode | Moderate |
| Max neighbors | 16 |
| Processing time | 4 minutes 0 seconds |
| Memory usage | 4.65 GB |
| Date created | 2026:02:19 14:50:44 |
| Software version | 2.2.1.20641 |
| File size | 874.76 MB |

DEM

| | |
|---|--|
| Size | 7,109 x 9,045 |
| Resolution | 5.00 cm/pix |
| Coordinate system | ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972) |
| Depth maps generation parameters | |
| Quality | High |
| Filtering mode | Moderate |

| | |
|----------------------------------|--|
| Max neighbors | 16 |
| Processing time | 4 minutes 0 seconds |
| Memory usage | 4.65 GB |
| Reconstruction parameters | |
| Source data | Depth maps |
| Interpolation | Enabled |
| Processing time | 4 minutes 57 seconds |
| Memory usage | 8.45 GB |
| Date created | 2026:02:19 14:55:43 |
| Software version | 2.2.1.20641 |
| File size | 218.33 MB |
| Orthomosaic | |
| Size | 14,215 x 18,086 |
| Resolution | 2.50 cm/pix |
| Coordinate system | ETRS89 / UTM zone 32N + NN2000 height (EPSG::5972) |
| Colors | 3 bands, uint8 |
| Orthophotos | 881.72 MB |
| Reconstruction parameters | |
| Blending mode | Mosaic |
| Surface | DEM |
| Enable hole filling | Yes |
| Enable ghosting filter | No |
| Processing time | 1 minutes 35 seconds |
| Memory usage | 1.49 GB |
| Date created | 2026:02:19 14:57:31 |
| Software version | 2.2.1.20641 |
| File size | 1.07 GB |
| System | |
| Software name | Agisoft Metashape Professional |
| Software version | 2.2.1 build 20641 |
| OS | Windows 64 bit |
| RAM | 127.15 GB |
| CPU | AMD Ryzen 9 7950X 16-Core Processor |
| GPU(s) | NVIDIA GeForce RTX 4080 SUPER |