Univerza v Ljubljani
Fakulteta za gradbeništvo in geodezijo

SISTEMa PARC

Young Authors' Paper

Analysis of ALS data and products in the Neusiedler See project

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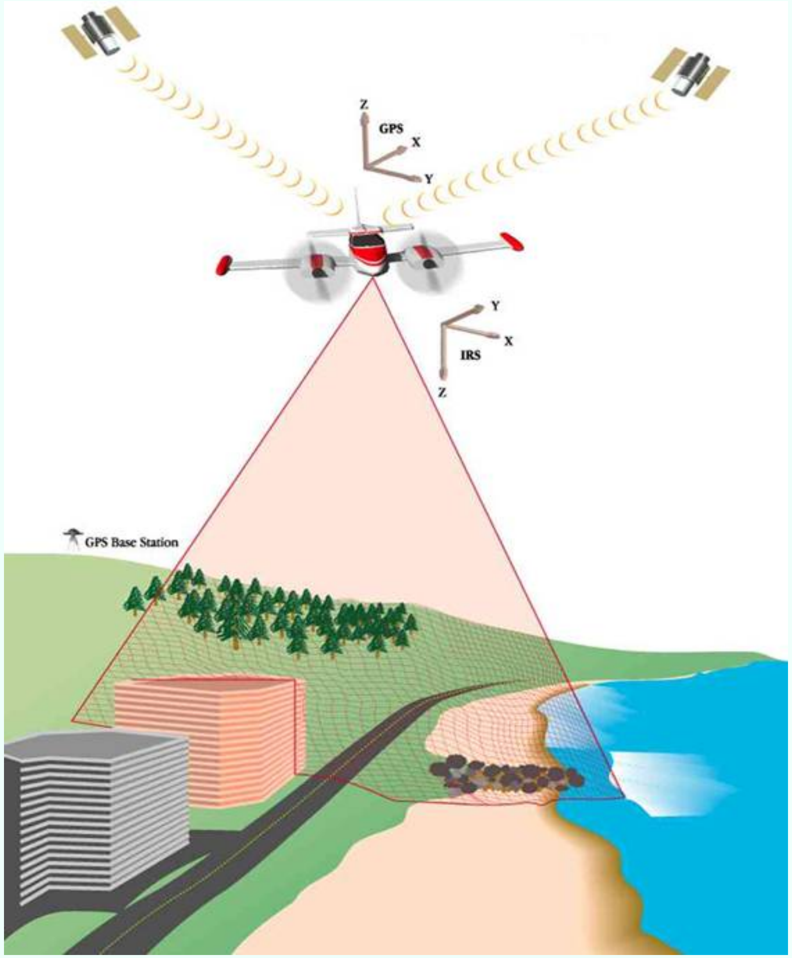
Outline

- Objectives
- Technology of ALS
- Project Neusiedler See.
- Analyse of DTM quality
- Analyse of intensity
- Conclusion



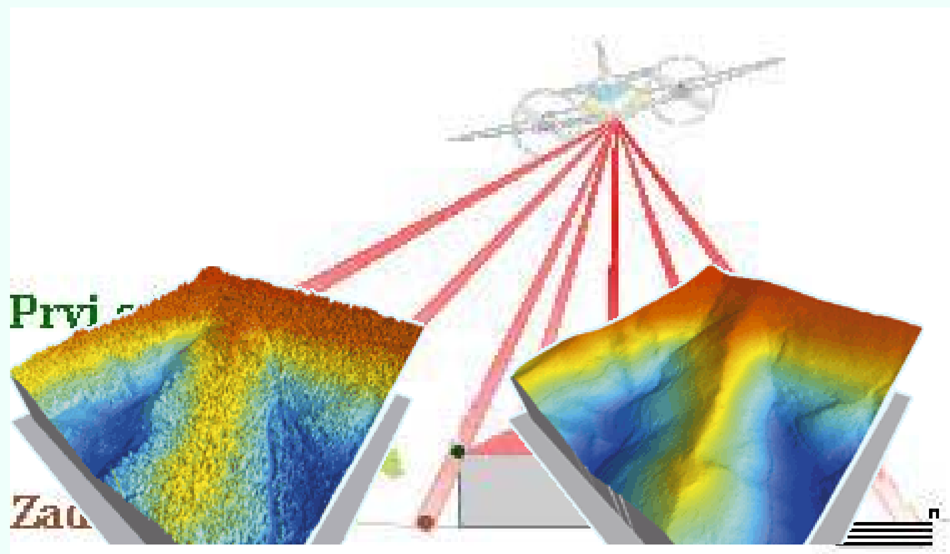
Objectives

- Getting to know the ALS.
- Acquiring practical experiences.
- DTM Quality control of the project Neusiedler See (sigmaDTM.exe).
- Analising the intensity measurements of the project Neusiedler See.

Basics of ALS

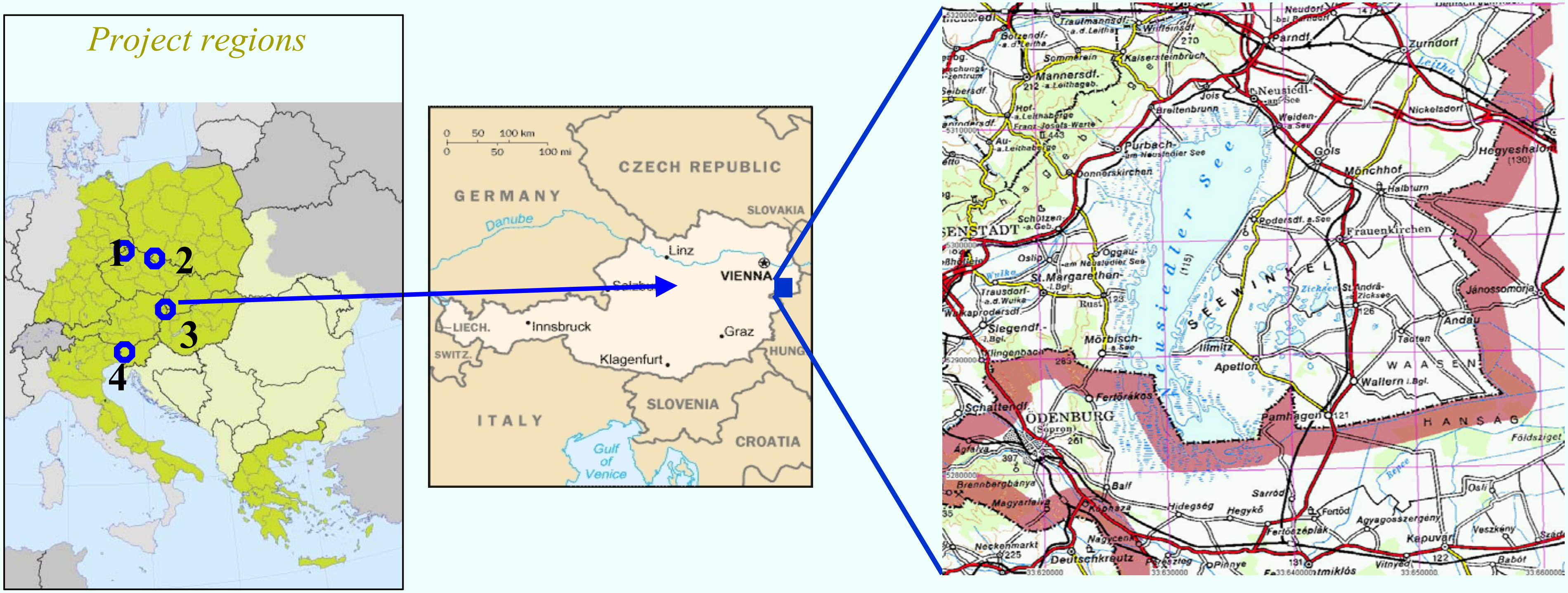
- ALS mission
  - o Data acquisition
  - o Laser light
  - o Moving of the laser beam

- Postprocessing
  - o 3D coordinates
- Computation of the results
  - o Digital Terrain Model (DTM)
  - o Digital Surface Model (DSM)



- Application

Project Neusiedler See-Seewinkel



Objactives: renaturalization of the natural basisn

Aim: modeling high resolution and accurateDTM fot hydrological analysis.

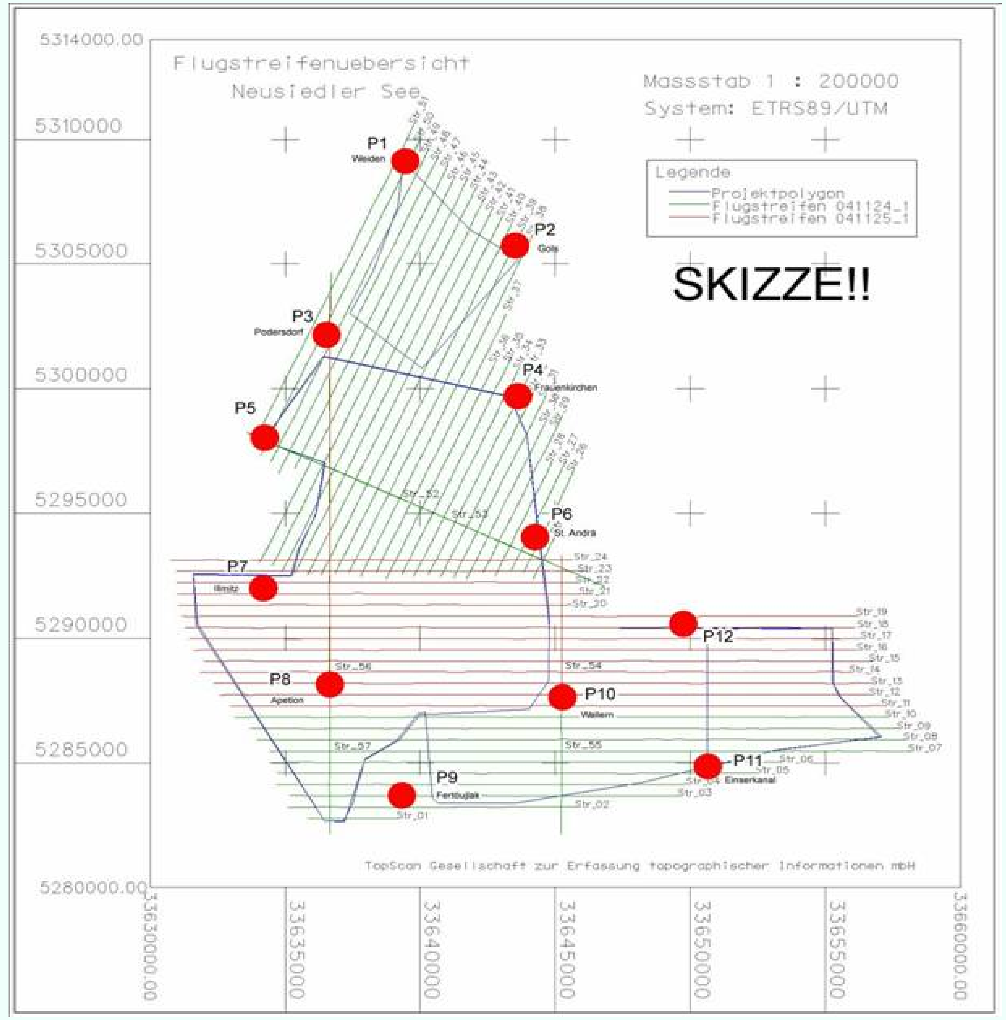
Data acquisition

ALS mision

- Company: TopScan
- Fliing date: 24. and 25. 11. 2004
- Area: ~ 250 km²
- Number of strips: 57
- Number of points: 1,05 miljarde
- Density: 1,5 točke na m²
- Measurement sistem: ALTM 2050
- Digital camera: Emerge DSS

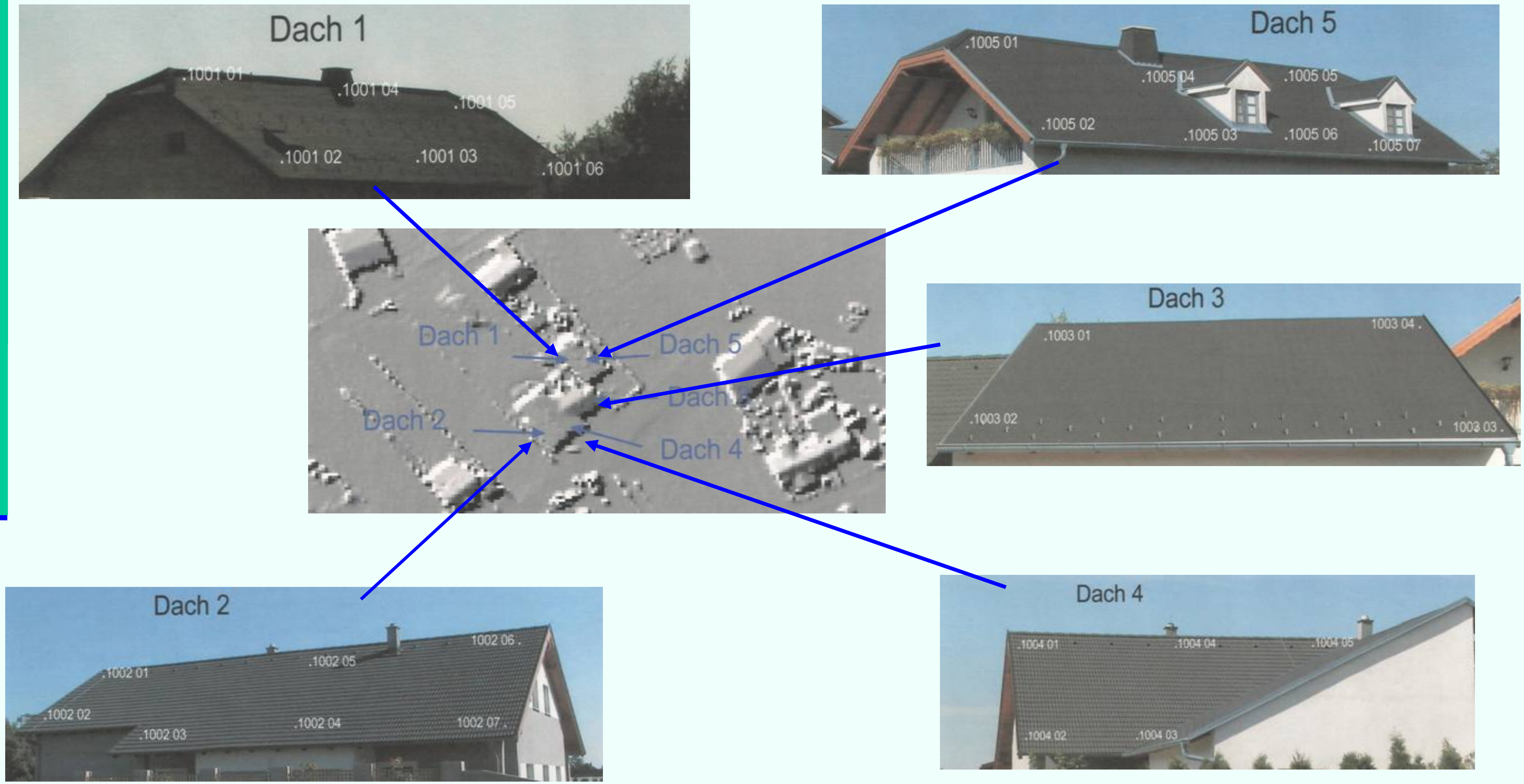
Terrestrial measurements

- Areas: 12 kontrolnih mest
- Measurement basis: GPS mreža
- Method: tachimetry
- Expected accuracy: ± 3 cm

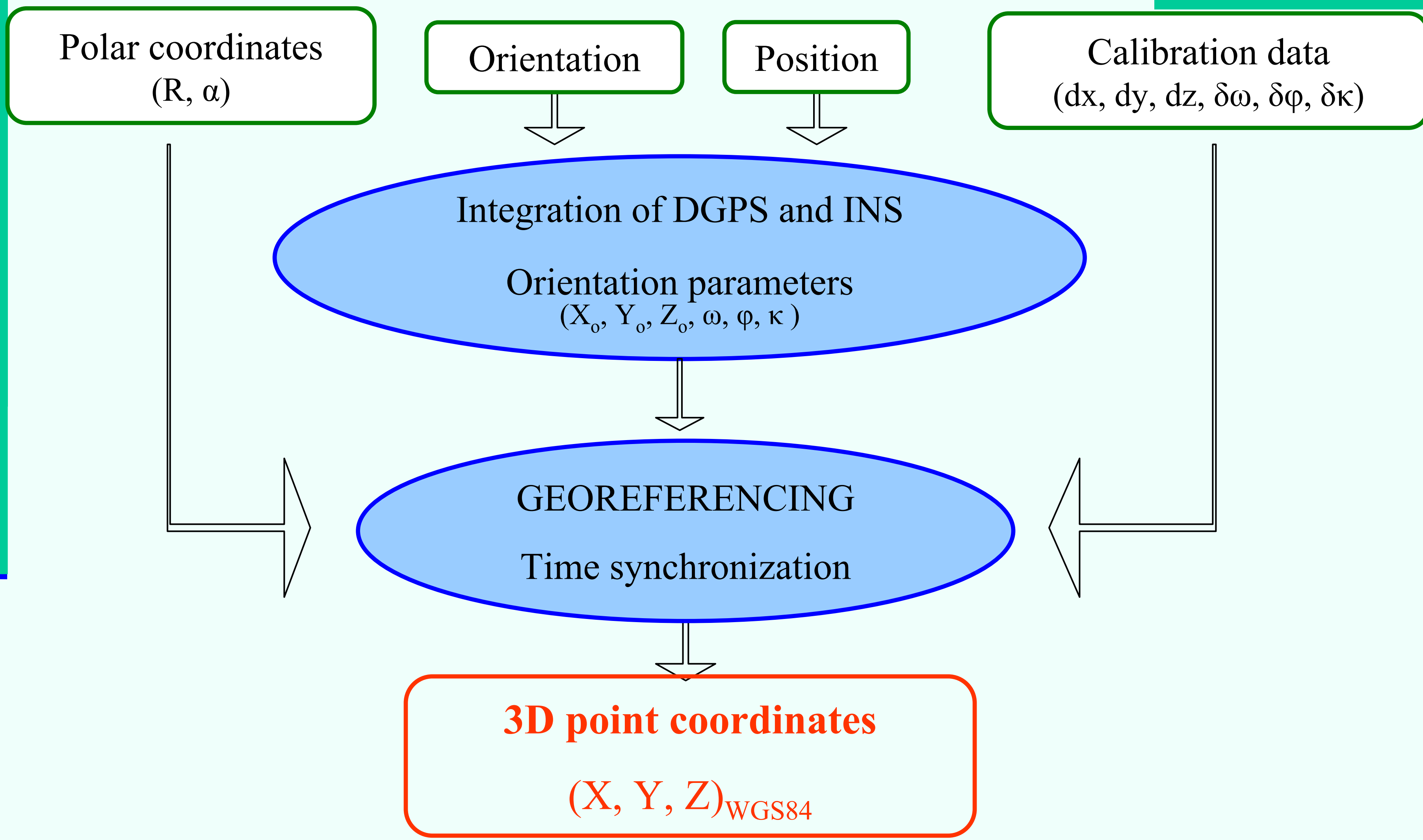


Terrestrial measurements

Example: surveyed roofs in control area 10



Postprocessing



Skrbno georeferenciranje

Polar coordinates
(R, α)

Orientation

Position

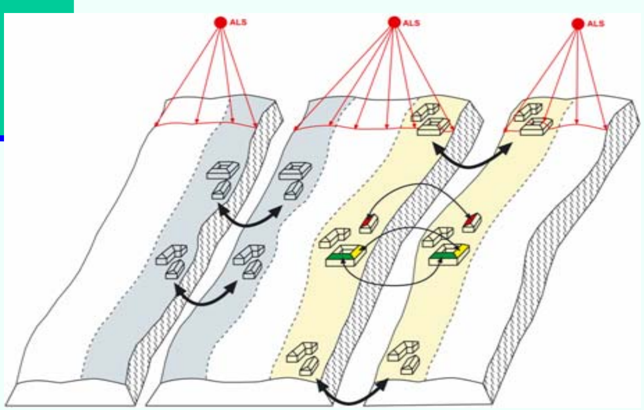
Calibration data
(dx, dy, dz, δω, δφ, δκ)

Tie points →
Tie patches
(searching in the overlapping area)

FINE GEOREFERENCING

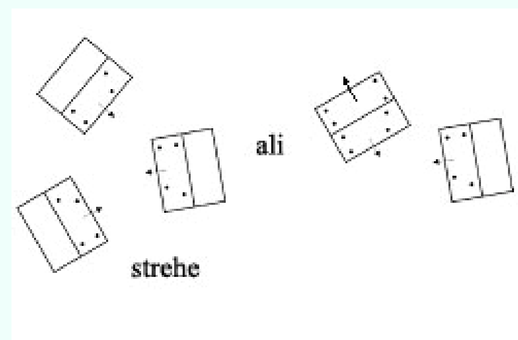
Simultaneous block adjustment of strips

Control points →
Control patches
(terrestrial measurements)



Adjusted 3D point coordinates

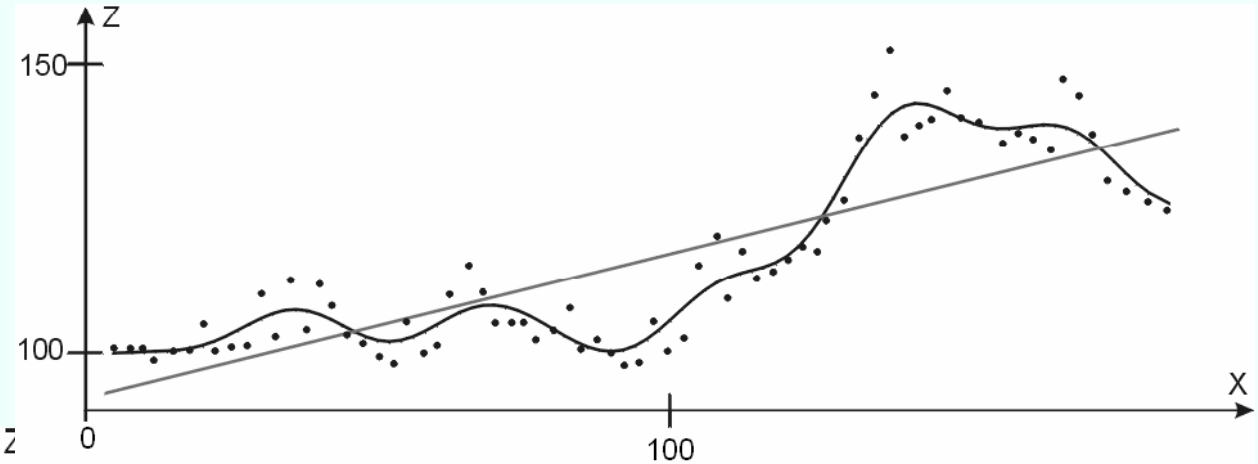
$(X, Y, Z)_{WGS84}$



The DTM computation

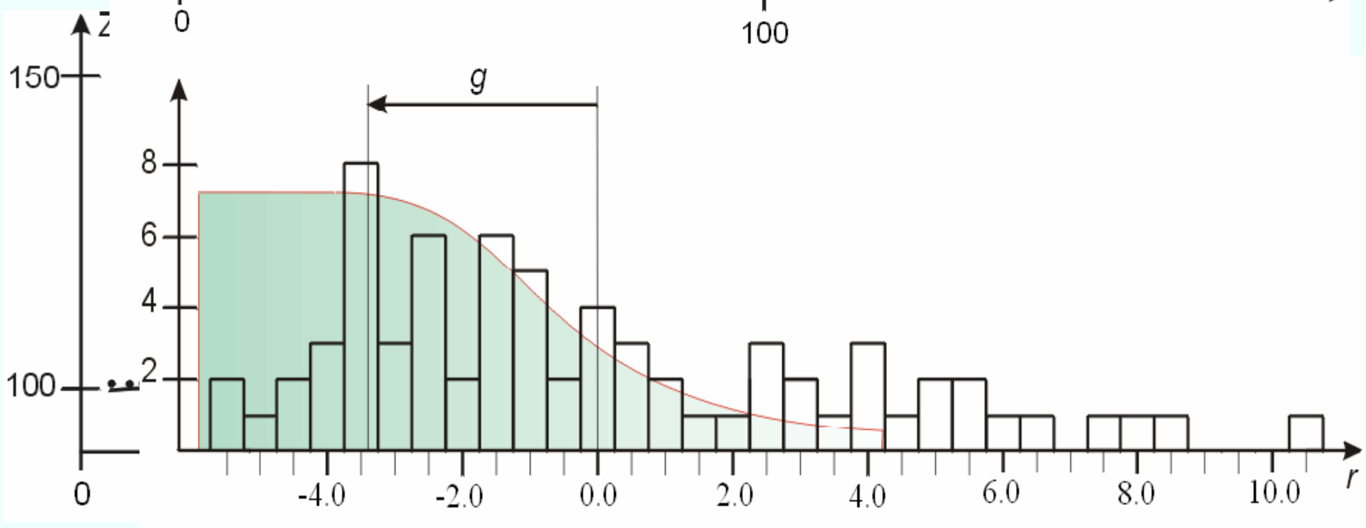
Iterative robust interpolation.

Profile



Weight

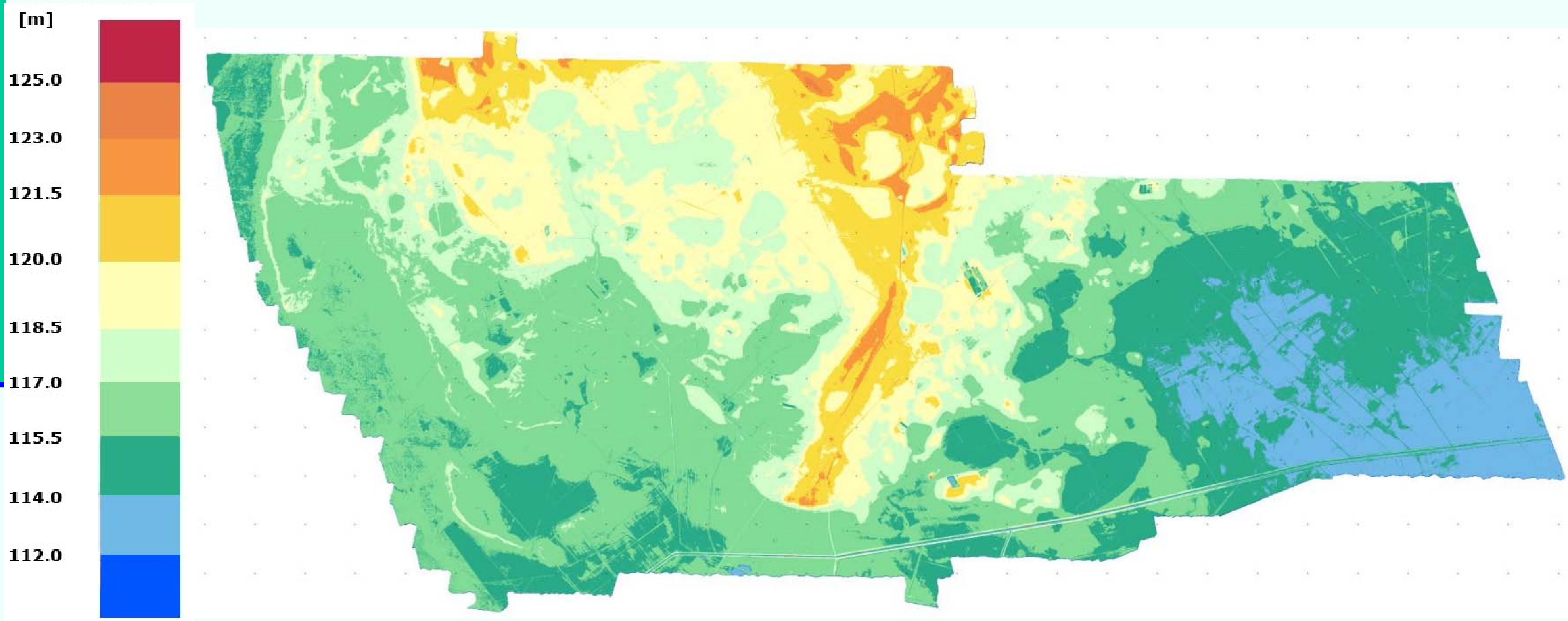
function



Processing the measurements

Digital terrain model calculation.

- Hierarchic iterative robust interpolation (SCOP++)



DTM quality control

Global quality parameters

$$\sigma_z[cm] = \pm\left(\frac{6}{\sqrt{n}} + 30\tan\alpha\right)$$

Where:

n … point density per square meter;

tan(α) … terrain slope;

6 in 30 … experimentally computed parameters

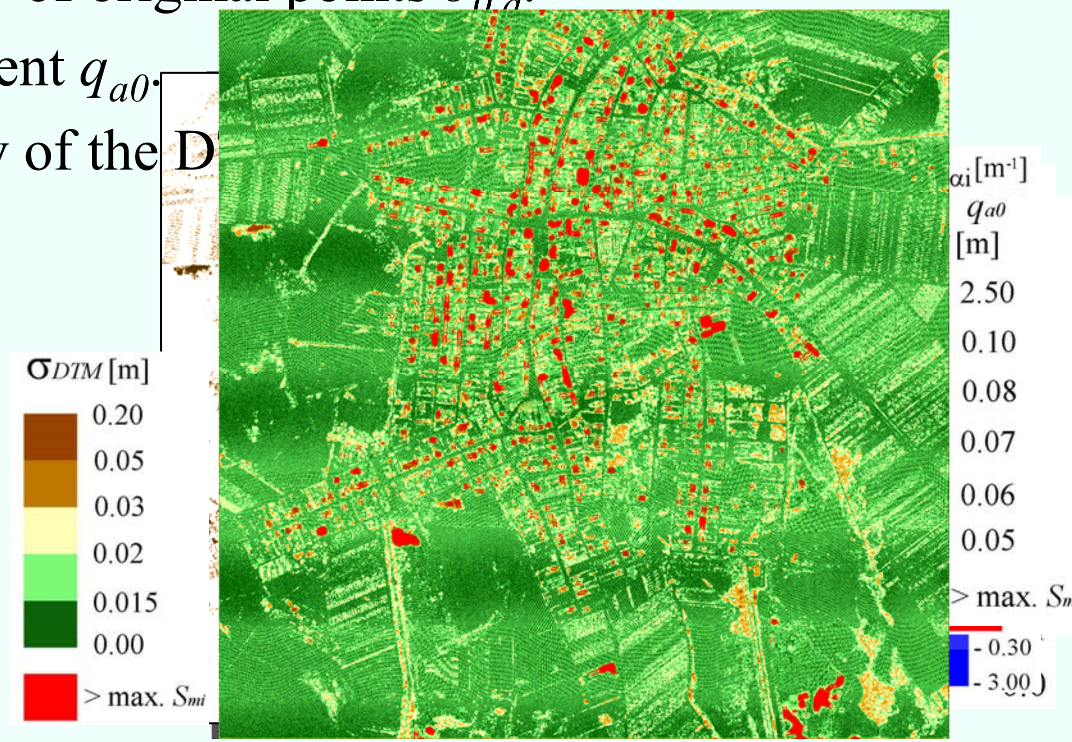
Local quality parameters

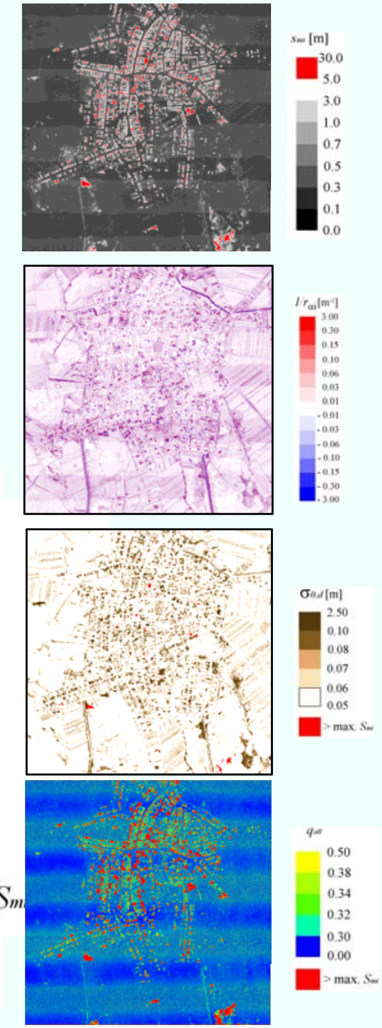
- **The method for the derivation of the height accuracy of each grid point.** (sigmaDTM.exe)
  - Used also for existing DTM.
  - independent of the interpolation method.
  - Grid resolution.
  - Attractive visualization (SCOP++).
  - Input data: original points, DTM.
  - Results: 5 digital models of quality parameters.

The local paramaters and visualization

- Minimum distance between each grid point and its nearest original point.
- Maximum main curvature.
- Height accuracy of original points $\sigma_{0.d}$.
- Weight coefficient q_{a0}.
- Height accuracy of the D

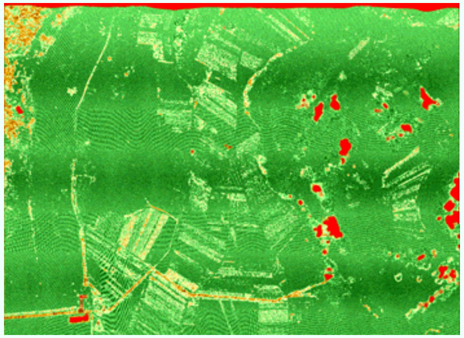
$$\hat{\sigma}_{DMR} = \sigma_{0.d}\sqrt{q_{a0}}$$



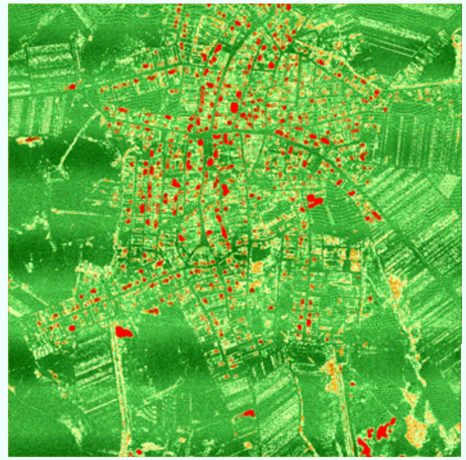


Comparison of local parameters 1/2

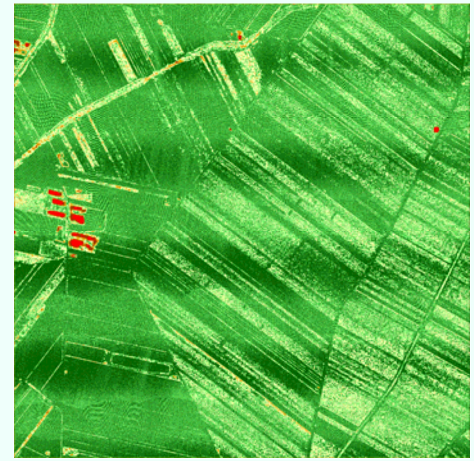
1. Schilf

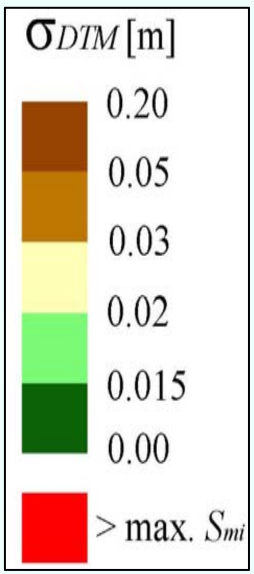


2. Village

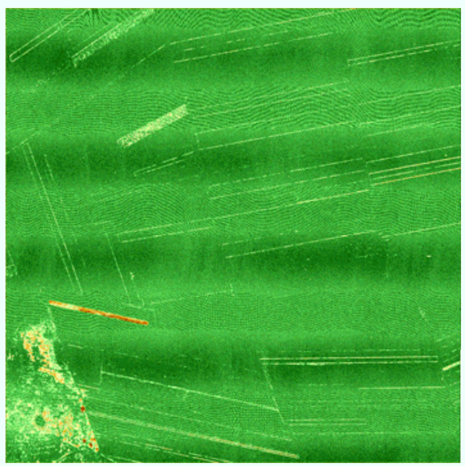


3. Vineyard

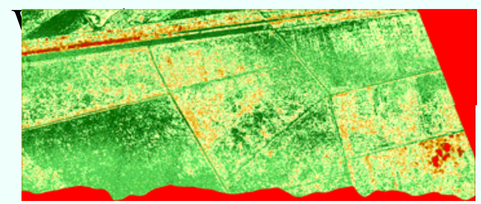




4. Field



5.



Comparison of local parameters

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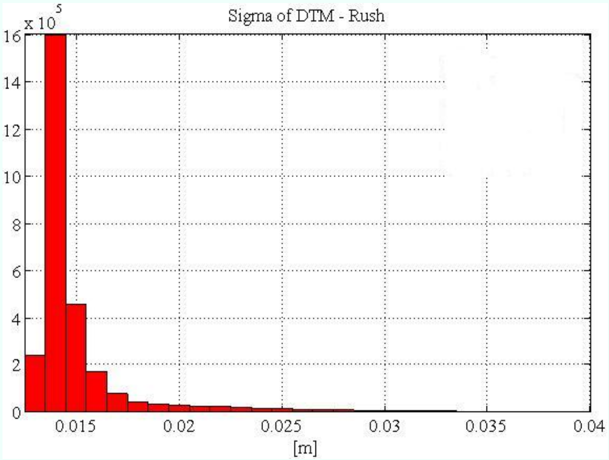

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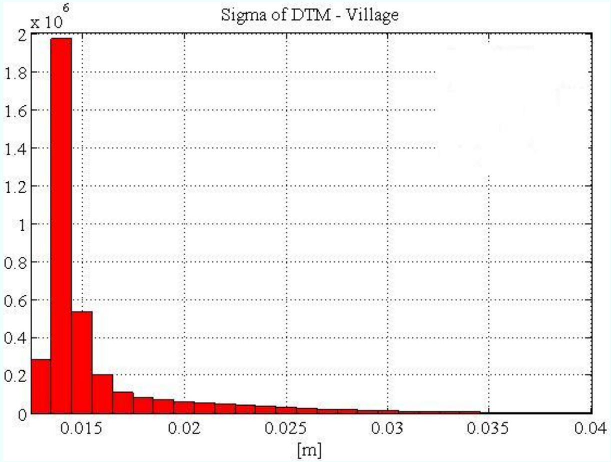

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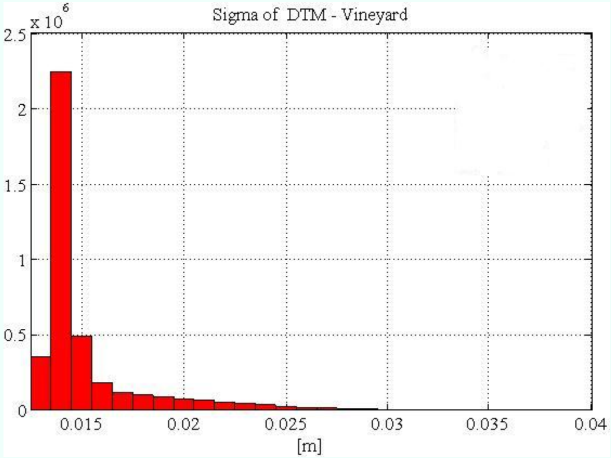

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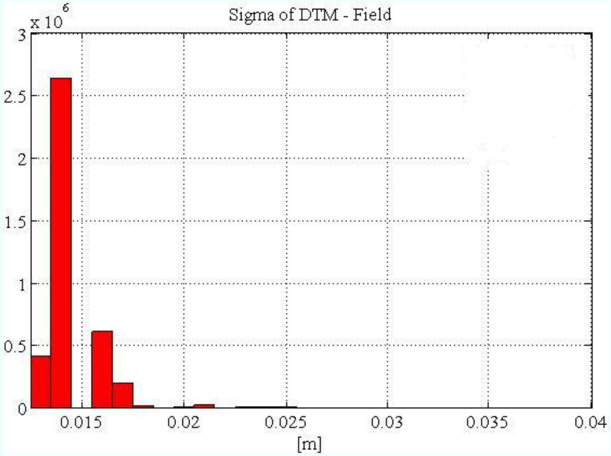
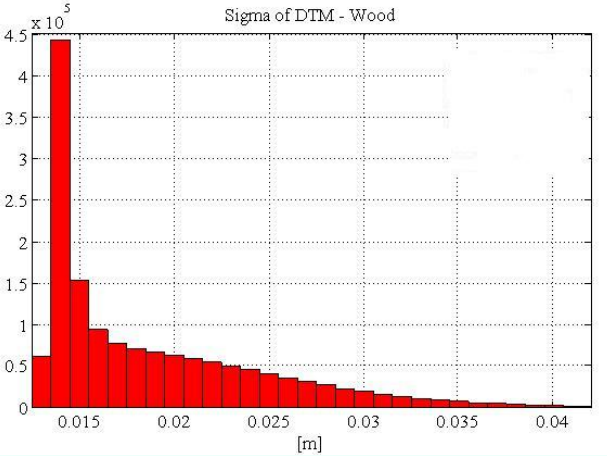
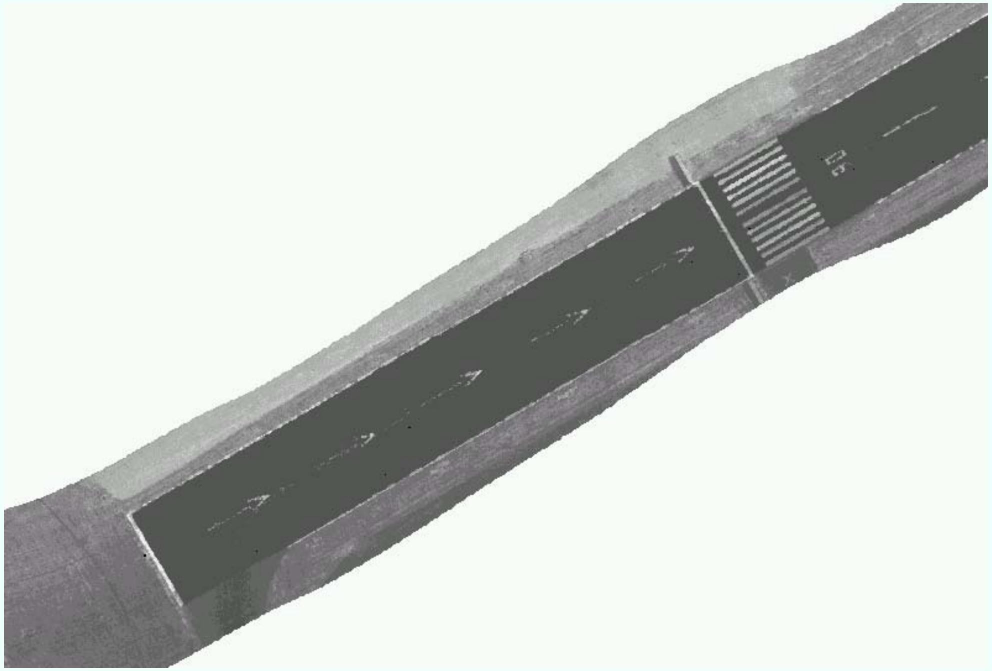


5. Wood



Intensity measurements analyze

- ALS measurements: polar coordinates, position, orientation, intensity.
- Influencing factors.
  - o Laser scanner
  - o atmosphere
  - o target



- Definition; relation between emitted and received strength of laser wavelength .

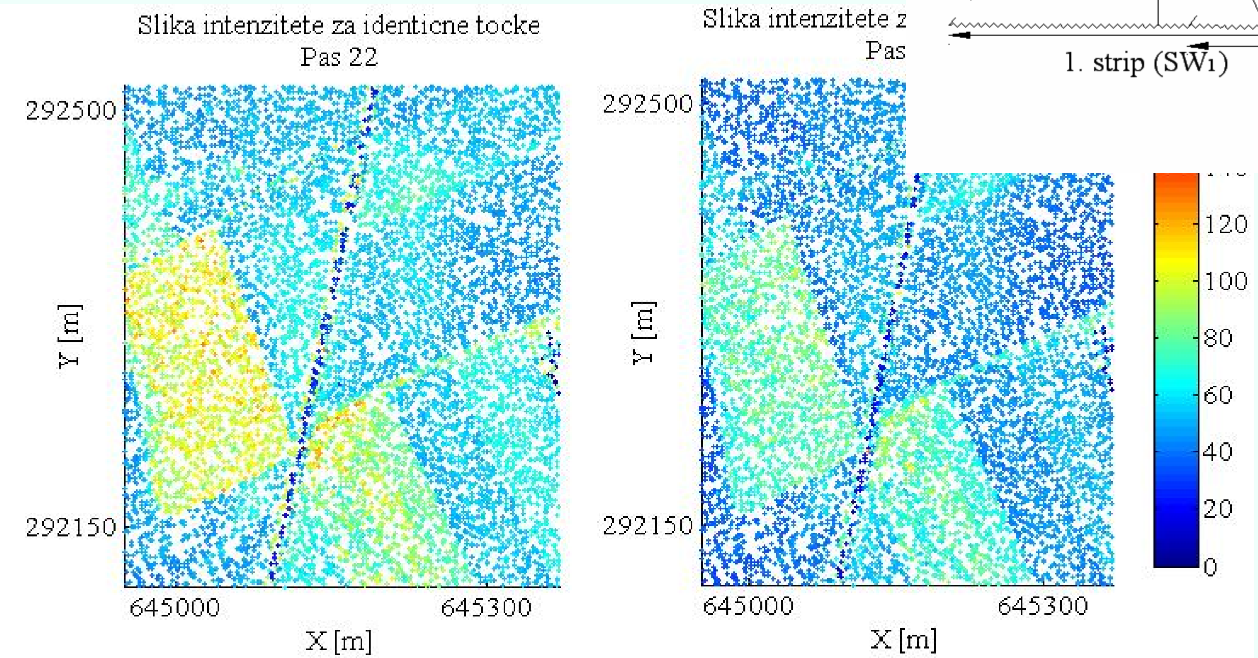
Identical points

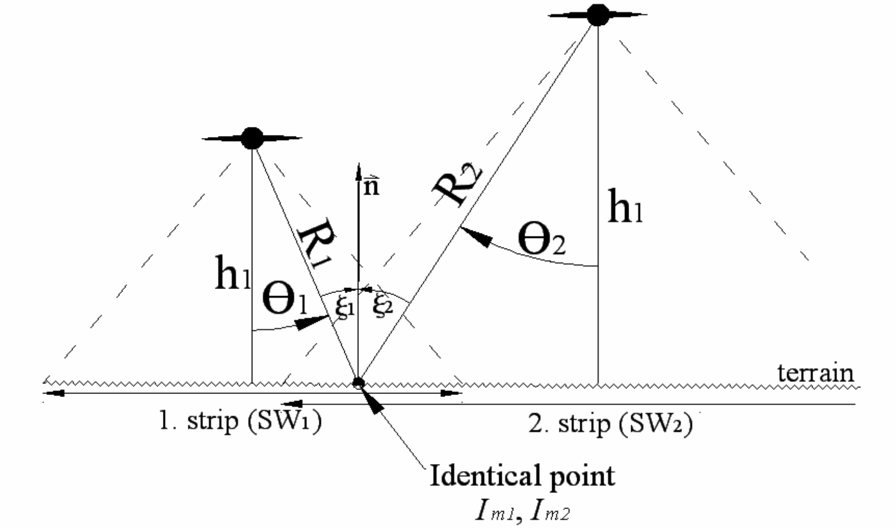
- Measured intensity:

$$I_m \approx \frac{P_r}{P_t} = \frac{\rho}{R^2} * konst.$$

- Intensity of identical points:

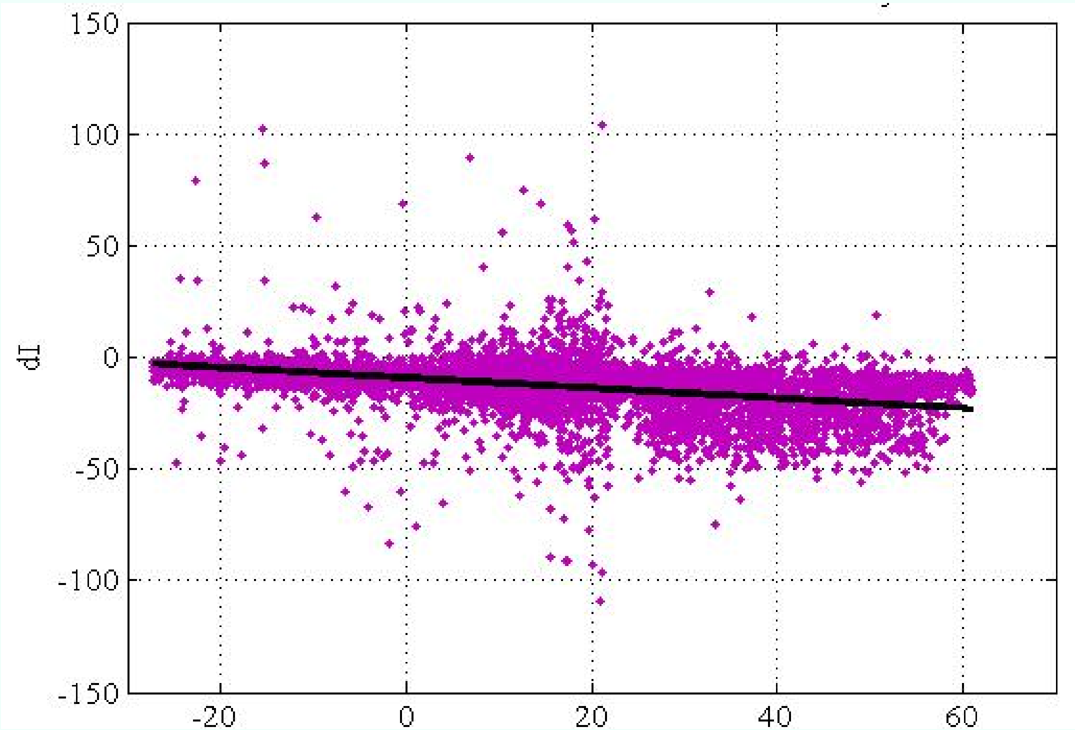
$$I_{m1} = I_{m2}$$





Normalization

$$\Delta I_m = a * \Delta R + b$$



Relative normalization:

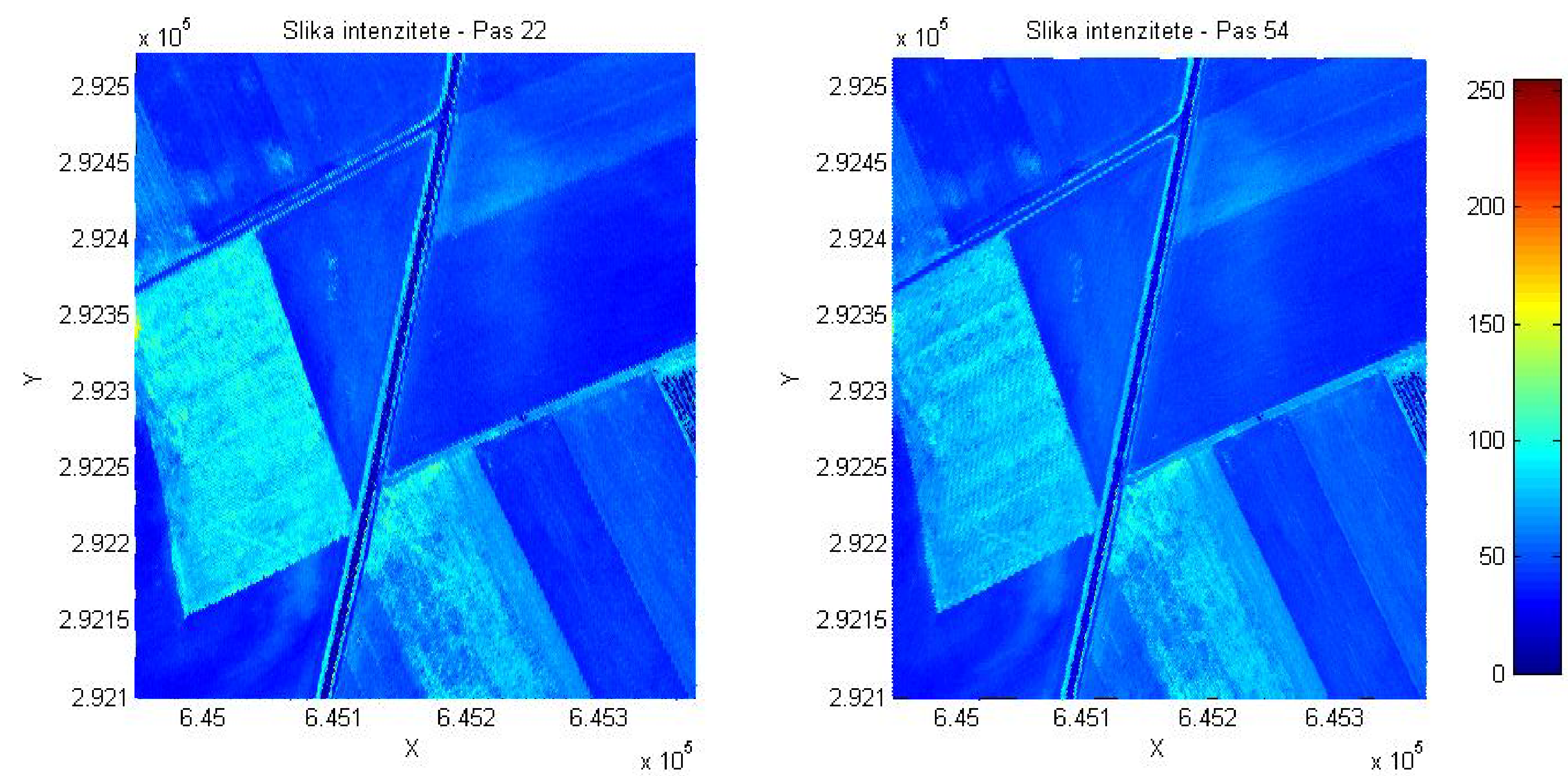
1. possibility : I_2 (2. strip is master)

$$I_1 \rightarrow I_1^n = I_{m,1} + \overline{\Delta I(\Delta R)}$$

2. possibility : I_1 (1. strip is master)

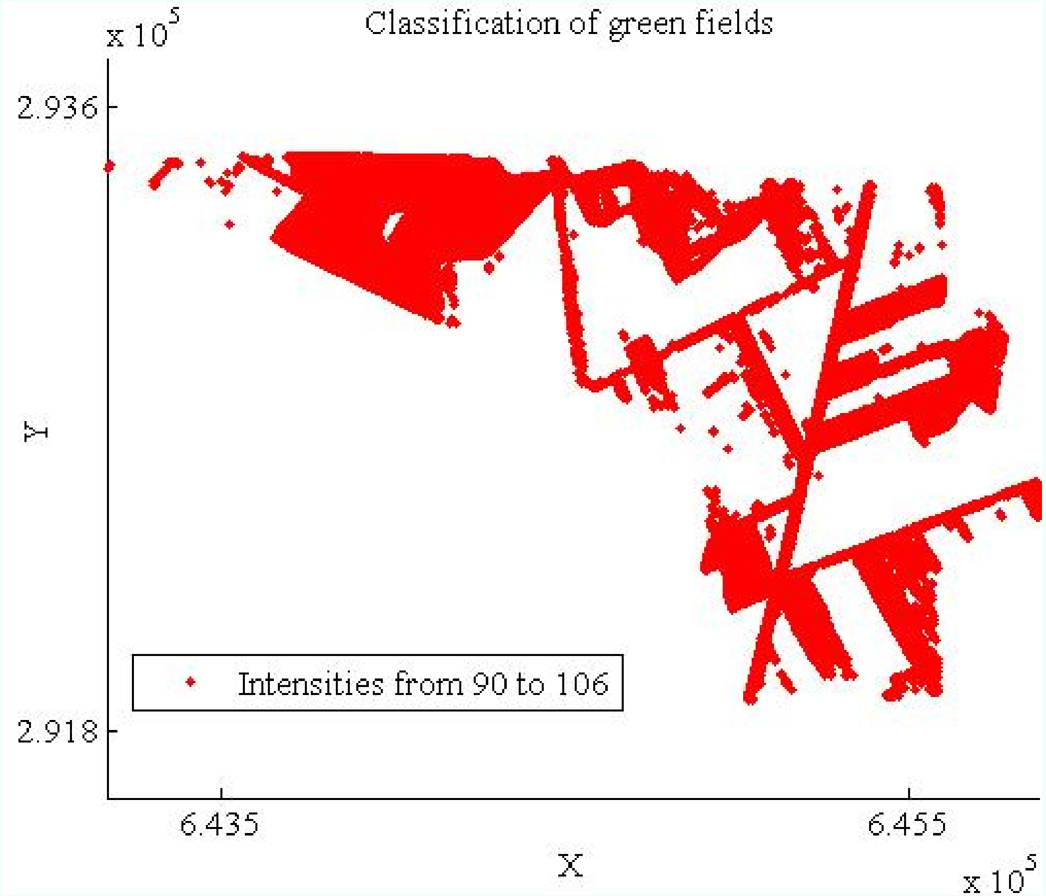
$$I_2 \rightarrow I_2^n = I_{m,2} - \overline{\Delta I(\Delta R)}$$

Normalization results



Classification

Example: classification of green fields (meadows).



Conclusion

- DTM quality control
  - The DTM of Neusiedler See is very accurate.
  - The planimetric control of the DTM.
  - The calculation and the visualization of parameters is simple.
  - Data layers.

Thank you for your attention!

- Intensity mea
  - Constant shift in measurements – height of the flight.
  - Classification is not possible. Just lidar data do not suffice.
  - Potentially useful information about the surface.
  - Influencing factors.
  - Intensity dependency.
  - Different applications of intensity.