

Pilot verification of the use of unmanned aircraft systems in cadastral mapping – case study

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Mapping projects



Cooperation
between public
and private bodies



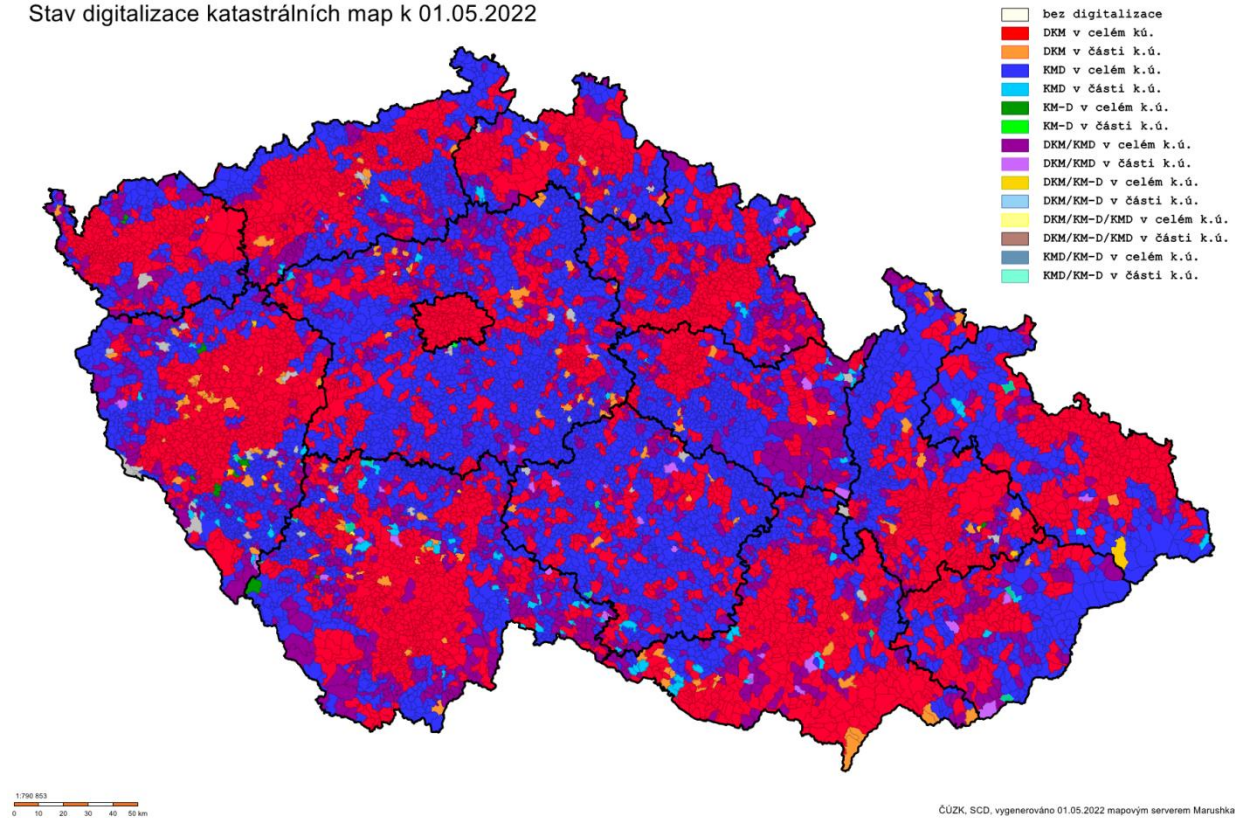
Case study



Summary

Mapping project - What is mapped and where?

Stav digitalizace katastrálních map k 01.05.2022



Cooperation between public and private bodies in cadastral mapping projects

Public sector



Responsibility according to the law



Administrative work



Determined boundary plan - owners may come to an agreement about the boundary between their properties



Land survey measurements – in most territories

Cooperation between public and private bodies in cadastral mapping projects

Private sector

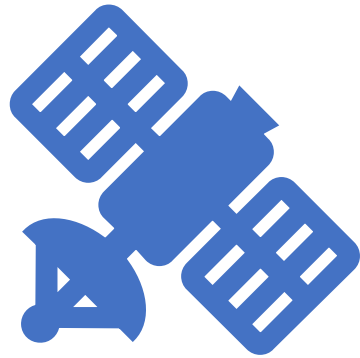


Submitting survey sketches - maintenance of cadastral maps



Land survey measurements – in some mapping projects

Case study - objectives



Can data taken by unmanned aerial systems be used for cadastral mapping?



Is data precise enough for accuracy class of boundary points stipulated by cadastral law?

Case study

Pilot verification of the use of unmanned aerial systems in cadastral mapping

- Two territories chosen – Žlunice and Klášter nad Dědinou

Involved parties:



An agreement between Cadastral office and **private company** on provision of data – orthophotos and a point cloud



Land survey measurements – carried out by **Cadastral office** (Ground control points, additional fieldwork)



Owners may come to an agreement about the boundary between their properties



Cooperation with the **municipality**

Drone



Trimble UX5 Unmanned Aircraft System

Fast and safe aerial data collection

Camera - 24 MP mirrorless APSC with custom 15 mm lens

Short setup time with automated procedures in Trimble Access field software

Flights were conducted in a fully automated manner

Height above take-off location (AGL) - 75 m to 750 m

Very sharp, colour rich images, even in dark or cloudy conditions

Raw image file

Obtained data - Orthophotos

Scaled photographs
positioned on a grid of
ground control points

Tilted images

Side lap 77 % (± 10 %)
and end lap 77 % (± 10 %)

Orthophotos processed
by Space Intersection
Photogrammetry of
multiple images

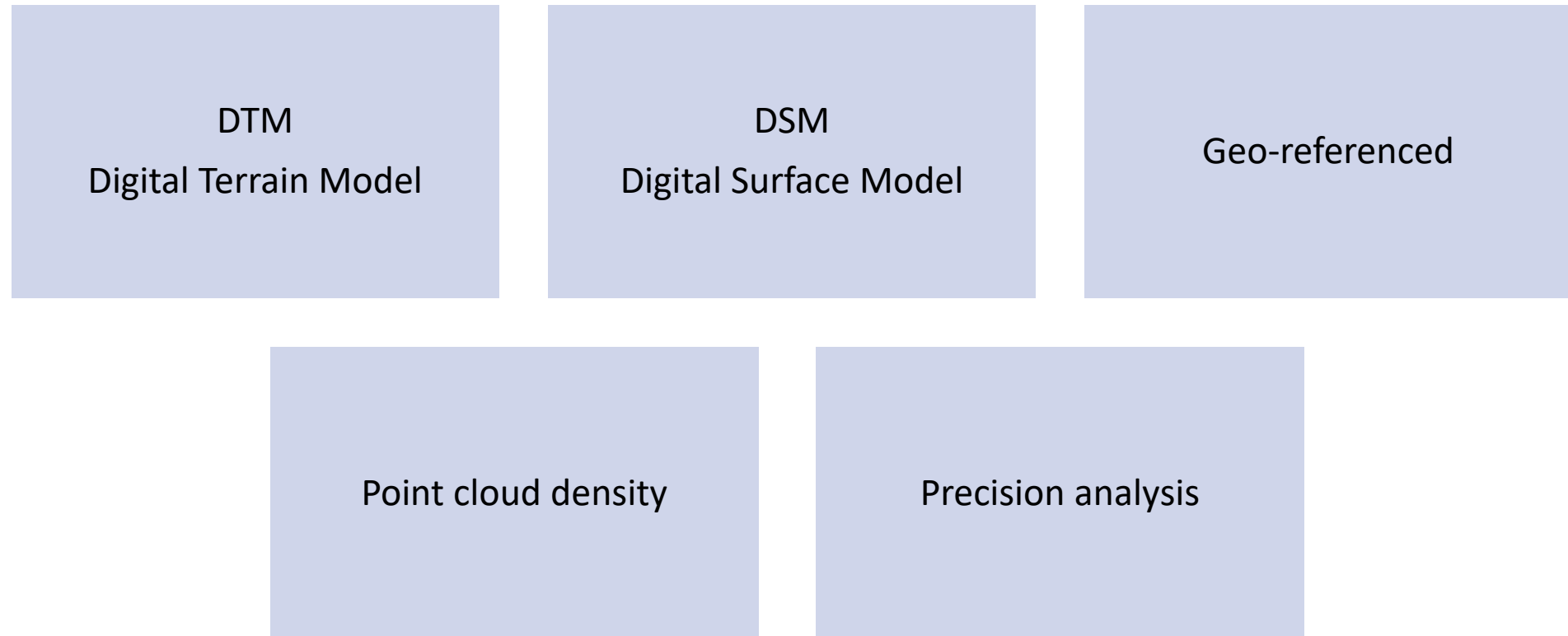
Adjusted files in TIFF and
JPEG format

Optimal image quality -
Ground sample distance
(GSD) 2 cm (± 20 %)
and GSD 10 cm

6000 x 4000 pixels

Precision analysis

Obtained data – Point cloud

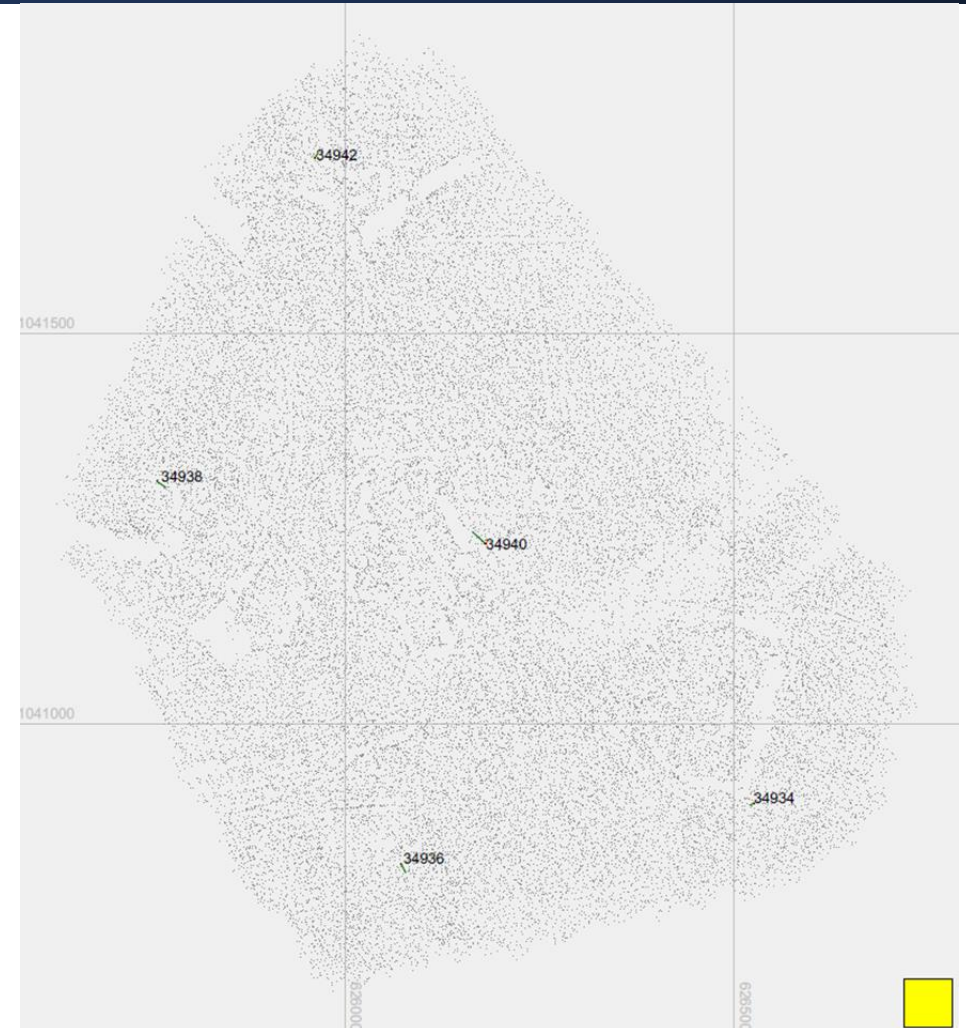


Ground control points

The area has a planimetric extent of about: 1219 x 1343 [m].

Rectification of images is generally achieved by "fitting" the projected images of each photograph to a set of ground control points whose positions have been derived from ground measurements.

- : Scale for the symbols. Symbol in the graphic is correlated to 0.008 [m] in the object.
- : Residual XY (5) for ground control points (min=0.001, avg=0.001, max=0.003 [m]).
- : Residual Z (pos.:2/neg.:3) for ground control points (min=-0.000, avg=0.000, max=0.000 [m]).
- : Tie point location for 39993 points.



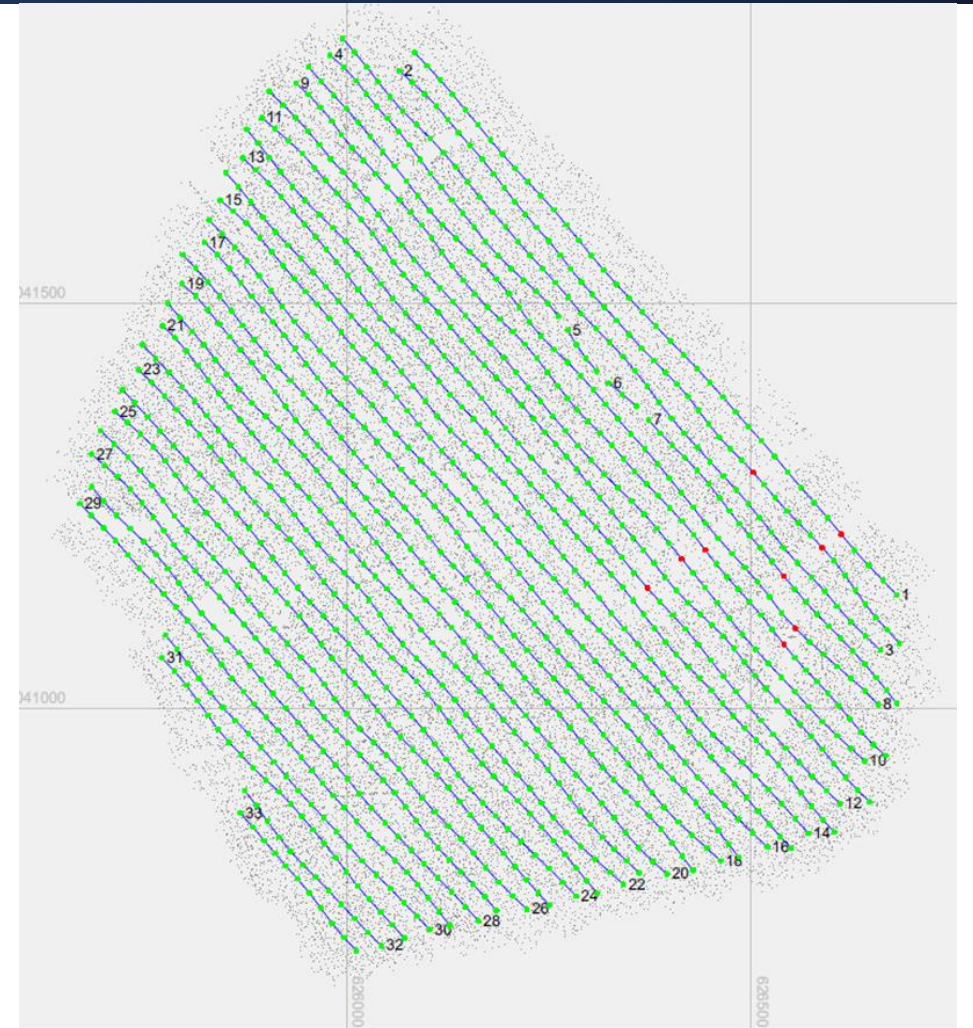
Flight overview

Graphic with 33 strip definitions for the arial triangulation.

1194 adjusted photos

9 eliminated photos

Flight time/duration 2 days



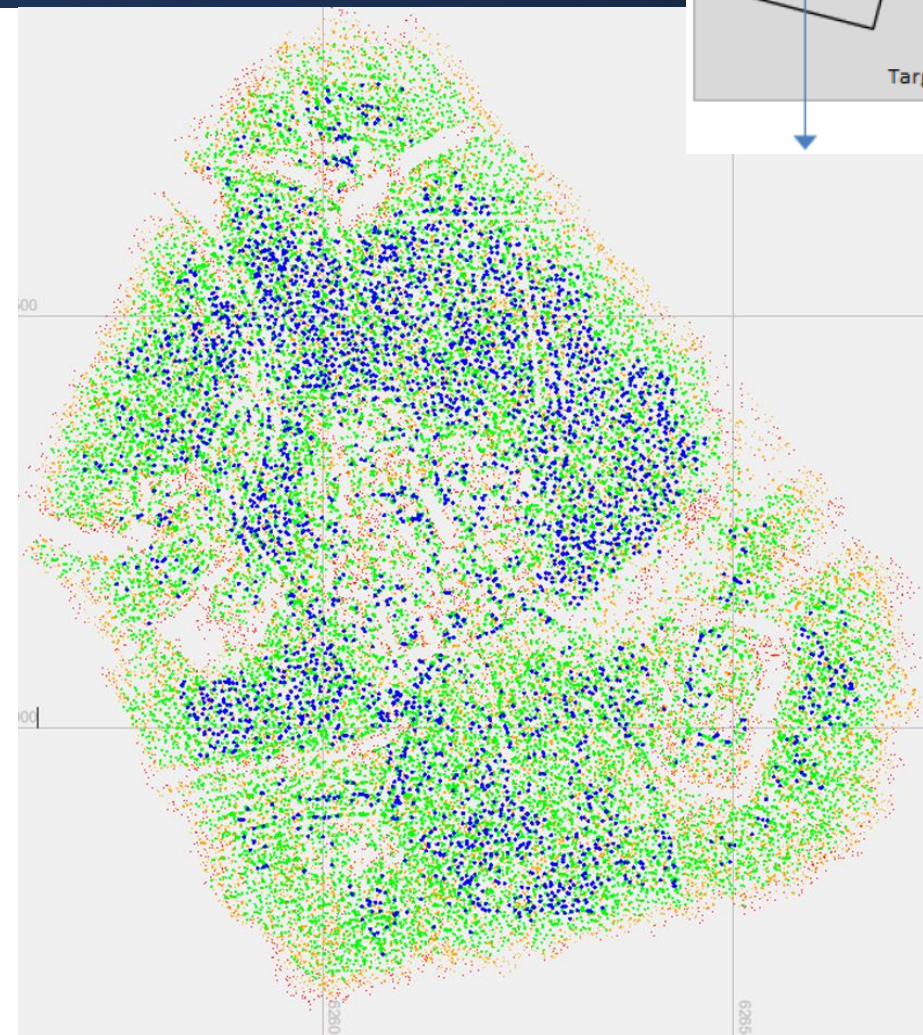
Tie point distribution

Tie point distribution of 39993 points in the project

The point size and colour reflects the number of images containing the point



- : Point found in (0-2) images.
- : Point found in (3-4) images.
- : Point found in (5-10) images.
- : Point found in (>10) images.



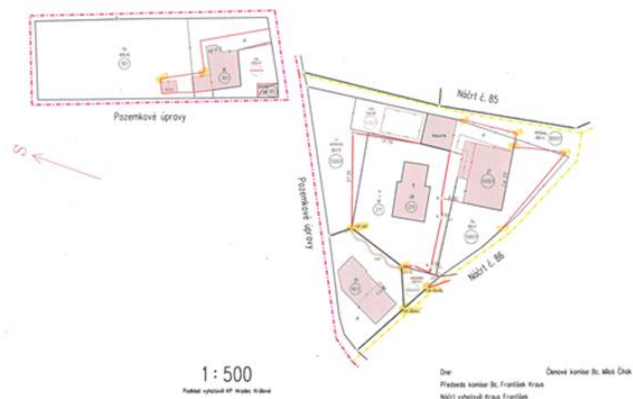
Determined boundary plan



K. ú. Klášter nad Dědinou
Náčrt zjišťování hranic č. 89



K. ú. Klášter nad Dědinou
Náčrt zjišťování hranic č. 84



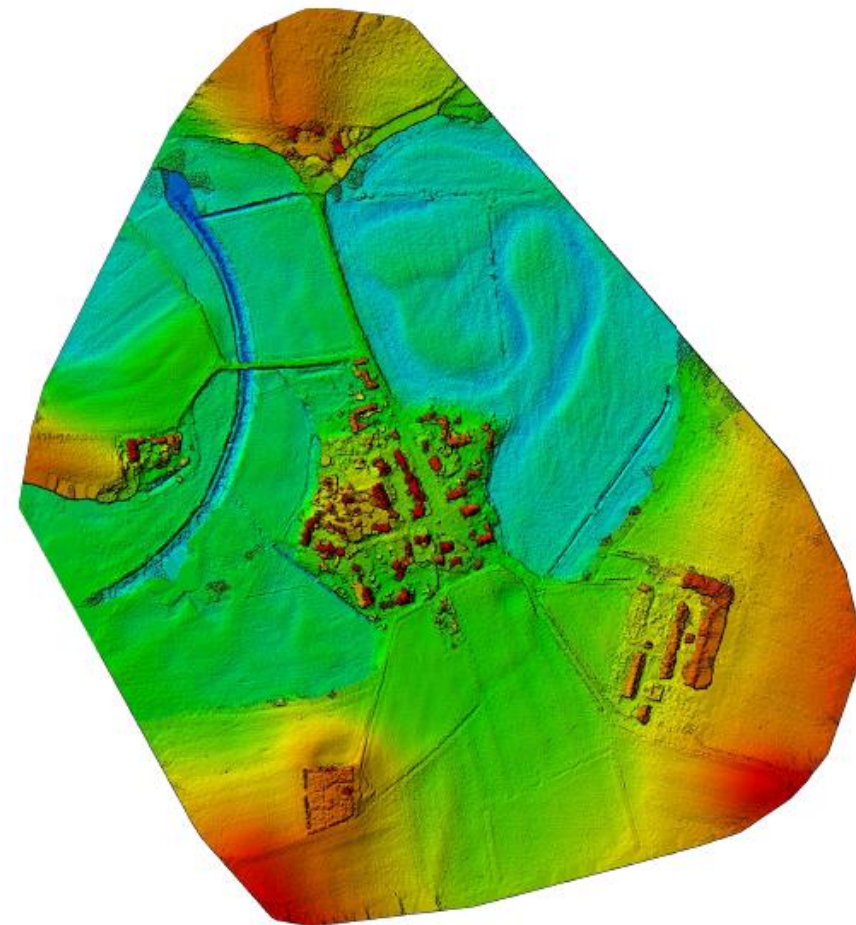
Software – GeoStore® V6

GeoStore® V6 is an advanced GIS system based on Microsoft .NET

application software V6-3D

graphic editor

point cloud processed



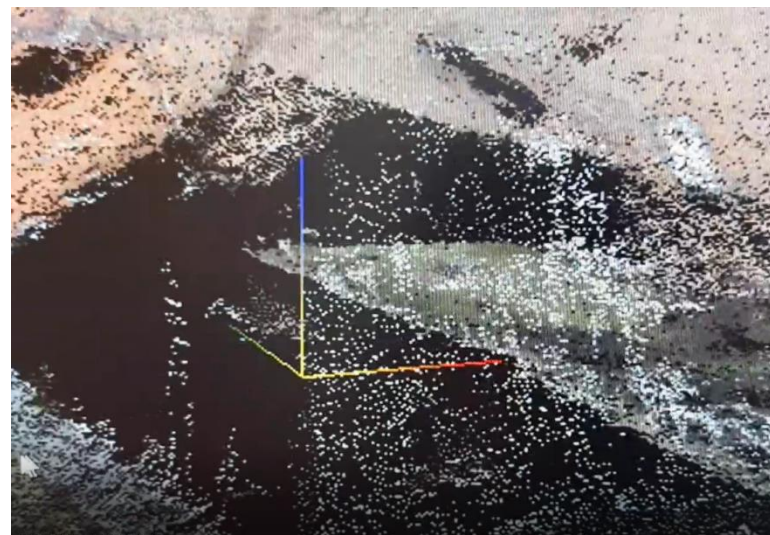
Point cloud



1

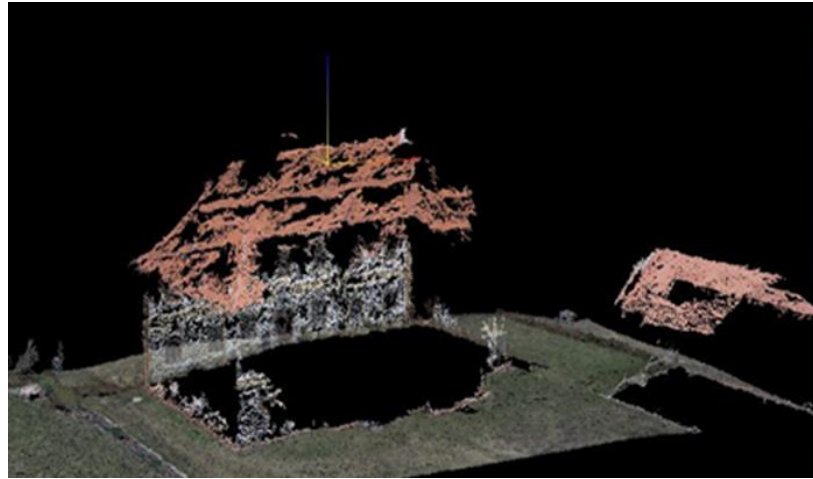


2



3

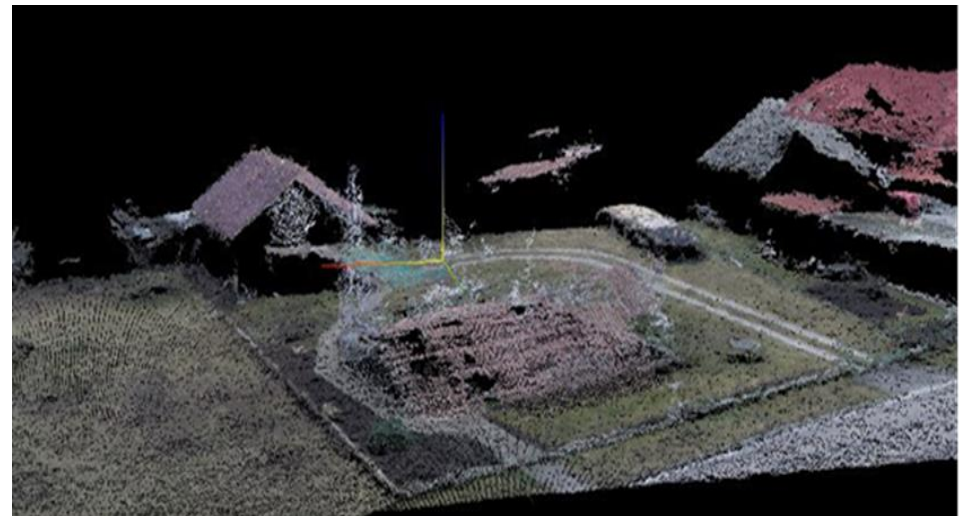
Point cloud



4

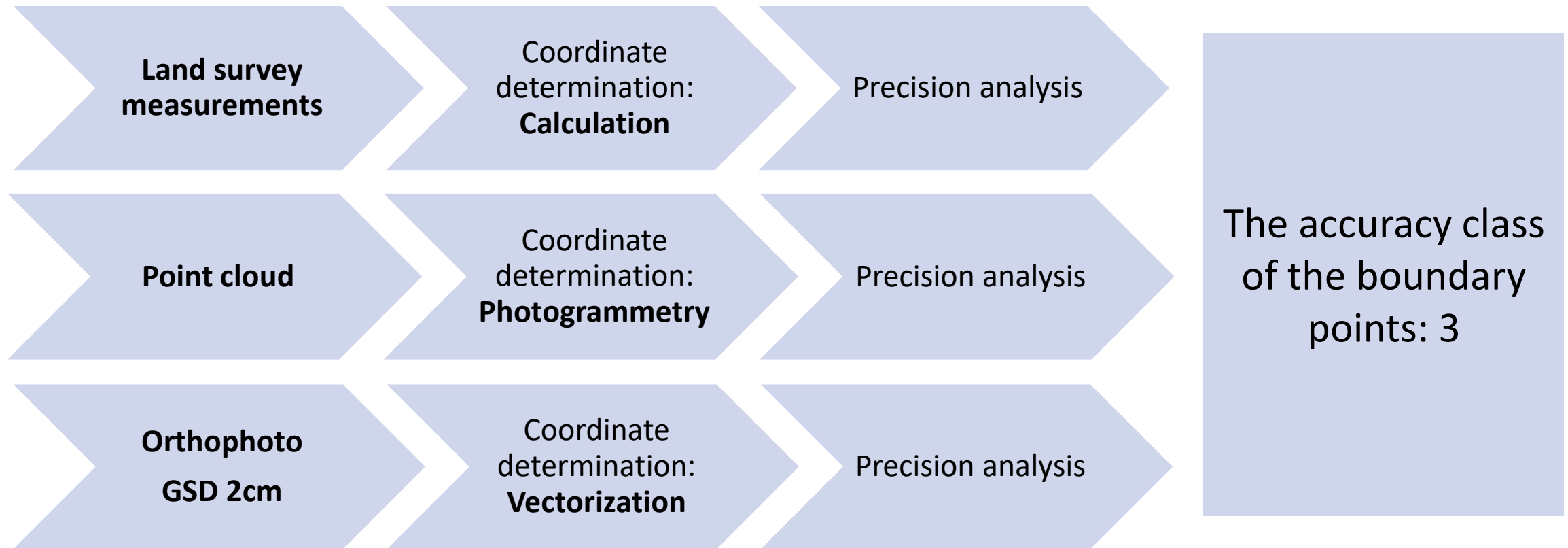


5



6

Coordinate determination and precision analysis



The accuracy class of the boundary points 3: root mean square error of the coordinates 14 cm (Decree n. 357/2013 Coll.)

Summary

Data taken by unmanned aerial systems can be used for cadastral mapping - determined about 45 % of all border points in the cadastral map, 55 % of the border points were not visible in the orthophoto or in the point cloud and had to be determined in cooperation with the owners

Data taken by unmanned aerial systems is precise enough for accuracy class of boundary points stipulated by cadastral law

Tilted images were useful for coordinate determination

Cooperation between public and private sector





Thank you for your attention