Laserscanning experiments and experiences in Norway

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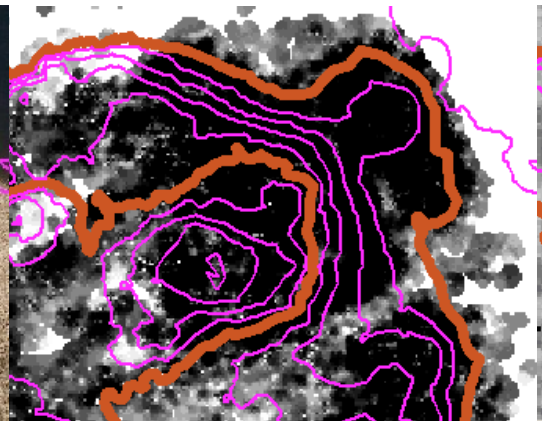
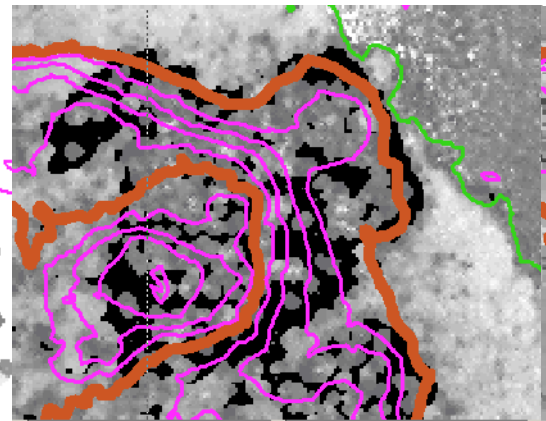
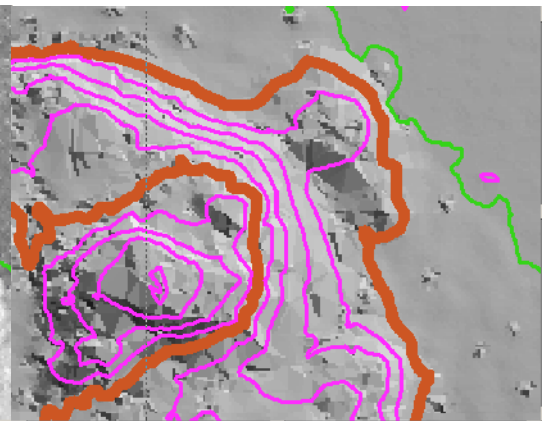






Experiences

- WOC 2010, Trondheim
  - Special purpose laser scanning by Terratec
    - Contours only
      - 1.25 meter contour interval – optimised smoothing
- NOF Map meeting, Bergen 2008
  - Tests in cooperation with Blom
    - Raw laser data from a GEOVEKST project
    - Testing of contour interval (1m, 1.25m and 5m)
    - Testing of other products (vegetation height, reflection intensity, shaded relief, ortophoto)

Orienteering basemaps in Norway

- Special purpose photogrammetry – dominant since the early 1960ies
  - A number of very competent companies/persons
  - Source of imagery: From archives or by paying for an air photo mission
  - Costs: Reasonable, considering the savings in field work
  - 2000-: Transition to digital photogrammetry

Public mapping in Norway

- Norge Digitalt
  - Sharing of geographical information within the public sector (including some utility companies)
- GEOVEKST - Cooperation on mapping
  - Coordination of projects among several governmental agencies and local government to maximise the amount of mapping

Laser scanning in Norway

- Most new mapping projects (public and private) apply laser scanning
- Two Norwegian companies do laser scanning (data capture and processing)
  - Blom
  - Terratec

How can orienteering benefit?

- Become a member of Norge Digitalt
  - Get access to standard products
- Participate in GEOVEKST projects
  - Influence projects
  - Specify standard products for orienteering basemaps
- Buy/get raw data or standard datasets from Norge Digitalt

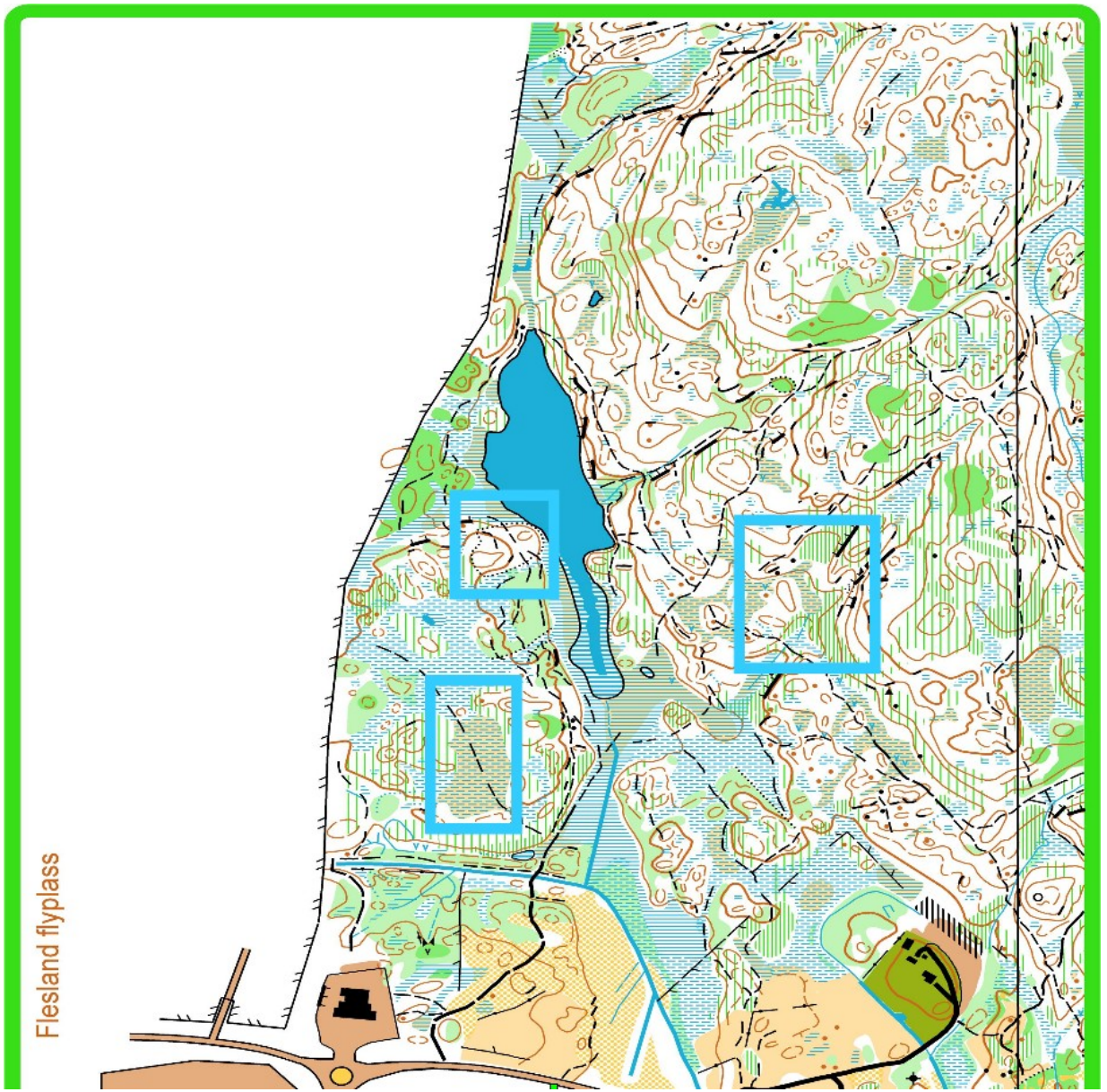
WOC 2010

- Laserscanning data used for contours only
  - 1.25 meter contour interval - Terratac
  - Contours: extremely accurate - forest or not
  - Contours: help identify ditches and cliffs
- Digital photogrammetry for the rest
  - Boundaries, paths, buildings, water features, etc.
- Challenge for the mapper:
  - Avoid excessive use of form lines!!
  - Redraw (smooth and adjust) all contours

Bergen 2008

- Test more «products» from laser scanning
  - Cooperation with Blom (data processing)
  - Data from a traditional mapping project
  - Norwegian west coast terrain
  - Contours
    - Contour interval, smoothing
  - Other products derivable from raw data
    - Usefulness for orienteering mapping

Bergen - existing orienteering map



The Bergen experiment
Contours

- 1 meter
  - Standard product in Norway (FKB)
- 1.25 meter
  - Could be suitable for orienteering maps
- 5 meter
  - Standard product for rural areas of Norway (FKB)
  - Some more smoothing?

The Bergen experiment Ortophoto

- Colour raster image (geo-referenced)
  - 0.1 meter resolution

«Raw data» from laser scanning

- The LAS format
  - Points
    - X, Y and Elevation
    - Intensity of the return signal
    - Return number: 1, 2, ... up to 5 (version 1.2)
    - Number of returns for this pulse
    - Classification (unclassified, ground, water, building, low vegetation, ...)
    - ...
  - Open Source library available (libLAS)

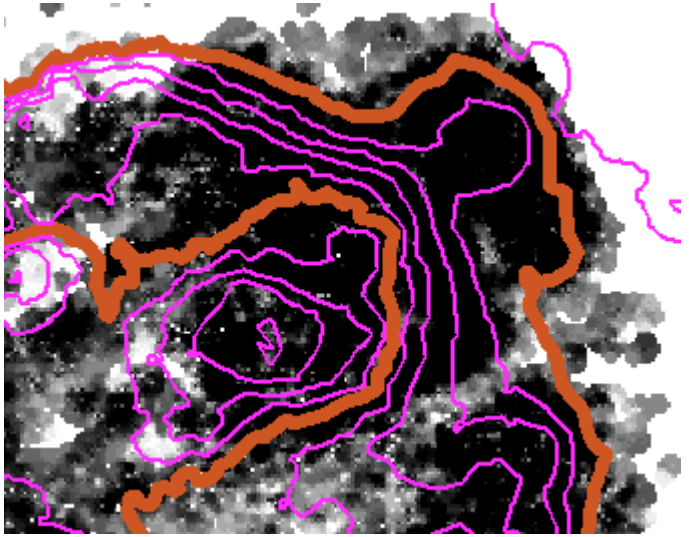
The Bergen experiment
Vegetation height

- The difference between the first and last reflection is an indication of vegetation height
- A raster map was produced
  - pixel size 0.5 meters
  - Grayscale - White: 0 meters; Black: >= 10 meters

A mistake was made in the data processing, so areas of 0 meter height were coded as black! - Fixed later

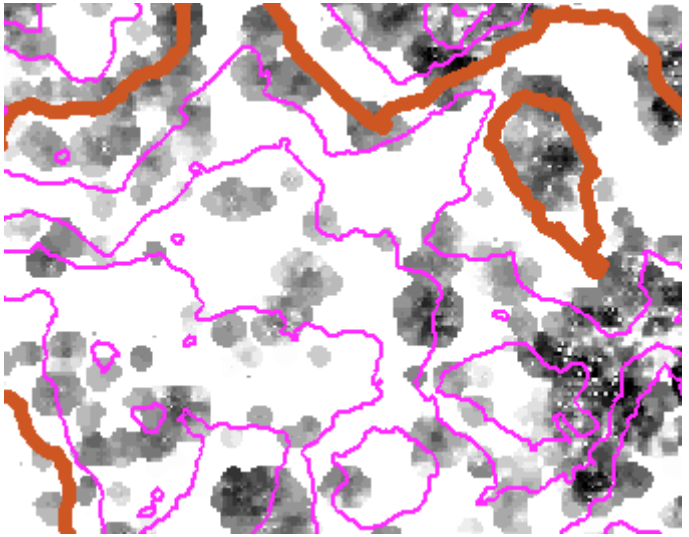
Vegetation height - examples

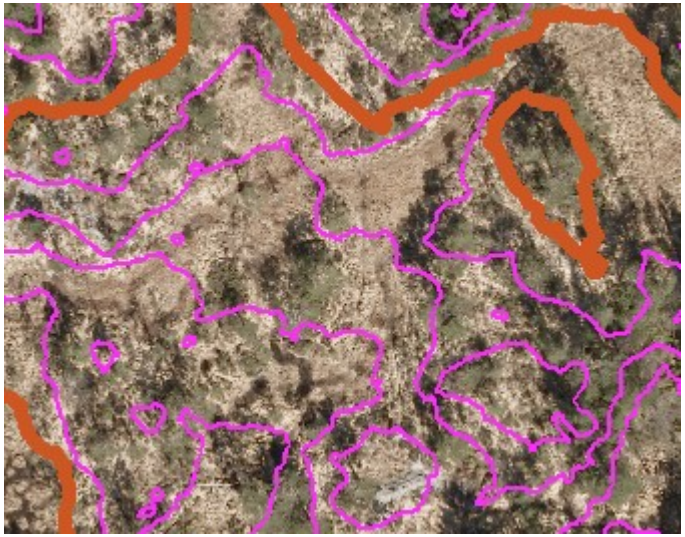
Spruce (quite dense)



Pine (scattered)

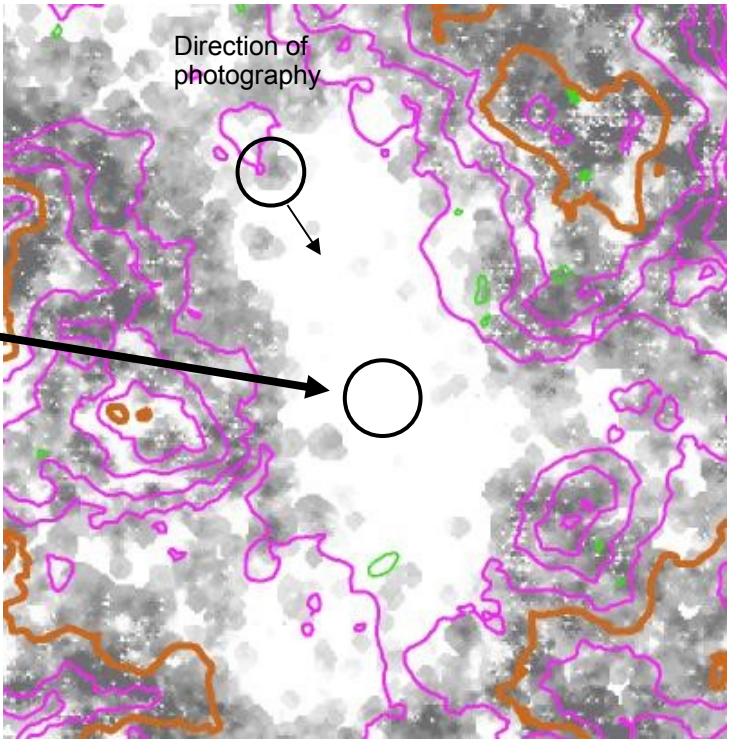
White: No vegetation
Lightest gray: very low
Black: >=10 m





Vegetation height

Partly wooded marsh



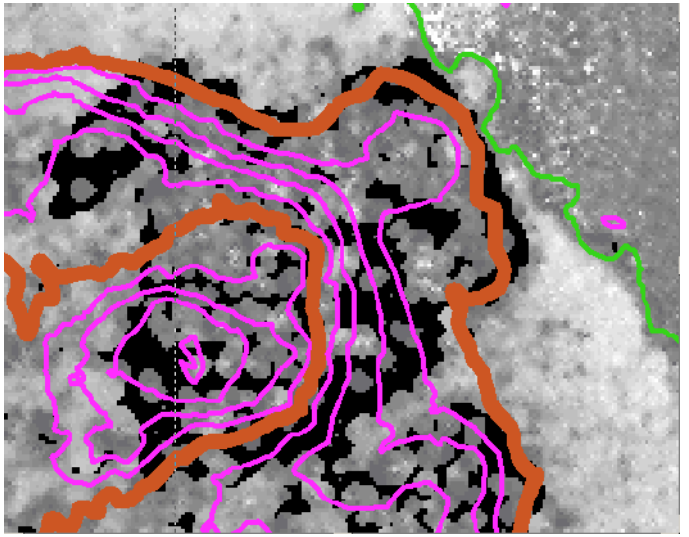
The birch trees on the marsh do not seem to be properly reproduced

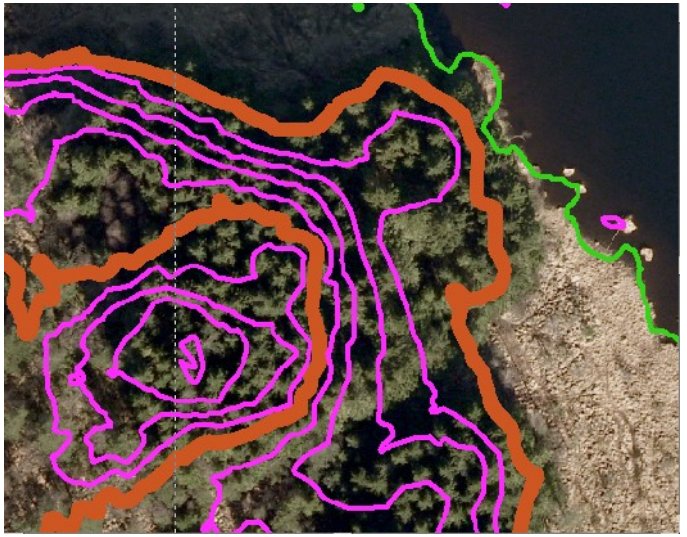
The Bergen Experiment Intensity

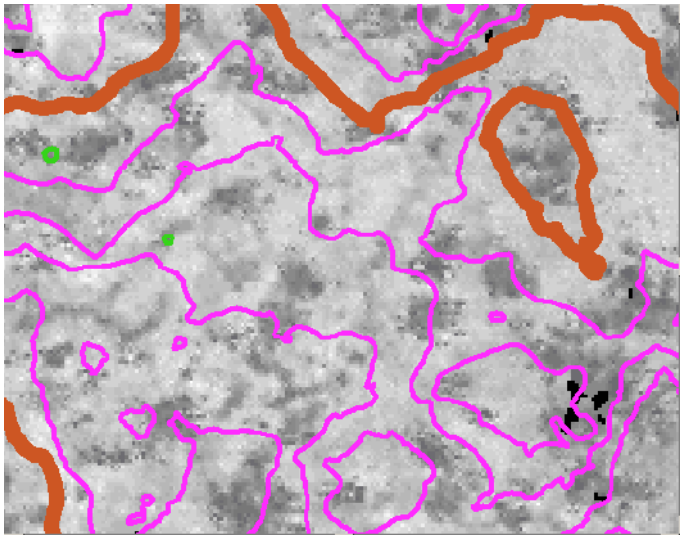
- The raw data from laser scanning contains reflected intensity values
- A raster map of intensity was made
  - Grayscale
    - White: Low intensity
    - Black: High intensity
  - Pixel size 0.5 meter

Intensity - examples

Intensity (near infrared):
Light surfaces have higher reflectance (white paint – high, ashpalt – low).
Sensitive to orientation (water - angle, waves).







Black: No reflection data from the ground
Darkest gray: very low
White: very high

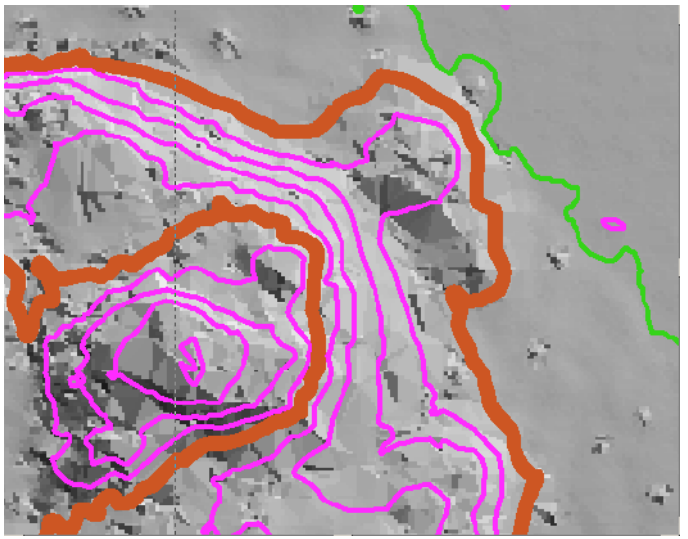
Shaded relief

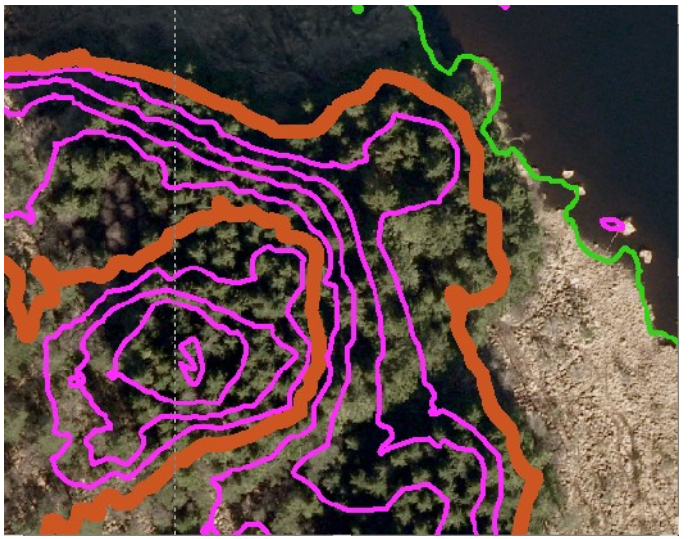
- Intuitive visualisation of terrain models
- Simulation of shadow from "the sun"
  - "Sun" (light source) traditionally in the north-west (top left)
- Raster
- Black to white
  - The more exposed to the "sun" - the lighter the pixel
  - The more in the "shadows" - the darker the pixel

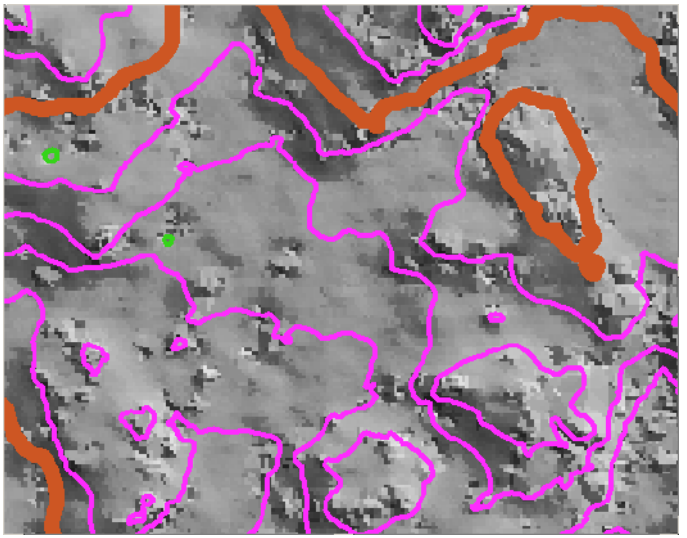
The Bergen Experiment
Shaded relief

- Raster map of shaded relief
  - Grayscale
  - Pixel size 0.5 meter
- Uneven ground in this terrain
  - Paths did not show up
  - Ditches showed up
  - Some small structures could be detected
  - Of questionable utility?

Shaded relief - examples







Light source - NE

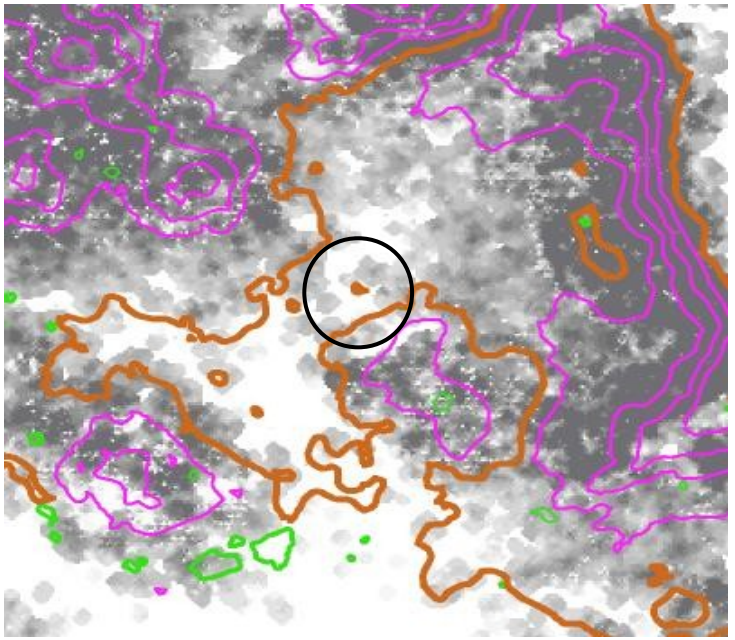
Usefulness of derived products in the forest

- When using paper/plastic in the forest
  - Not very useful – the base map gets too dark
  - Need very large scale base map to get details
  - Could be used for reference (separate)
- When using a computer in the forest
  - Background could be switched quickly
  - Zooming is possible (to see details)
  - Intensity/transparency could be adjusted
  - All sources of information could be valuable!

Terrain model - Vegetation artifacts

Willow thicket (Salix)

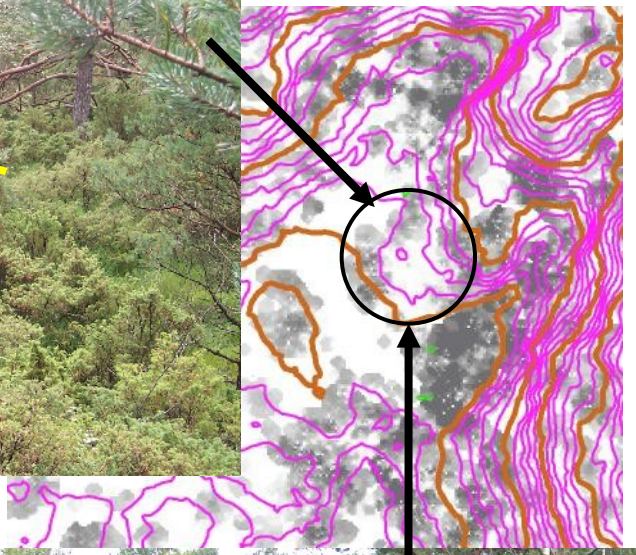
Small knoll?



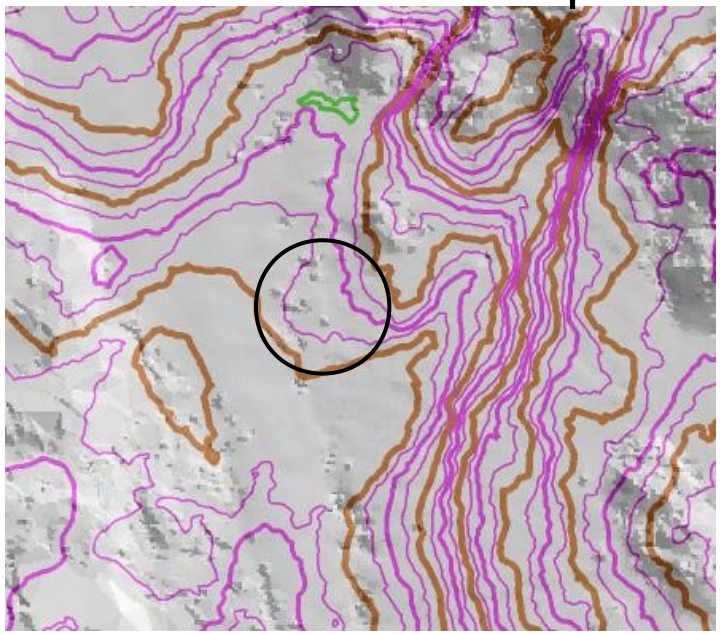
The low willow thicket appears as a small knoll

Vegetation artifacts

The white area in the circle is covered by junipers which do not show up in the vegetation map

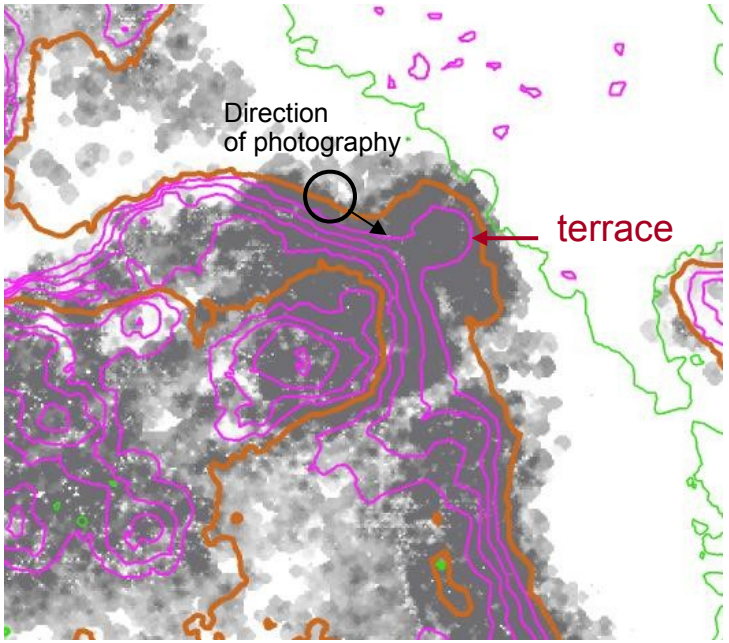


… nor in the relief map



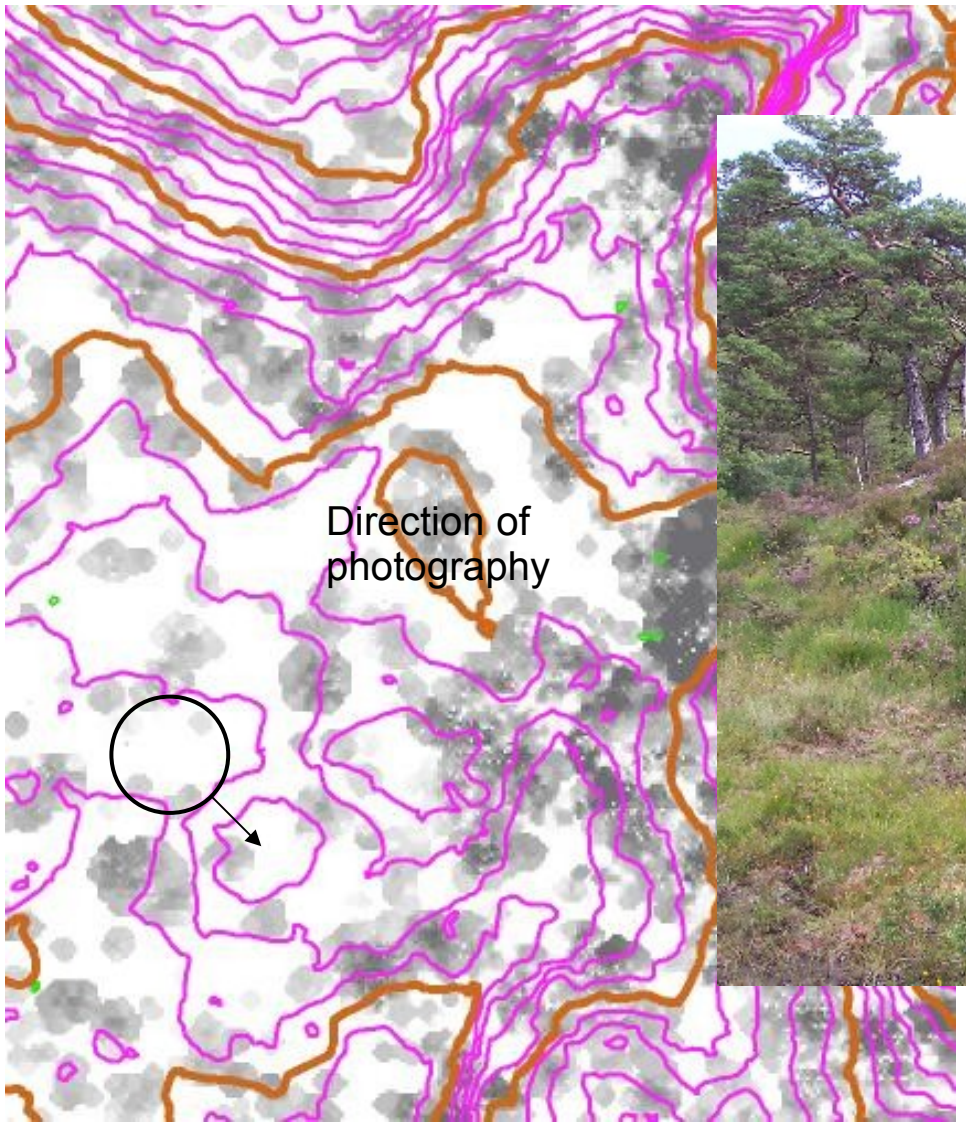
How does tall spruce influence the laser contours?

Picture taken from the north showing a spruce grove



The terrace is clearly reproduced

Contours - open pine forest



The 2 m high knoll in an area with minimal ground vegetation is well reproduced

Software and formats

- Coordinates were UTM 32 / Euref89
- Blom delivered
  - contours as layered DXF
  - imagery as geoTIFF
- OCAD was used to integrate the material
  - start with contours and imagery (same coord.sys.)
  - fit the scanned version of the old map

To do

- Investigate smoothing levels for contours (considering sampling frequency?)
- Vegetation boundaries from the raw data?
- Features from the raw data