USING DRONES FOR SURVEYING OF BOUNDARY MARKS

2023-04-20 QUALITY KEN

TORSTEN SVÄRD

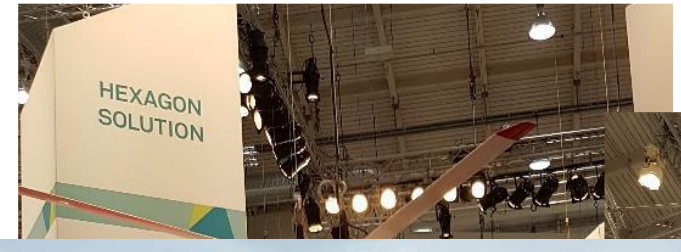
LANTMÄTERIET

CONTENT

- What about the technics behind drones?
  Drones or UAV - Unmanned Aerial Vehicles

- Cooperation between Municaipalities and Lantmäteriet for quality improvements
- Results from a project using drones in Värmdö municipality
- What's in it for us, Lantmäteriet?

DRONES – NOT A FAD

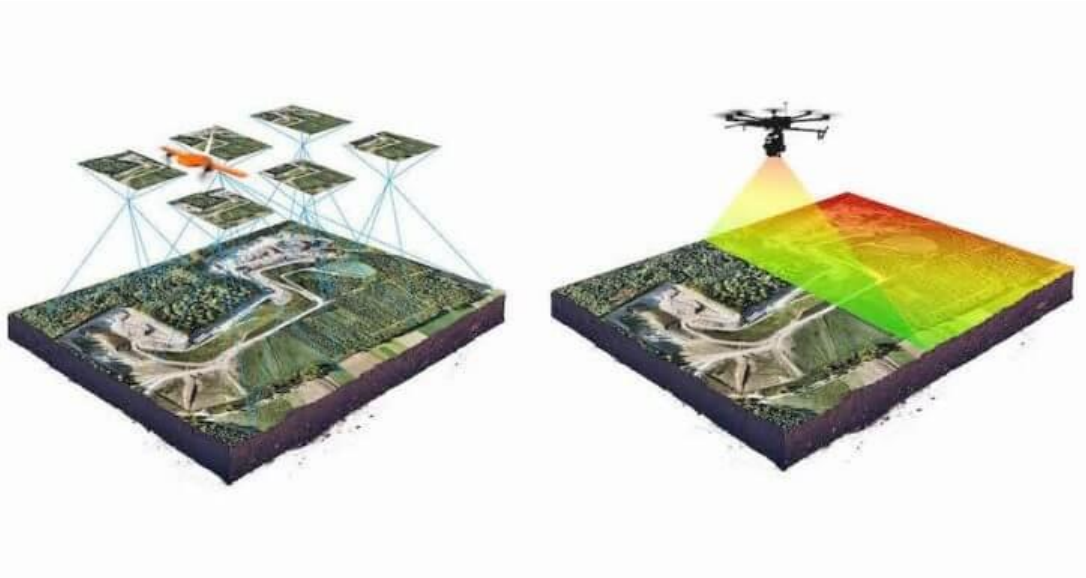


2016:
Bransch fair INTERGEO
100+ different models

2018:
First drone with RTK-capacity
(DJI Phantom 4 RTK)

WHAT CAN YOU DO WITH A DRONE TODAY?

”A flying instrument tripod”



Sensors:

- Cameras (RGB or multispectral)
- LiDAR (Light Detection and Ranging)
- GNSS

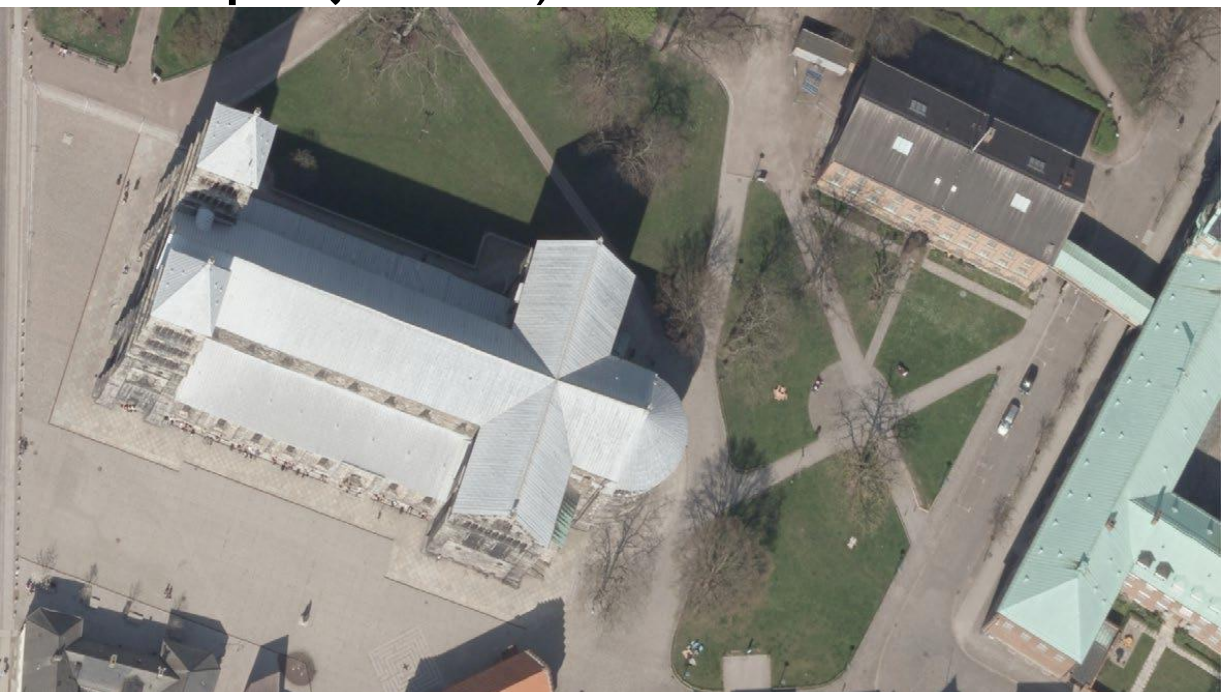
… for: georeferenced orthophoto/orthomosaic, ground surface models, 3D models, LIDAR point clouds, multispectral maps

PRODUCING ORTHOIMAGERIES

- Overlapping photos with picturematching
- Corrections of object geometries with support from height data
- All object portrayed scale correctly (ortogonal projection)

Height data can be:

- Digital Elevation Model (DEM)
- Digital Elevation Model + 3D-building model
- Surface height model



A LOT OF POSSIBILITIES TO AUTOMATIZE

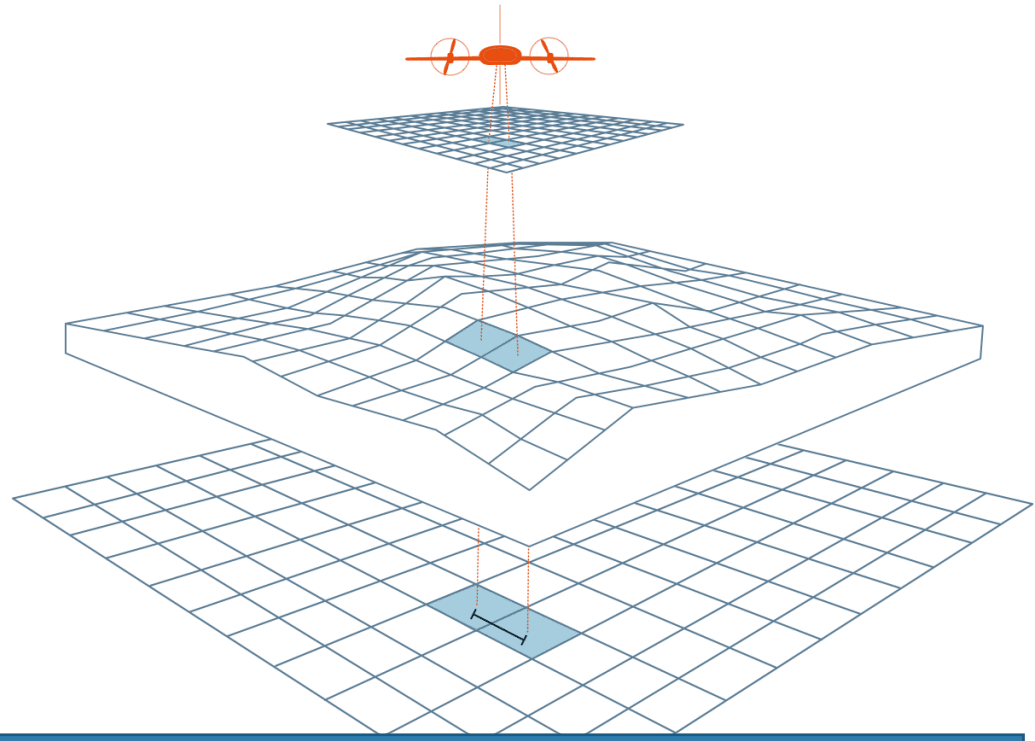
Not so difficult to georeference ortophotos if you have drones + software (and permission to fly and take photos)

Can be programmed or automized:

- Flight path
- Picture matching
- Extract height model
- Find flight ground signals in pictures

LOTS OF DETERMINANTS EFFECTS QUALITY

- Flight altitude, flight speed
- Camera solution, focal distance, time of exposure
- Picture overlap, along and across path
- Height elevation models accuracy
- For georeferencing: Measured positions, e.g. network-RTK



GSD = Ground sampling distance

SOON STANDARD IN THE TOOLBOX

Gävle kommun

’Drones acts as a complement to total station or GNSS. To use drones is in some circumstances a faster method for collecting geographical information. The techniques of drones make possibilities for a safer working environment e.g. roads, contaminated areas or other tough terrain’

(free translation: https://www.gavle.se/kommunens-service/bygga-trafik-och-miljo/trafik-vagar-och-parkering/dronare/)

PROJECT 'DRONE BOUNDARIES'

Positional determination of property boundaries with assistance of pictures from drones.

Project participants

- Municipality of Värmdö
- Aveki, GIS-company
- LE34, surveying consultant

Questions for the project

- Is the working method effective and rational?
- Can you get sufficient quality?

WHAT IS 'SUFFICIENT QUALITY'?

Benchmark, cadastral surveying:

- Network-RTK, total station
- Accuracy of 0,05 meter in SWEREF 99 (The Swedish national reference frame)

i.e. possitional accuracy good enough

- as a basis for digital base map
- to show detail development plans with other geographical information
- for 'automatic' building permissions in future

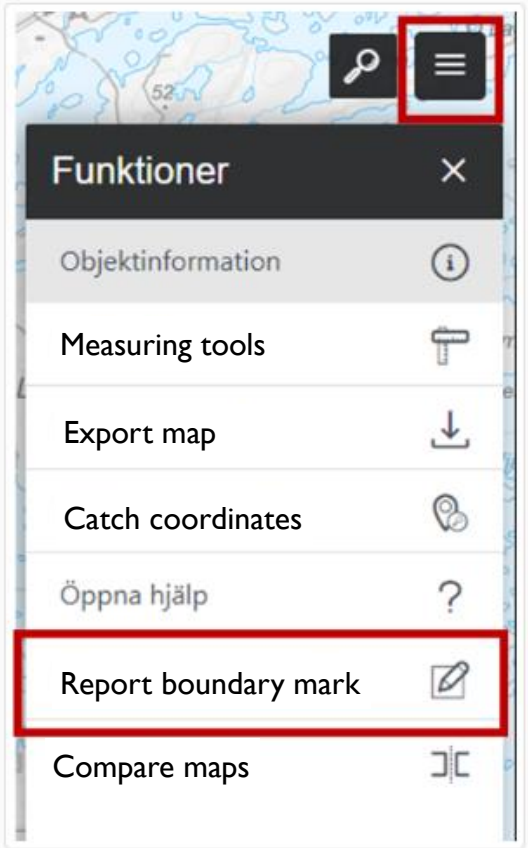
CROWDSOURCING INCLUDED IN THE PROJECT

The property owners was invited:

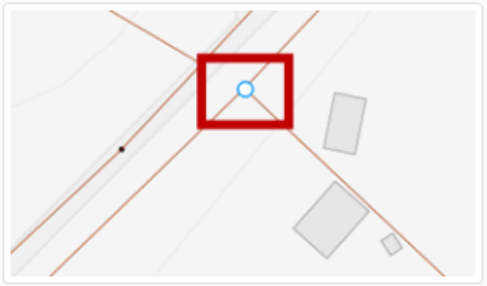
- Information of the project by mail
- Tip to recognize boundary marks
- Flight markings (controled by municipality)
- 20-25% of all property owners participate

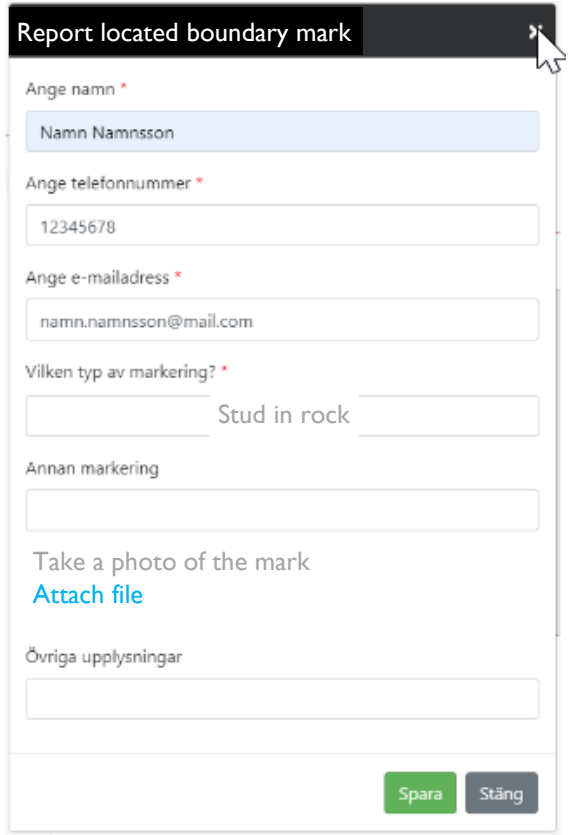
REPORTING FUNKTION

Reminds of Lantmäteriets test app ”My marking”

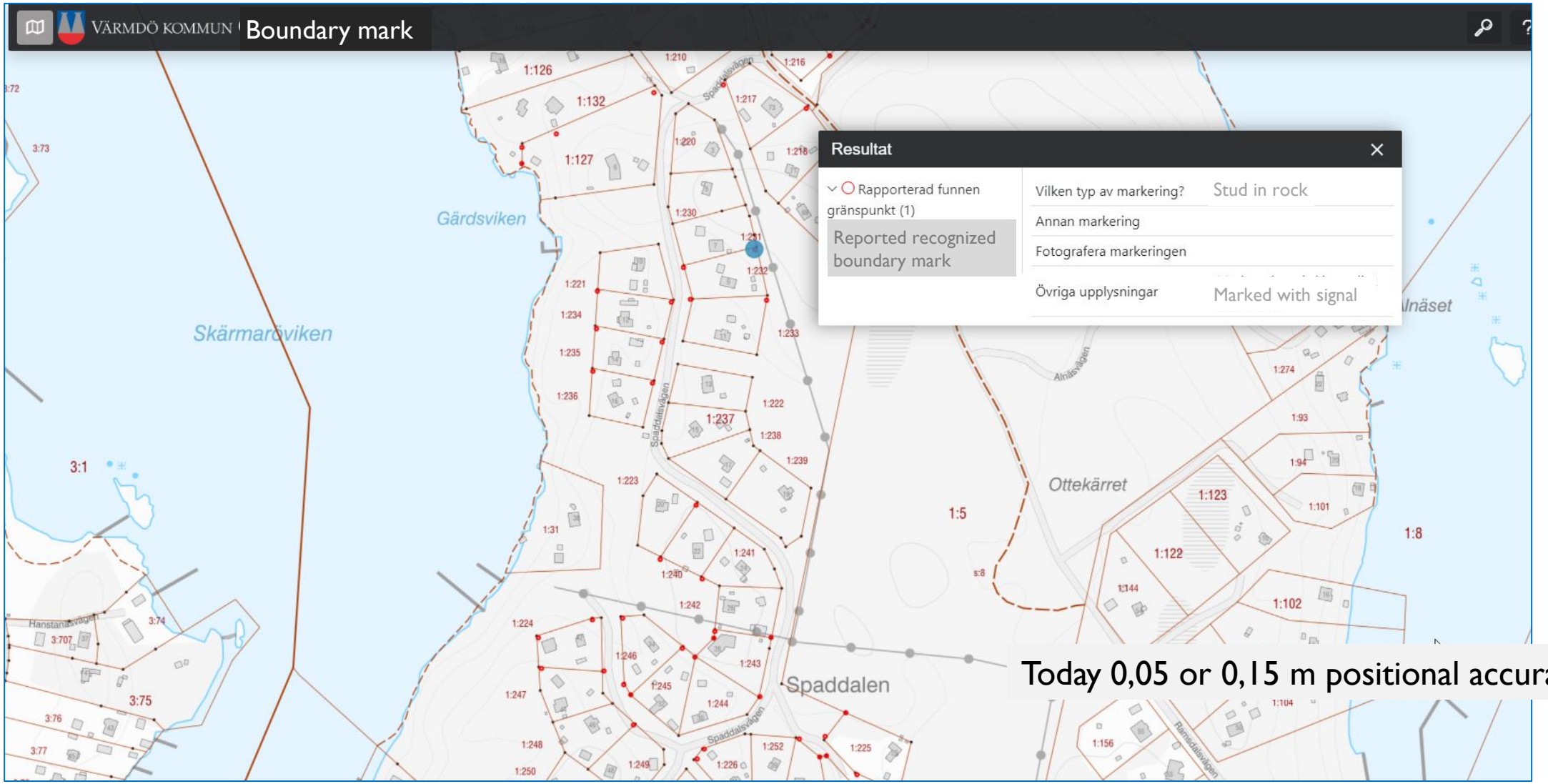


Search for the boundary mark wich will be reported. Click at a point with finger or mouse trapper so close as possible where you belive the boundary mark is situated in the map. Some boundary marks is already in the map





DISPLAYING OF REPORTED MARKERING



DRONE MAPPING DONE IN THREE STAGES

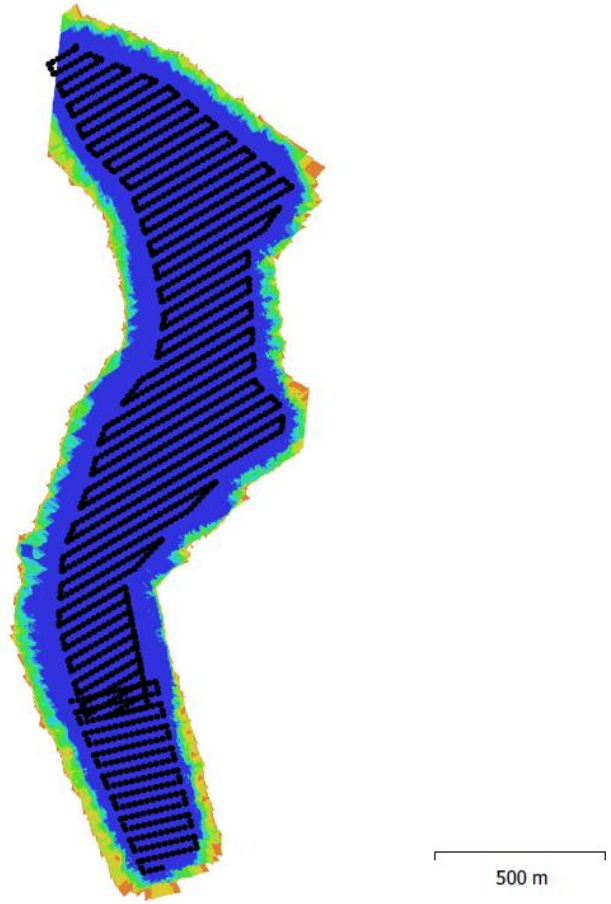


Fig. 1. Camera locations and image overlap.

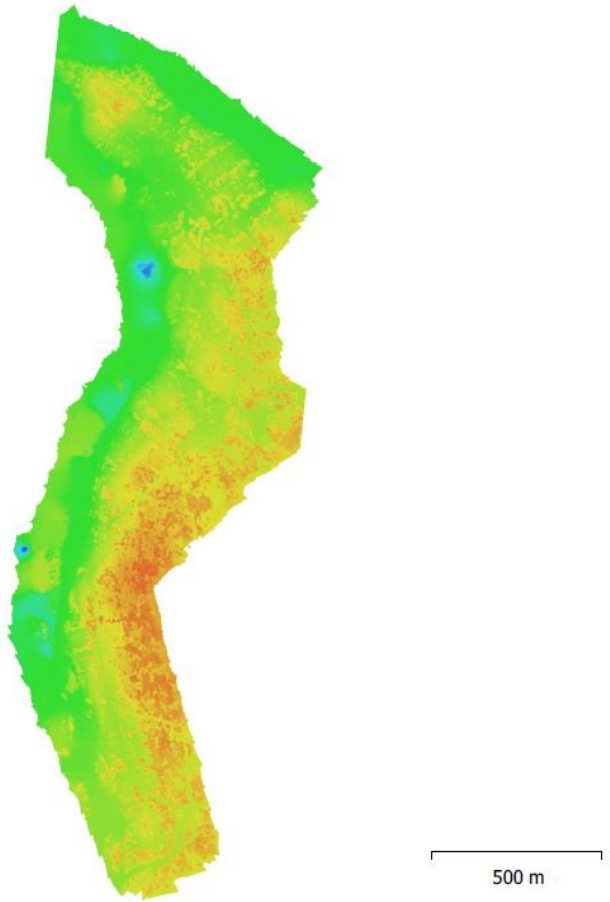


Fig. 5. Reconstructed digital elevation model.

QUALITY ANALYSIS

- The sample included approx 100 boundary marks
- The drone measured coordinates was compared to 'keys' properly measured in SWEREF 99 med GNSS/RTK.
- Hypothesis: standard error = 0,05 meter
- Statistical aprovement:
  - **Positional accuracy** – is the standard error consistent?
  - **Systematic deviations** – seems the method to be 'uncalibrated'?
  - **Gross errors**– exists blunders or measure errors in the sample?

VAD UPPNÅDDE MAN FÖR KVALITET?

	Stage 1 (37 pc) ground reference		Stage 2 (18 pc) only GNSS		Stage 3 (44 pc) only GNSS	
	Tolerance	Result	Tolerance	Result	Tolerance	Result
Positional accuracy?	0,085 m	0,045 m	0,090 m	0,071 m	0,084 m	0,047 m
Systematic abbreviation?	0,024 m	0,016 m	0,033 m	0,044 m	0,022 m	0,008 m
Gross errors?	0,212 m	2 pc	0,212 m	0 pc	0,212 m	2 pc

CONCLUSIONS FROM THE PROJECT

- Positional accuracy better than expepted, but still important to recognize gross errors
- The method is rational if you work over large areas.
- In addition: collected information for maintenace of detail development plan map and planning background
- Huge involvement from property owner, but instructions could be better.

WHATS IN IT FOR US?

- Drone measured boundaries: not less quality than GNSS-measured, but needs a new measure method in the cadastral index map, as metadata for a measure
- Can add smarter working process within quality enhance acctions. Possibility to catch more data by the way, less odd jobs
- Within property formation: a base for cadastral plan, maybe for measuring and control of boundaries and other important objects.

Challenge today:

How do we do quality assurance of the normally measured data today?

FRÅGOR? QUESTIONS? PREGUNTAS? FRAGEN?