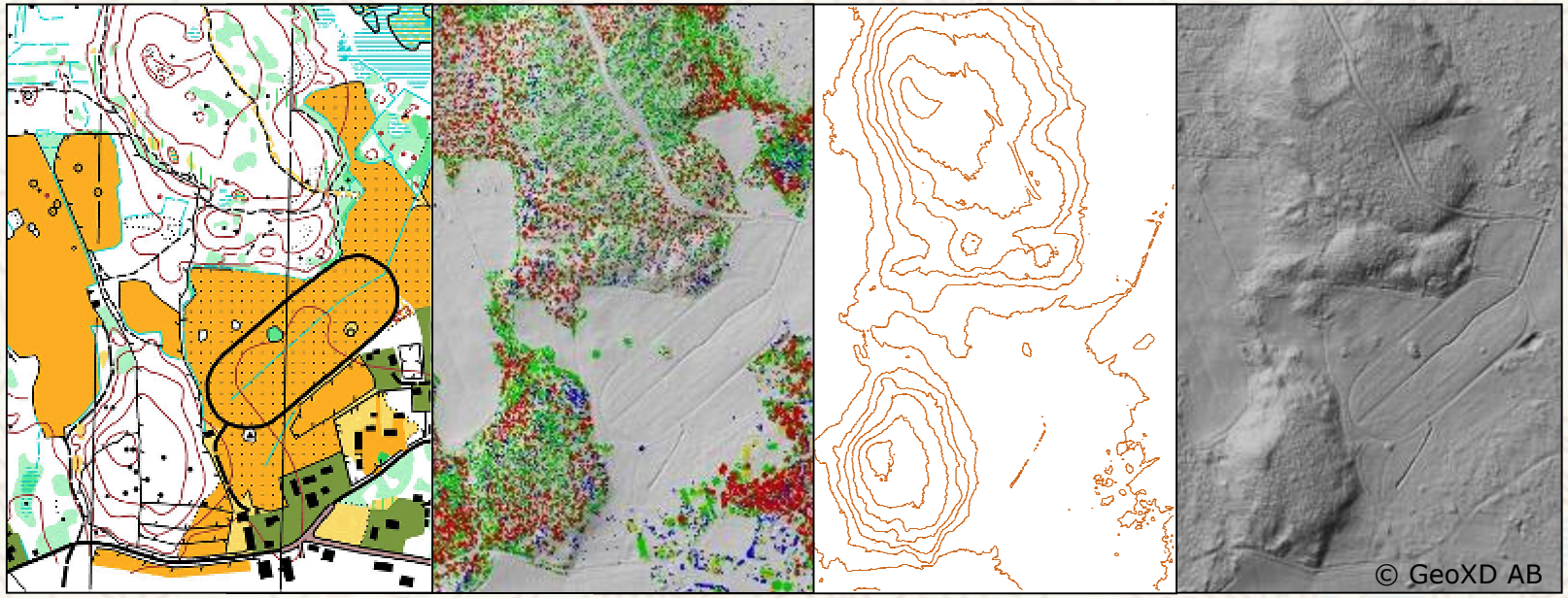
Laser scanning and O-mapping in Sweden



ICOM and Open Nordic Map Meeting, Trondheim 11-13 August 2010

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Offensiv orientering
Vägval till glädje och framgång

Svenska Orienteringsförbundet

The present situation

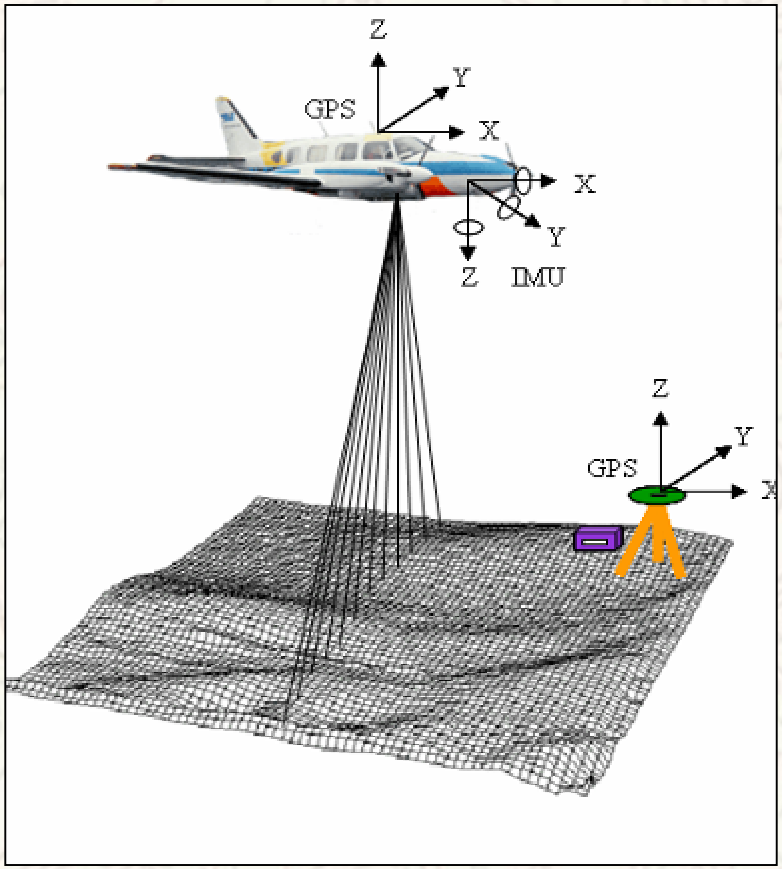
- Conventional (analogue) aerial photography is no longer available for production of base maps
- Laser scanning and digital aerial photography is expected to be the major new sources of information for production of base maps
- Some map makers have started to work with base maps based on laser data
- Laser scanning specially ordered for o-mapping is expensive
- Available commercial software is tested and new customized software is being developed by commercial as well as non commercial parties
- Development work is also carried out on how to compose the "optimal" base map from laser data (some of this will be used for the terrain visit)

SOFT's aim regarding the use of laser data for orienteering maps

- SOFT will monitor the availability and development of software and hardware that can be used for o-maps
- SOFT will gather experience from map makers regarding the development of methods for compilation of "optimal" base maps for o-maps and field work using laser data
- SOFT will communicate information to the map makers through annual Map Meetings and articles in Skogssport

The future

- Lantmäteriet (the Swedish mapping, cadastral and land registration authority) has initiated laser scanning of the entire Swedish territory to be finalised within approximately 3 years
- Laser data will be available for o-mapping at a very low cost (approx. € 0.2 / sq km)



Parameters for scanning

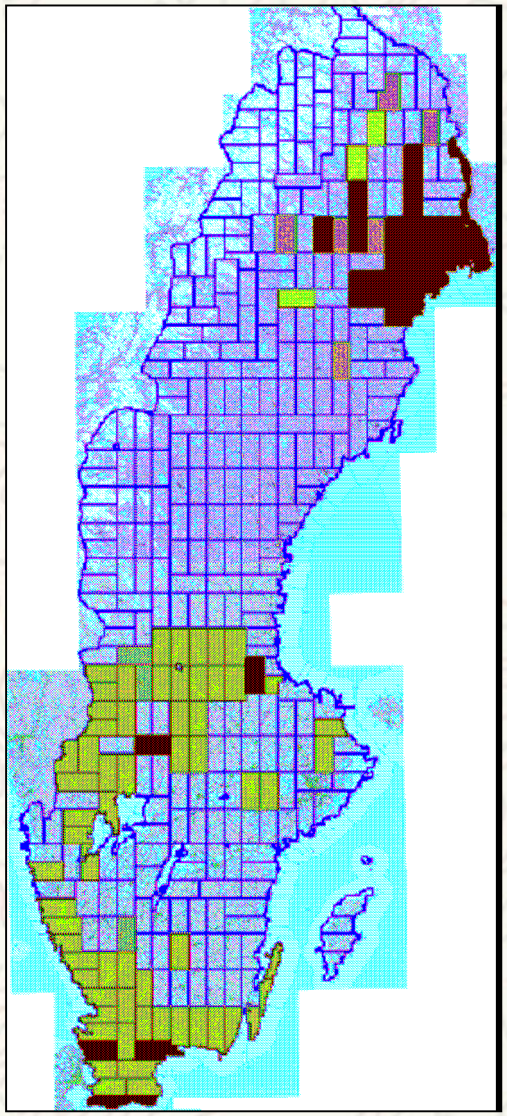
Lantmäteriet's requirements

- Point density minimum 0,5 point/m²
- Multiple returns on each laser pulse
- Maximum scanning angle ±20º
- Minimum overlap between strips 200 m

To be decided by the contractor

- Flying altitude (2300 m)
- Flying speed (280 km/hour)
- Pulse frequency (100 kHz)
- Scanning frequency (40 Hz)

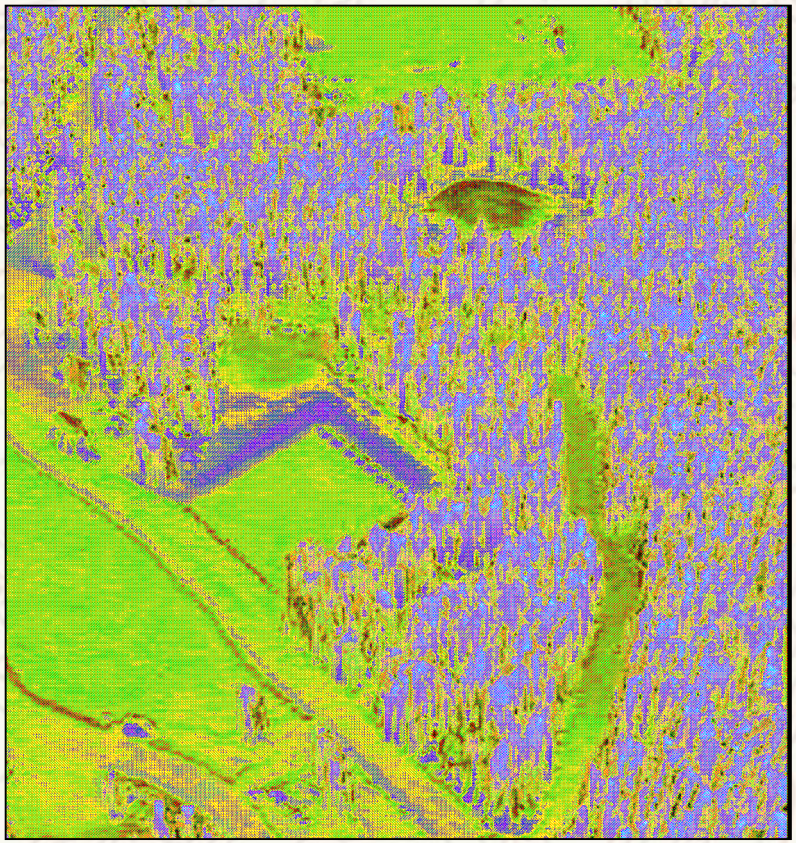
This is a relatively low point density compared with laser scans customized for o-mapping but has proven to be sufficient for most cases



Production up to July 31, 2010

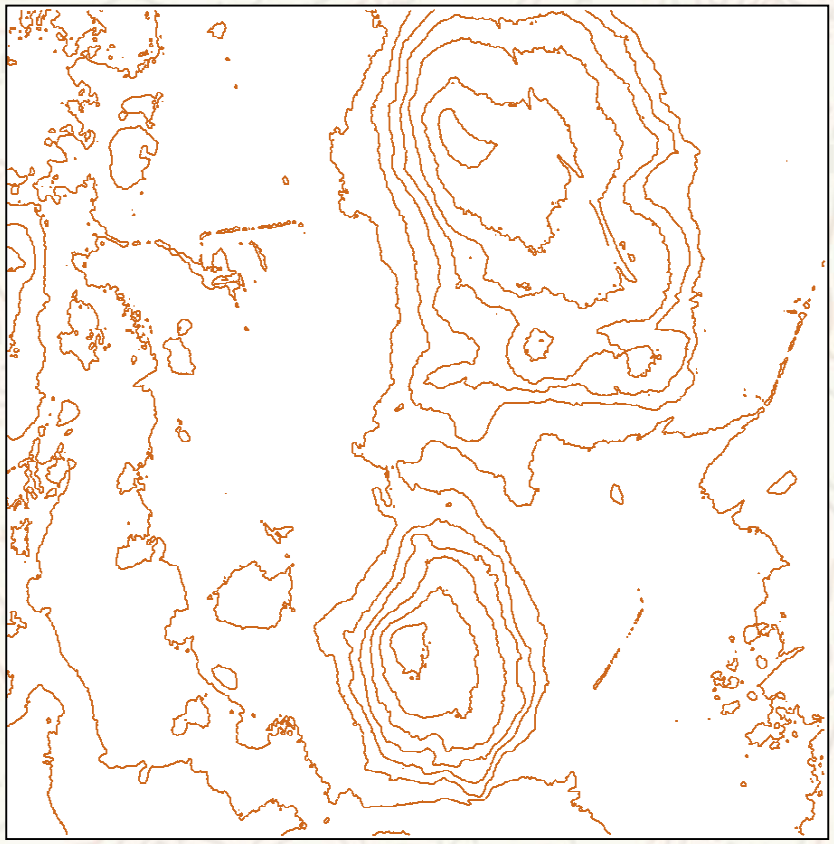
The southern part of Sweden shall be scanned outside vegetation season (late autumn, winter or early spring). The northern part can be scanned during vegetation season, provided that the terrain is not covered with snow or flooding.

- Scanning areas
- Scanned areas
- Areas ready for delivery to end users



What can be extracted from laser data?

- Contours with high accuracy
- Vegetation height
- Vegetation density
- Hill shading
- Linear features, incl. vegetation boundaries
- Rock faces
- Buildings and other man made features



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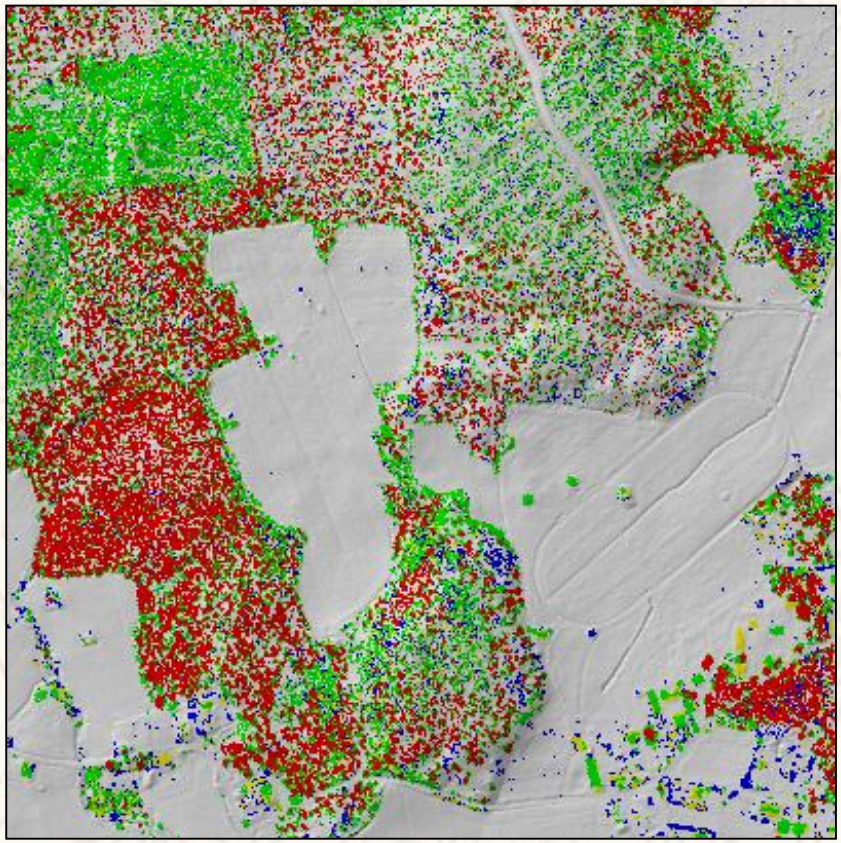
Contour lines

- Contour lines with optional interval can be calculated using OCAD or other "off the shelf" software
- In most cases, the quality of the contour lines is superior to photogrammetric contours. Especially in terrain covered by dense forest



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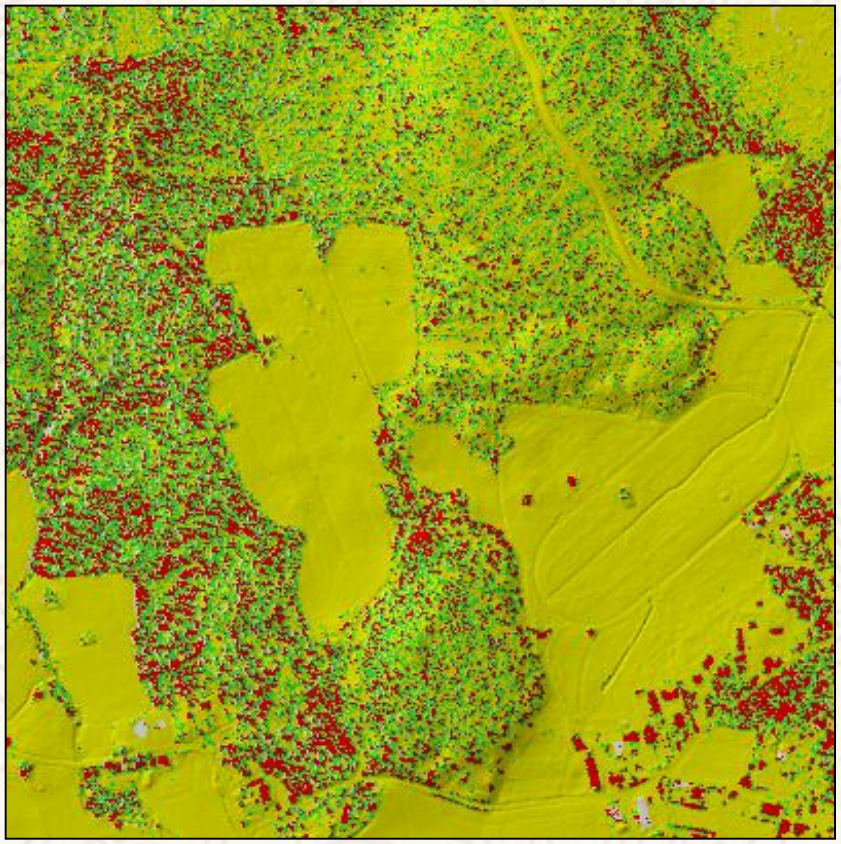
Vegetation height

» Points in the laser cloud can be classified according to height in order to allow mapping of vegetation boundaries, vegetation types, etc.

Height

- <1 m
- 1-3 m
- 3-5 m,
- 5-15 m
- > 15 meter



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Vegetation density

» Density can be used as complement to vegetation heights to identify different vegetation types, small open areas etc.

Density

- Open area
- Medium density
- High density

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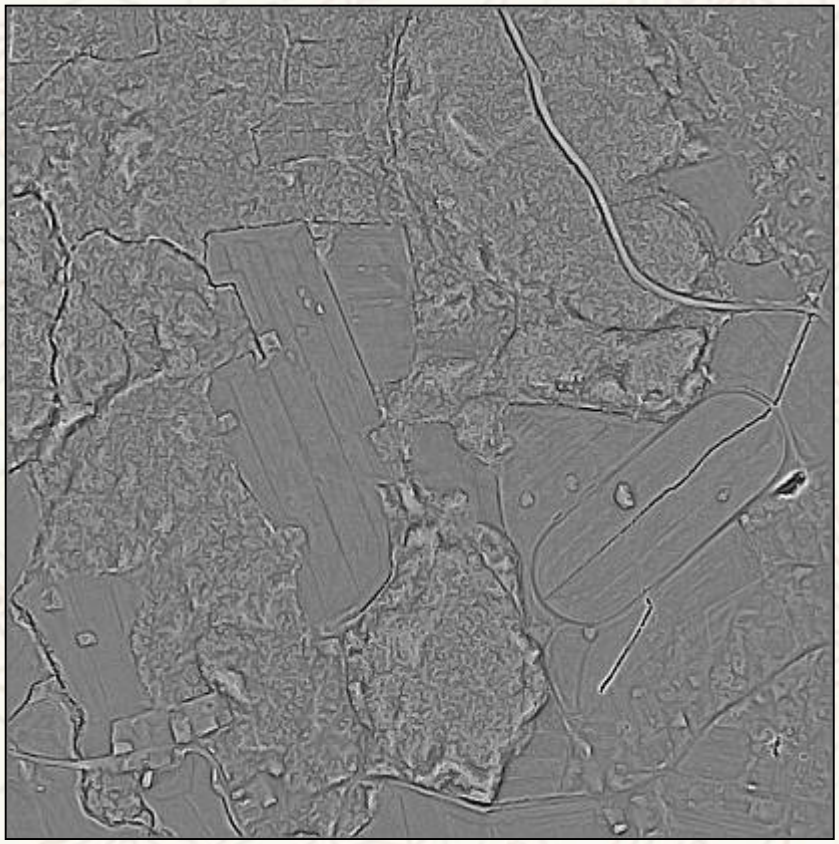
Hill shading

- Hill shading can be used for visualisation of land forms
- Some linear features can also be detected in the shading



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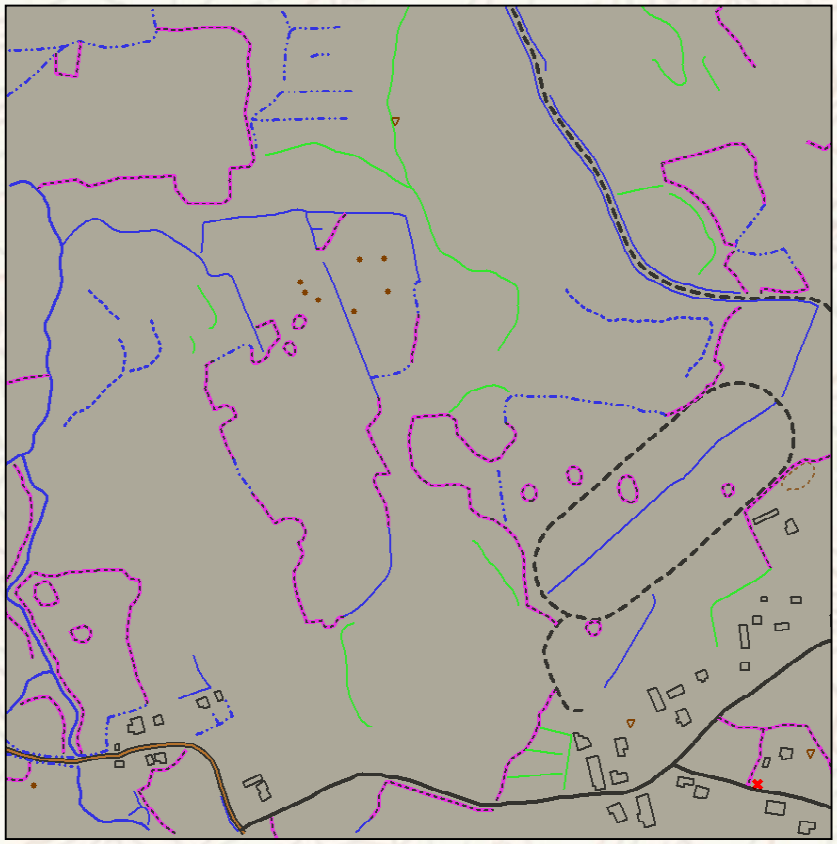
Enhanced linear structures

- Special software developed by GeoXD for enhancement of linear structures in the laser data
- Ridges appear as white lines and depressions as black lines



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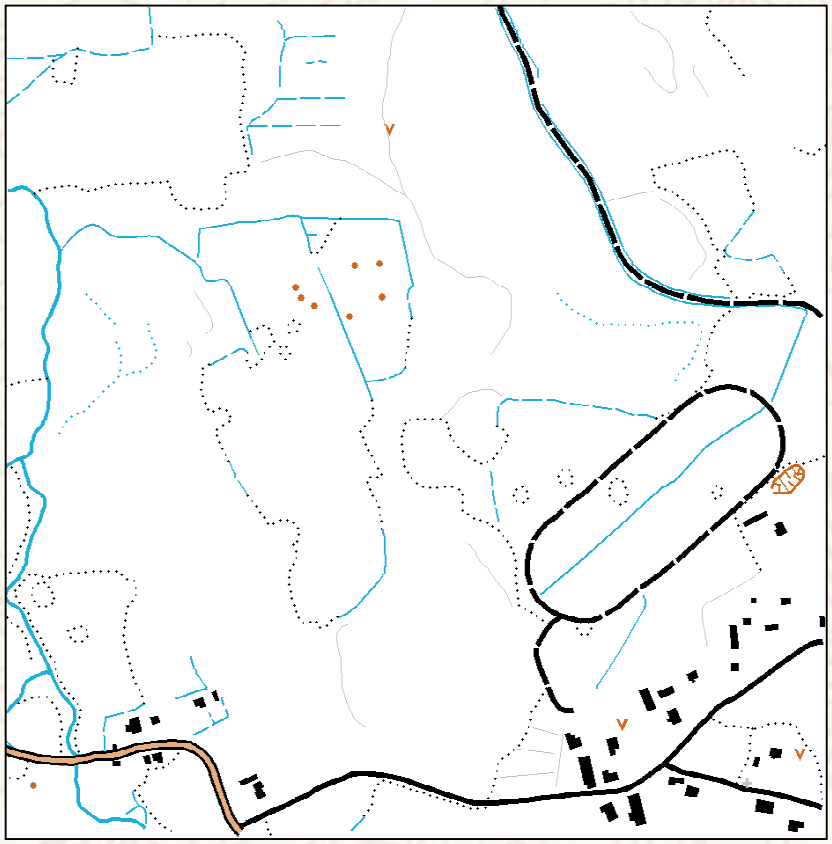
Vectorisation

» Linear features and other objects visible in the different processing's of laser data can be located and digitized in order to create a base map in vector format



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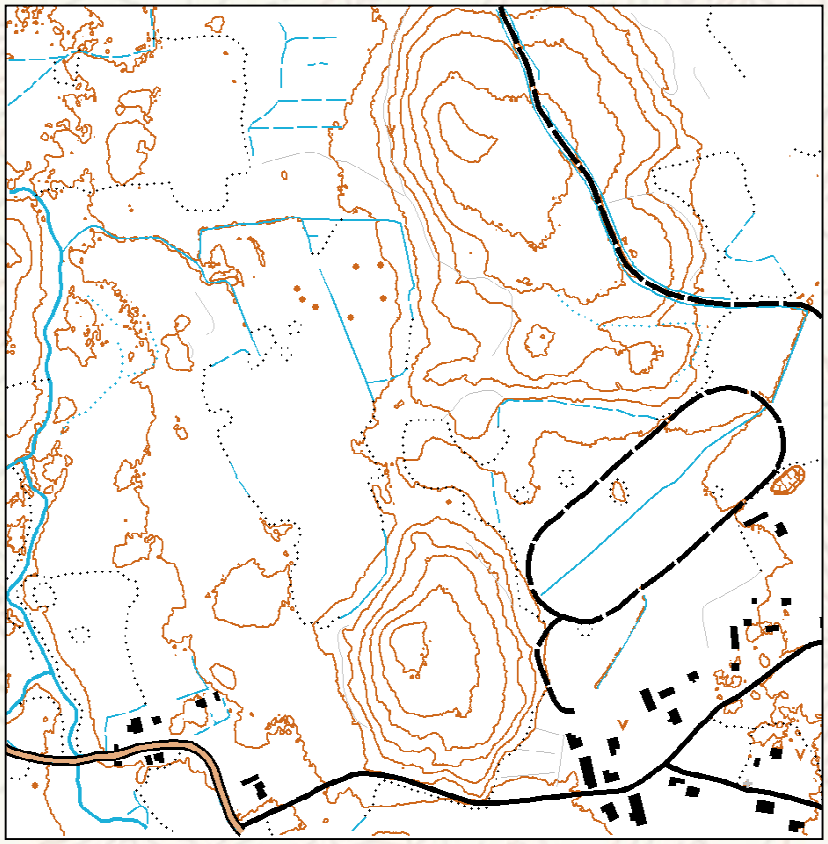
Feature coding

» Vectorised features can be coded in accordance with the map specification



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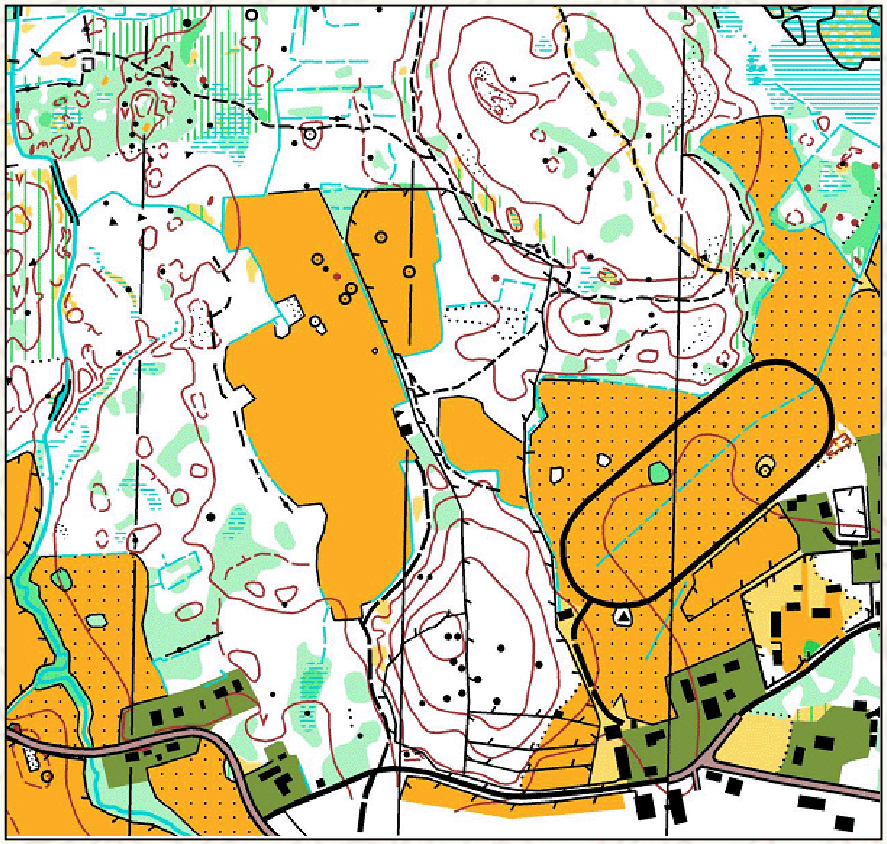
Compilation

- The different sources of information can be compiled to create a suitable base map for the field survey
- *All information in this example is generated from laser scanning carried out by Lantmäteriet for the new national DEM.*

Further information about this method for production of base maps can be provided by GeoXD AB
geoxdab@geoxd.se
www.geoxd.se



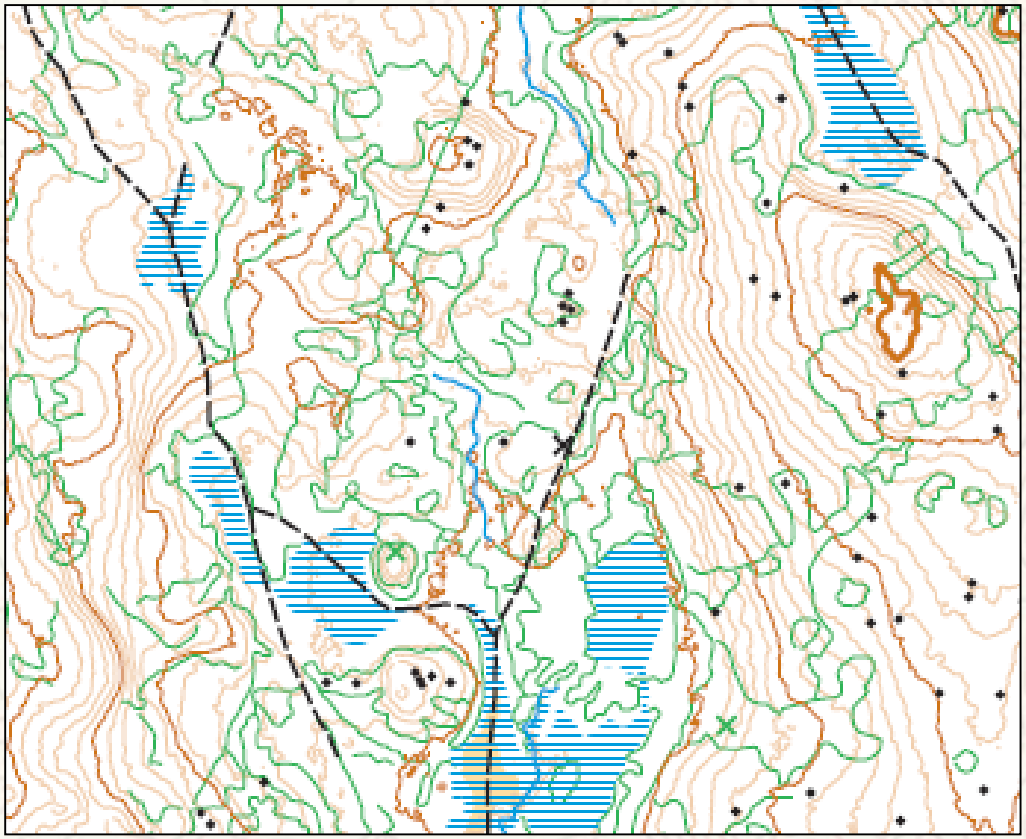
© OK Hammaren (Field work by K-E Engblom)

Old map of the area

- This is the latest version of the existing o-map covering the same area as the laser data. This map is made from a base map produced using photogrammetry

Conclusion

- Base maps based on laser data open new doors to useful information for map makers
- Contour lines of high quality can be generated also in areas covered by dense vegetation
- Working with laser data in the way described above require a lot of indoor work before going out into the forest, especially if you are working with an analogue base map on a drawing board
- The competence regarding procurement of laser scanning for o-maps must be improved. The purchaser must be aware of what specification of deliverables, accuracy etc. is needed



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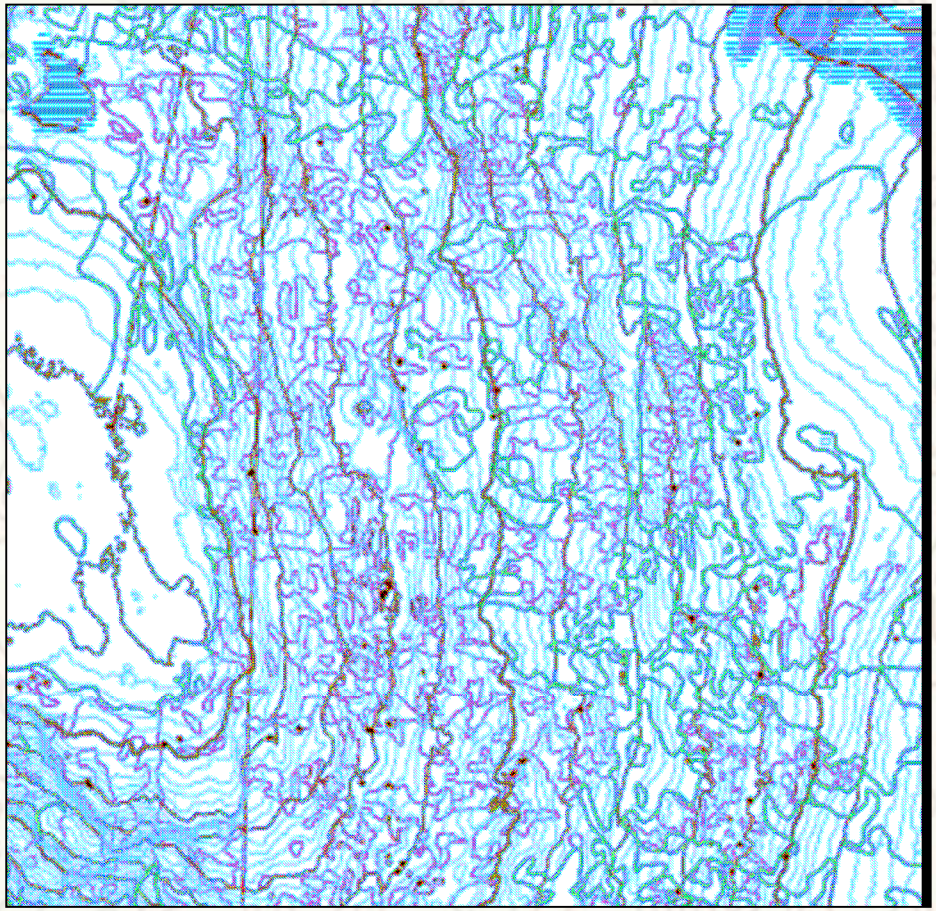
Laser data and photogrammetry

- Contours calculated from laser data together with linear features, vegetation boundaries and other objects mapped from digital aerial photography using photogrammetry.
- This method gives a base map that has contours with better accuracy than from photogrammetry, combined with high accuracy photogrammetric feature mapping from digital aerial photography

Further information about this method for production of base maps can be provided by ann.rm.jansson@telia.com



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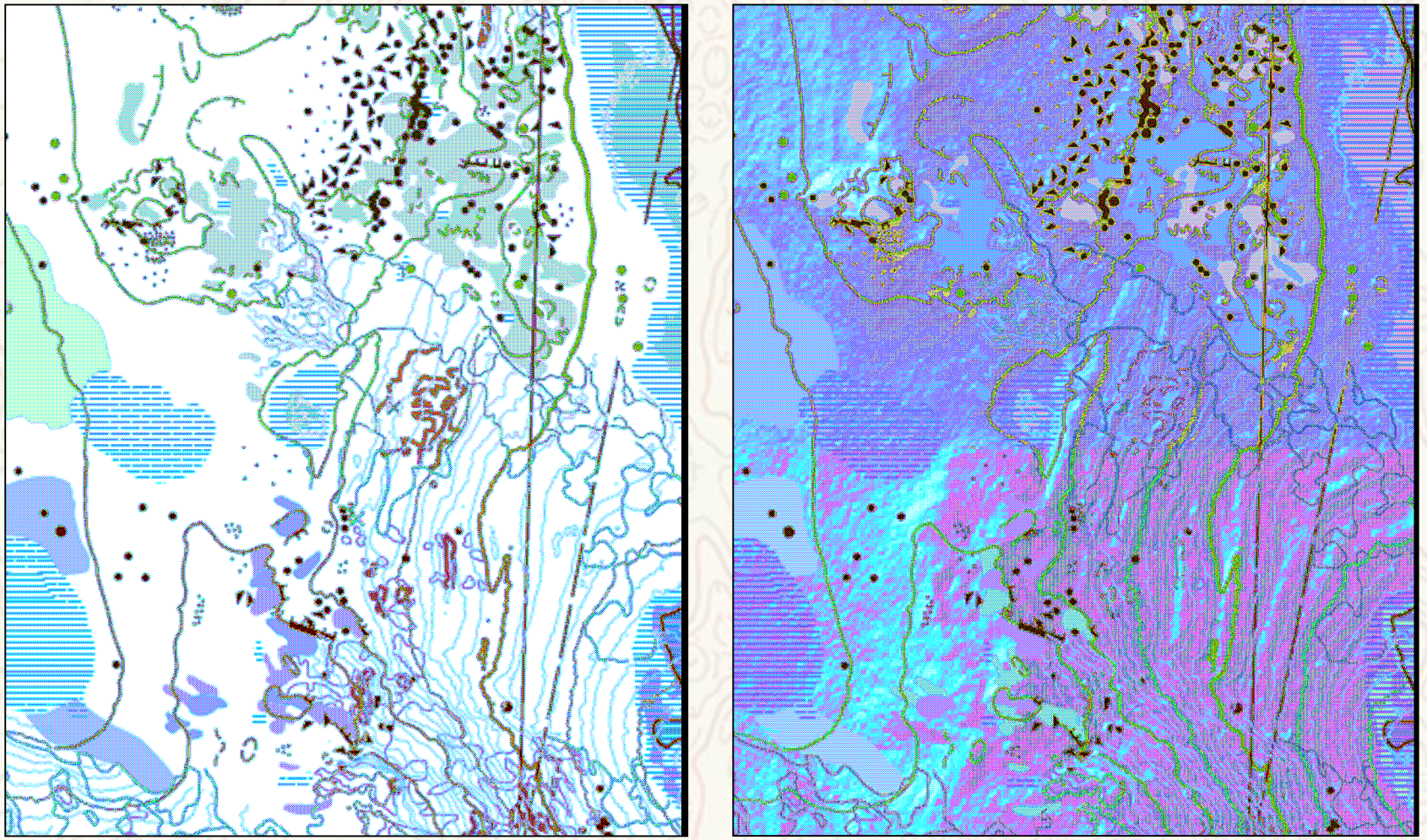
Laser data and photogrammetry

- Contours, 5 m interval
- Contours, 1 m interval
- Vegetation boundaries
- Bare rock
- Stony ground/Boulder fields

» Espa software is used for the photgrammetric data capture and Arc Map is used to create shape files for import to OCAD

» Laser data from Lantmäteriet 2009

» Digital aerial photography 2009 from Lantmäteriet, flying altitude 4 800 m



Examples from ongoing field work in which different ways of showing the information in the base map is tested

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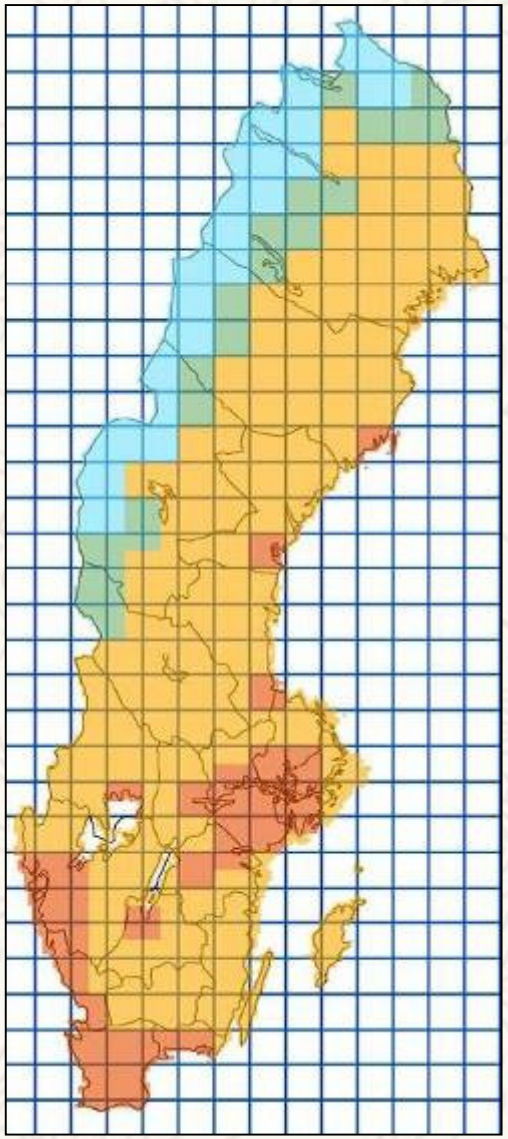
Conclusion

- Working with laser data in combination with digital photogrammetry for feature capture creates a base map that is very similar to base maps that the map makers are used to work with
- It is probably possible to capture more object features using digital photogrammetry than in the laser data
- This method of producing base maps will probably be very useful also when laser data is old and do not longer show the actual status of the vegetation



Digital aerial photography

- Digital aerial photography is carried out at regular intervals over the entire Sweden
- Standard flying altitude is 4 800 m, which give a resolution of approx. 0.5 m
- The 130 most urban areas are photographed from 2 500 m, which give a resolution of approx. 0.25 m
- Approximately 30 % of the territory is photographed every year
- Ortho photo, 0.5 m resolution, is available at a very low cost (approx. € 0.5 – 2.0 / sq km)

Photography interval

- 2 years
- 3 years
- 4 years
- 6-8 years

New software: OL Laser

- Jerker Boman, the creator of OCAD Transformer, is working on a new software for handling of laser data and compilation of base maps. The software is now undergoing beta testing
- When finished, this software will be available as freeware (so far only in Swedish)
- First "official" version is planned to be released in August 2010

The software OL Laser (beta version) can be downloaded from: www.oapp.se

Tools in OL Laser

From laser data (LAS-files) it is possible to create:

» GRID/TIN models with optional spacing

» Contours with optional intervals (export to shape format)

Images with optional resolution showing:

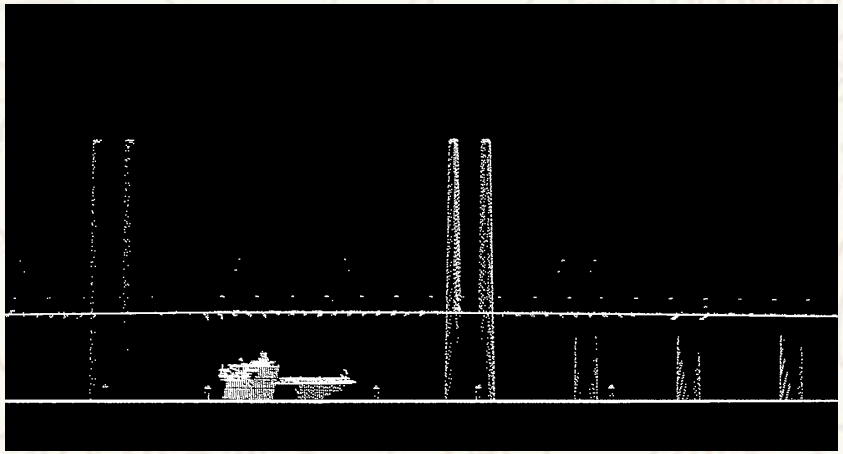
» Intensity

» Shading

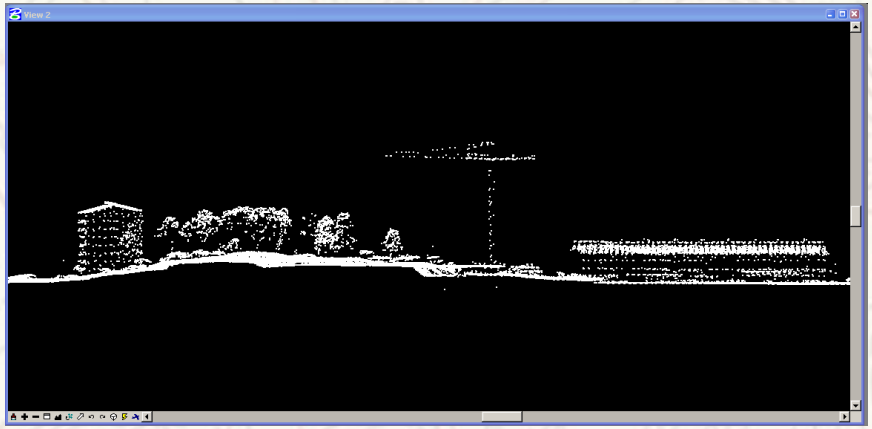
» Slope (gradient)

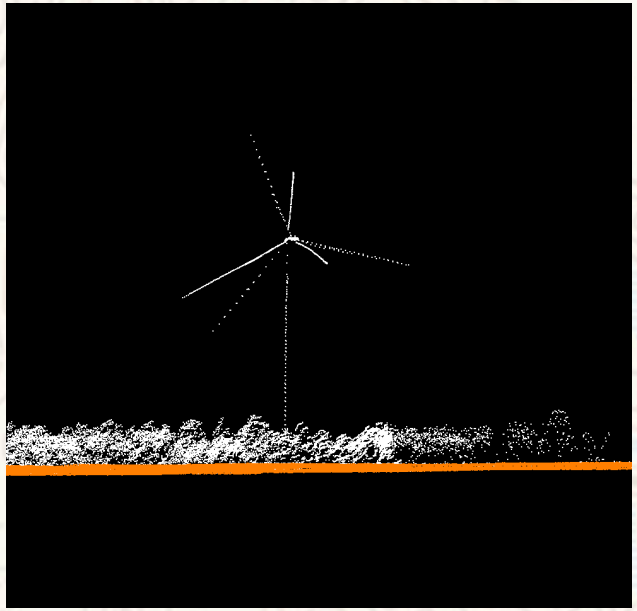
» Point class (vegetation height)

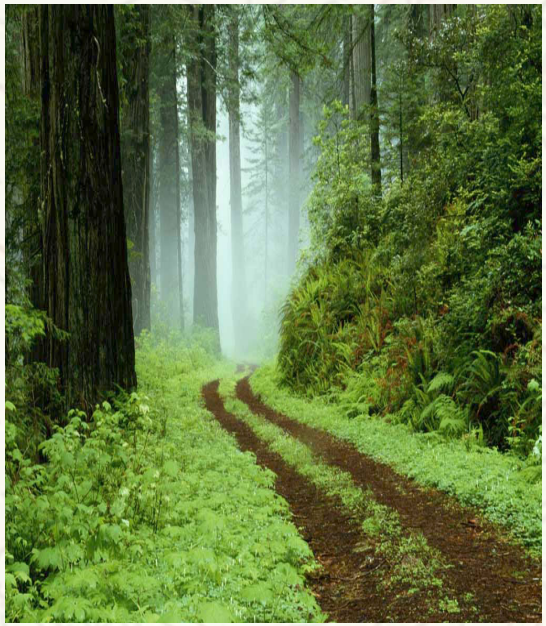
Objects captured by the laser scanner



- Even with the relatively low point density in Lantmäteriet's scanning, some objects are easily recognised in the laser point cloud

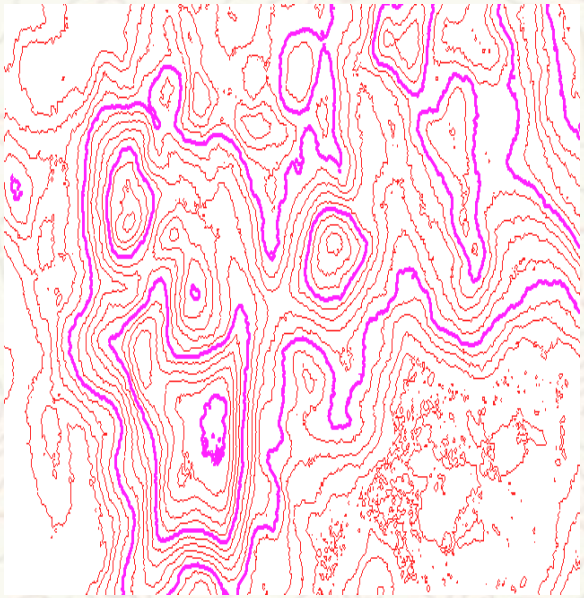






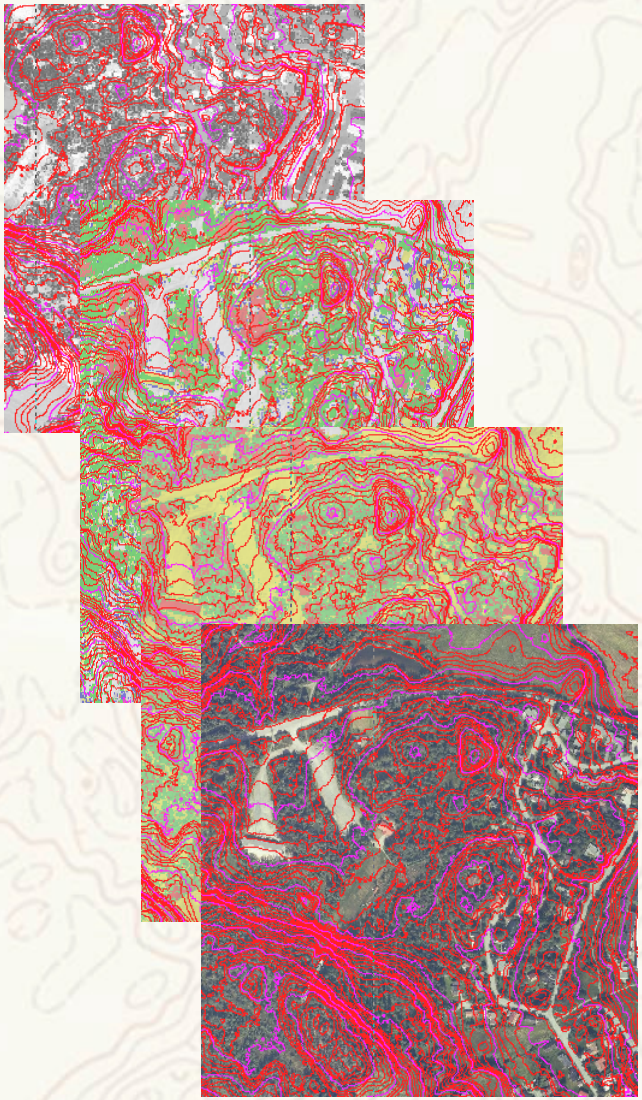
Experiences from field work with laser data

- Advantages
- Difficulties/disadvantages
- Background images used



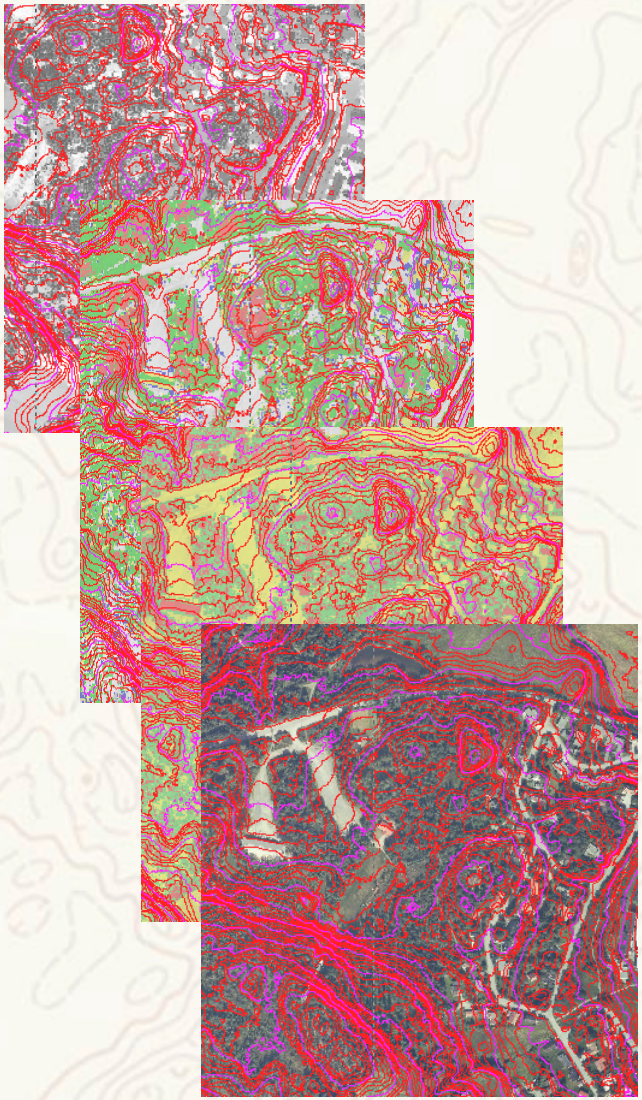
Advantages

- Accurate contour lines, even in high and dense forest
- You decide the interval
- Lead time can be shortened from flying to field work



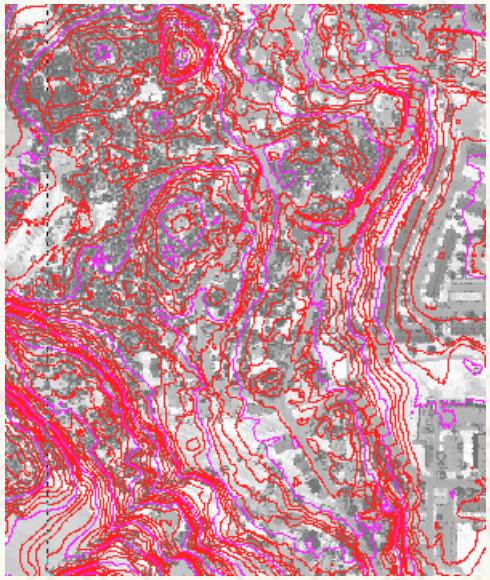
Difficulties/disadvantages

- To define the right level where to put the 5 m contour line
- Difficult to se buildings and stones
- Many different images to get different useful data from
- Much colour in images, can make it hard to see what you draw



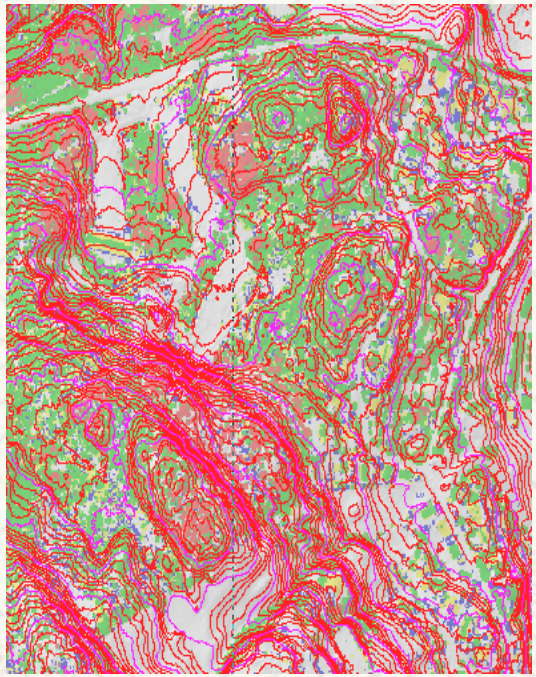
Images + contour line

- Intensity image
- Object height
- Object density
- Ortho photo



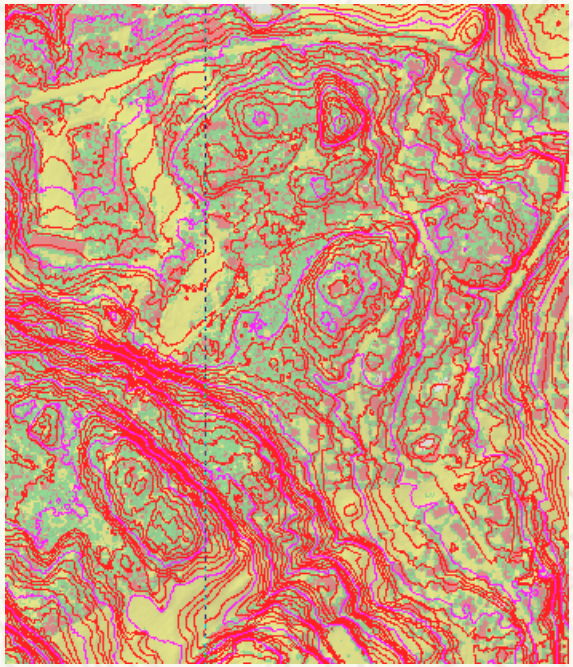
Intensity

- To black for hand held computer *(my opinion)*
- Works with drawing board and pens
- Needs to be down tuned to be able to see what you are drawing.
- Easy to see paths and vegetation boundaries
- Hard to see buildings



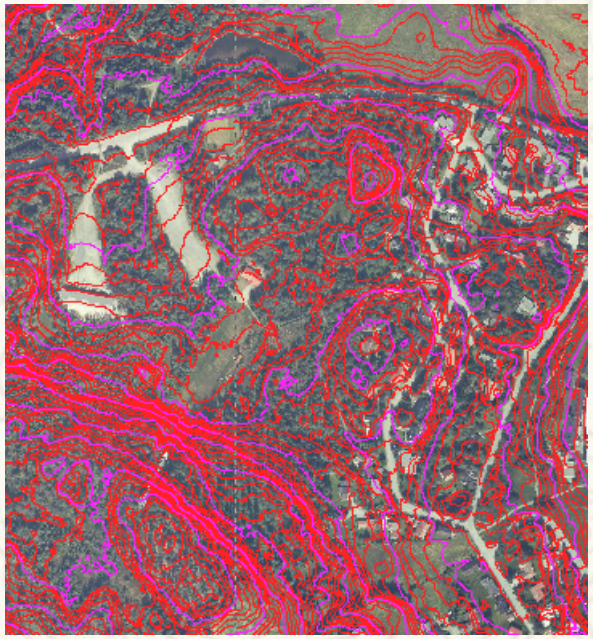
Object height

- Works with hand held computer
- Works with drawing board and pens
- Easier to see what you are drawing but you still need to tune the image.
- Rather easy to see paths and vegetation boundaries
- Hard to see buildings



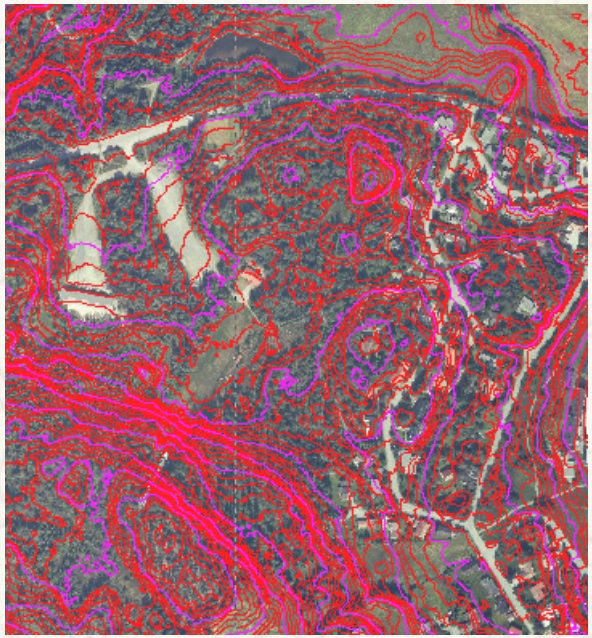
Object density

- Works with hand held computer
- Works with drawing board and pens
- Easy to see what you are drawing if you tune the image.
- Rather easy to see big paths and vegetation boundaries as well as clear cuttings, fields and small open areas in forest
- Hard to see vegetation boundaries between high and low forest with same density
- Hard to see buildings



Aerial photo (orthophoto)

- To black for hand held computer (*my opinion*)
- Works with drawing board and pens
- Needs to be down tuned to be able to see what you are drawing.
- Rather easy to see paths and vegetation boundaries as well as clear cuttings, fields and open areas in forest
- Easy to see paths and vegetations boundaries
- Easy to see buildings. It is even possible to see stones some where.



Conclusion

- There is a lot of images to collect data from
- Photogrammetry + laser contour lines will probably be very useful when laser data is old an do not longer show the actual status of the terrain. *(higher cost?)*
- Ortho photo + laser contour lines might also be useful when laser data is old and do not show the actual status of terrain. *(lower cost?)*

Our vision:
In a few years time, Sweden will become "HappyLand" for O-mappers

Thank You for listening