

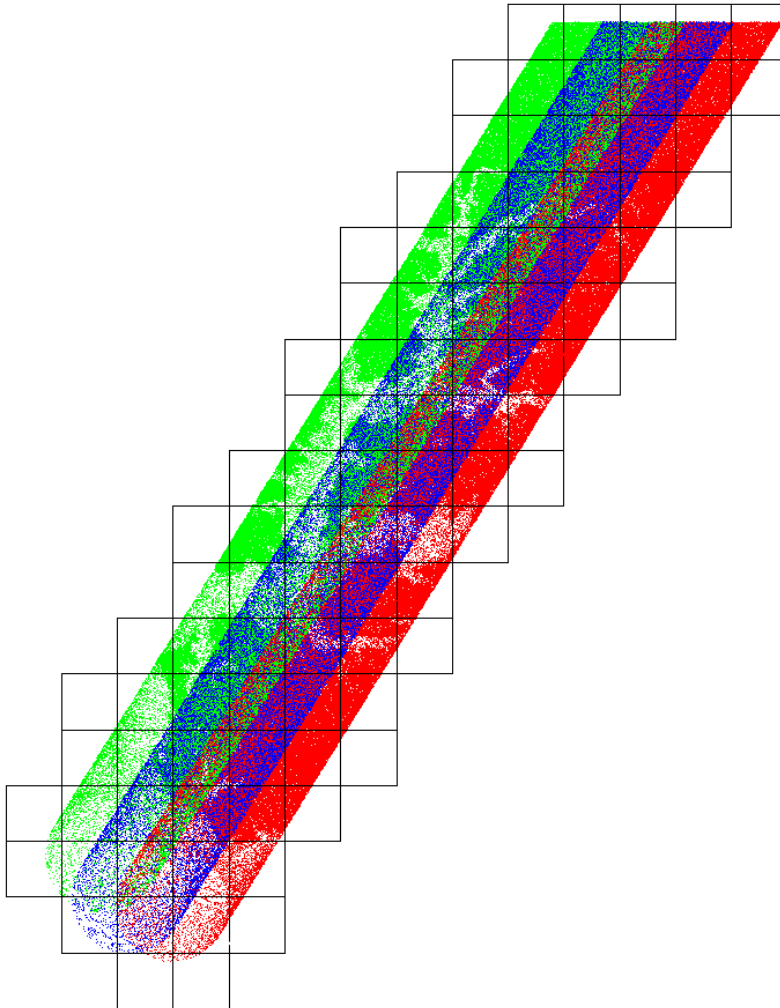
EuroSDR Preliminary Study – Potential of SPL
Single Photon and Geiger Mode Lidar Workshop
Barcelona, Spain
6th March 2019

Charly Bernard, ENSG/IGN, France

Background / aims of study

- EuroSDR interested to investigate potential of SPL on behalf of NMCA members
- SPL100 Dataset kindly provided for provisional analysis by Leica Geosystems
- Analysis performed in Summer 2018 during vacation scholarship at Newcastle University
- No ground truth available

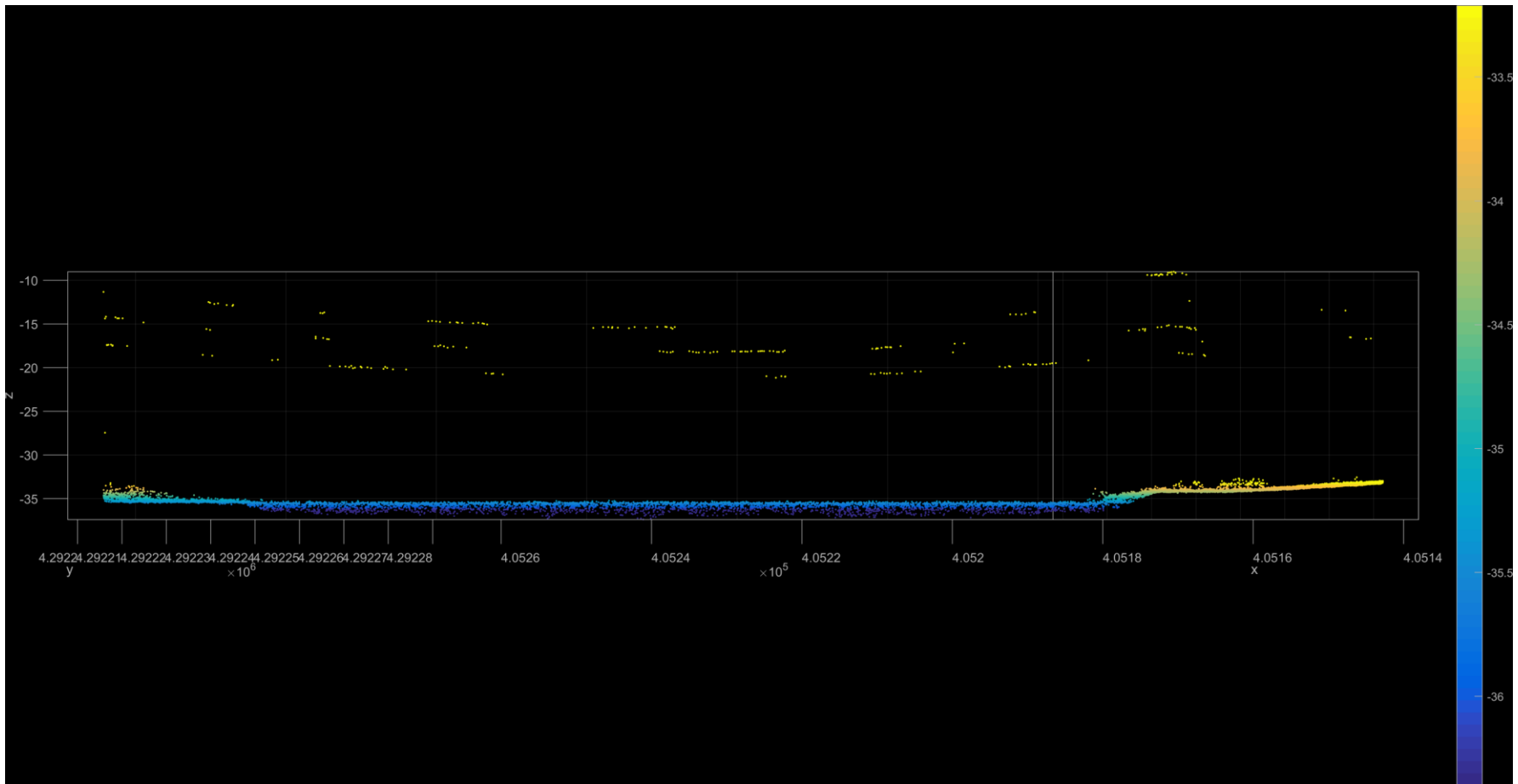
Dataset for the study



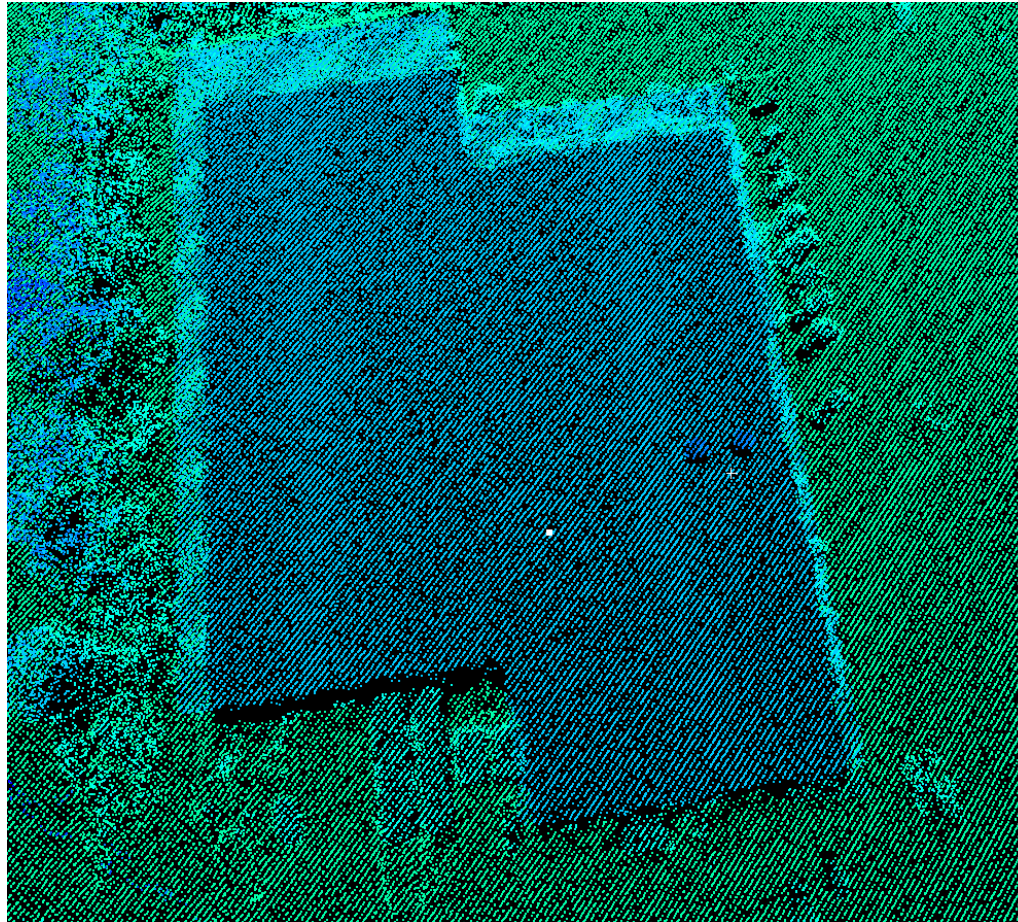
- Location: Easton, MD, USA
- Acquisition date: 25/01/17
- 3 flight lines
- c. 1 billion points
- Lateral overlap: 60%
- Urban areas, vegetation, water, fields / bare soil
- 97 tiles 1x1km²

- Selection of 8 tiles
- Computation of density, precision, water penetration

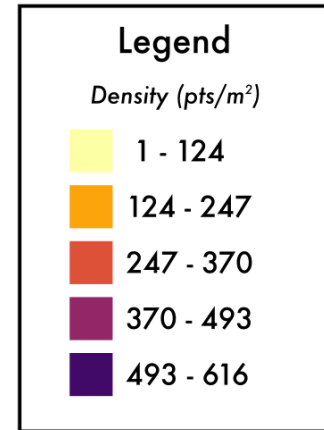
Extract of the points cloud



Extract of the points cloud

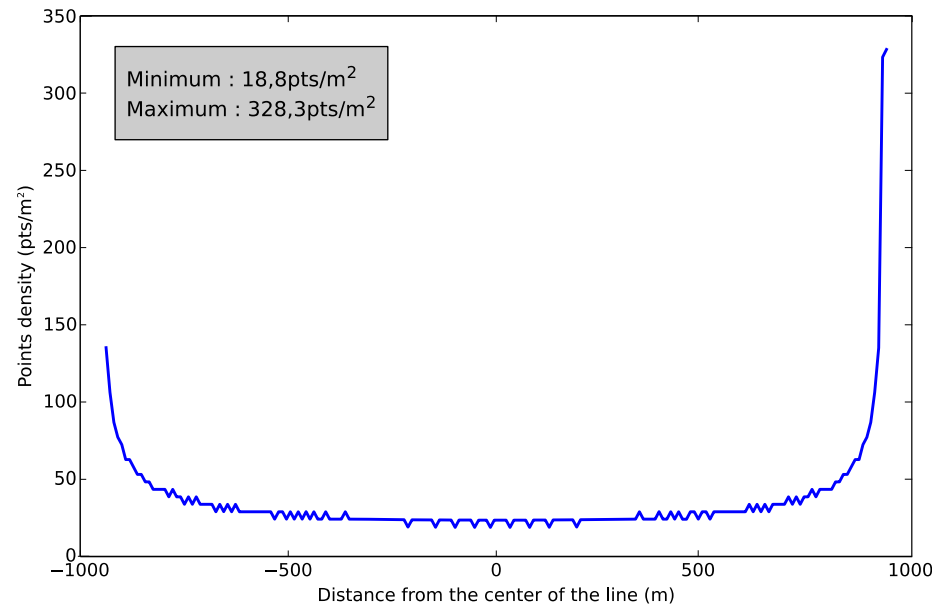


Theoretical density

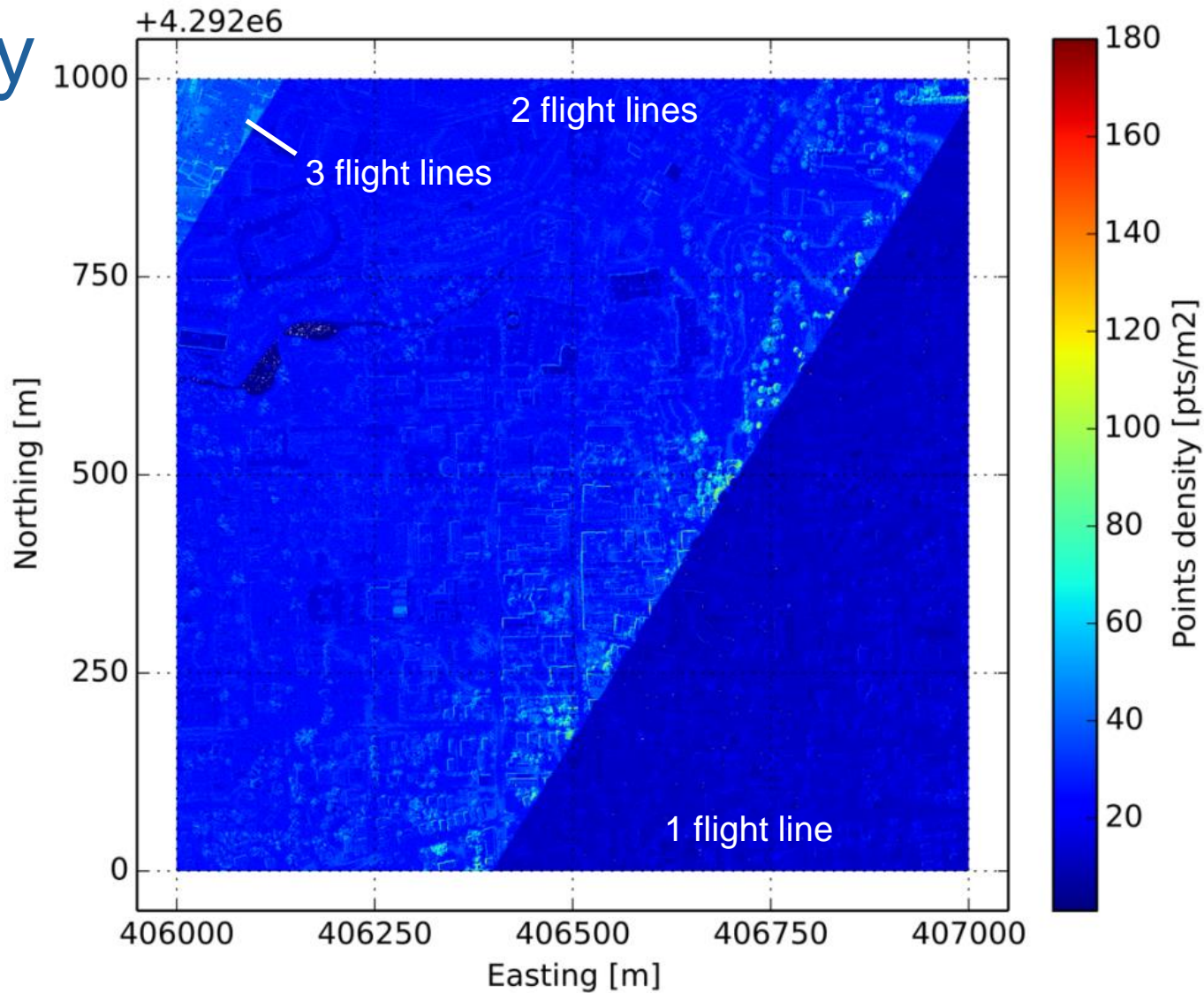


Selected settings :

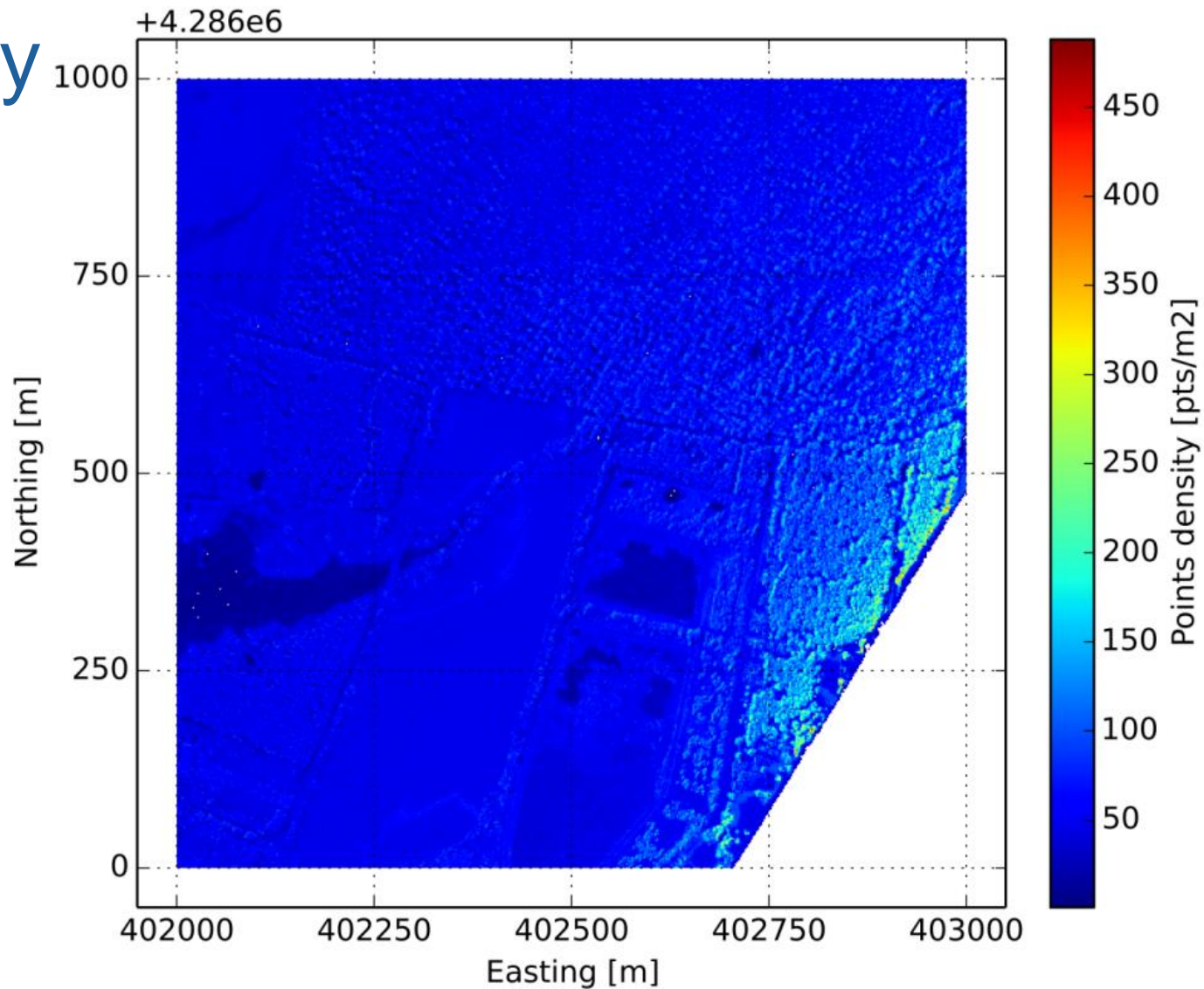
- Flying height: 4000 m
- Flight speed: 370 km/h
- Angle : 30°
- Sweep speed: 6324°/s
- 60 000 pts/s



Density

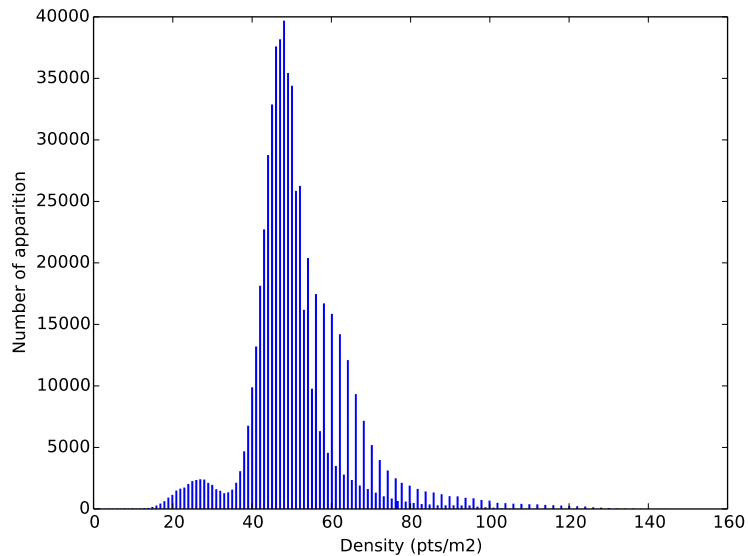


Density

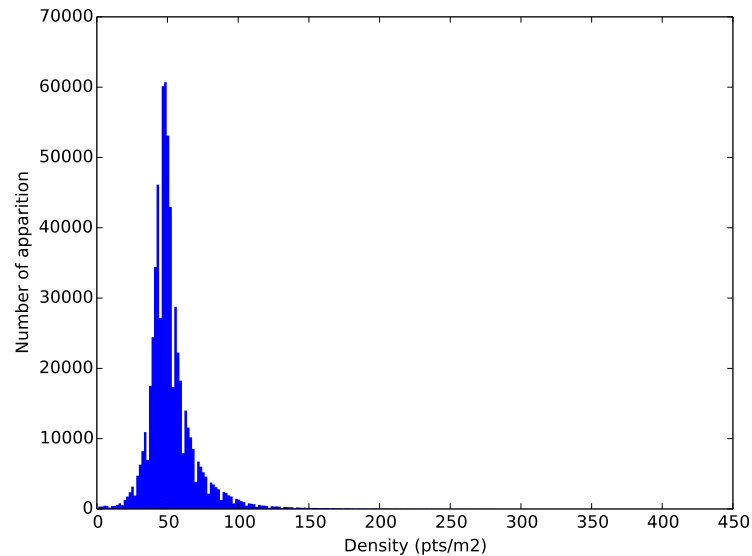


Density

Element	Number of tiles	Average [pts/m ²]	Standard dev. [pts/m ²]
Bare soil	615,775	51.2	12.68
Urban area	626,321	52.7	18.75
Vegetation	411,953	57.3	28.47
Water	673,386	10.1	7.23

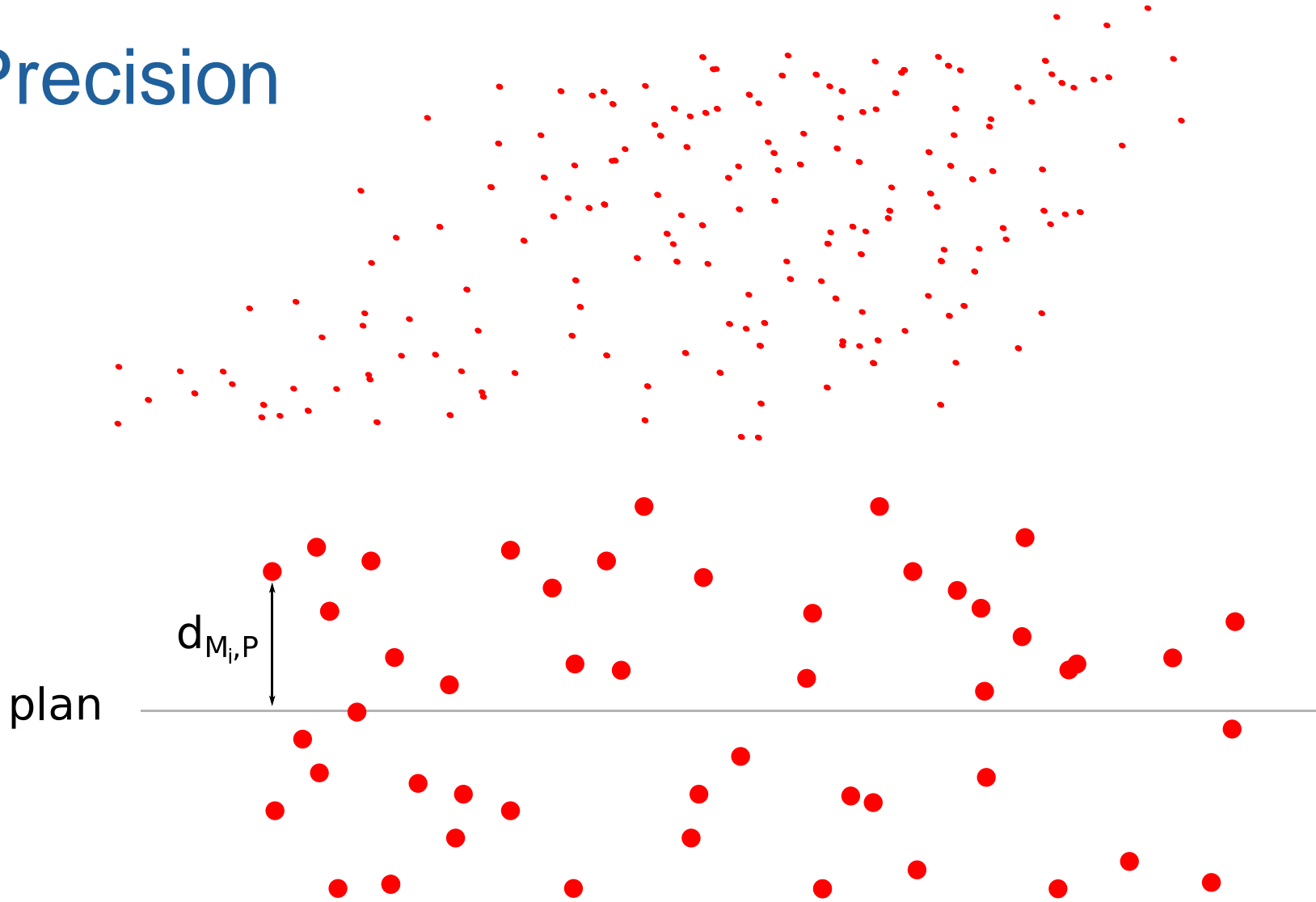


Bare soil



Urban area

Precision

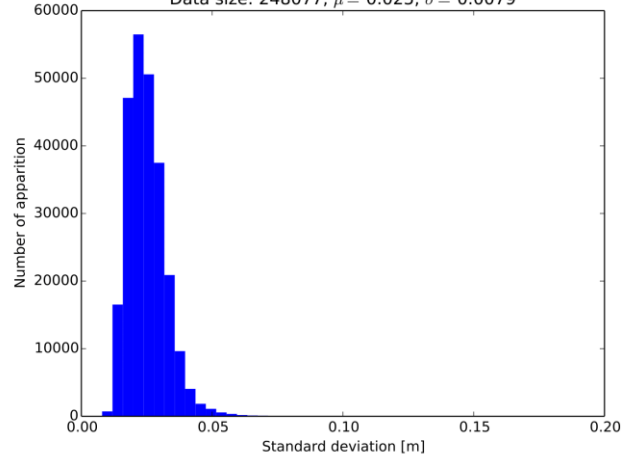


Precision

Element	Number of points	Average [m]	Standard dev. [m]
Water	56,281	0.019	0.024
Bare soil	248,077	0.025	0.008
Soil under vegetation	188,700	0.029	0.009
Urban soil	35,151	0.026	0.008
Roads / Car parks	12,330	0.023	0.007
Flat roofs	9,106	0.022	0.017
Sloped roofs	3,744	0.073	0.036

Frequency of standard deviation

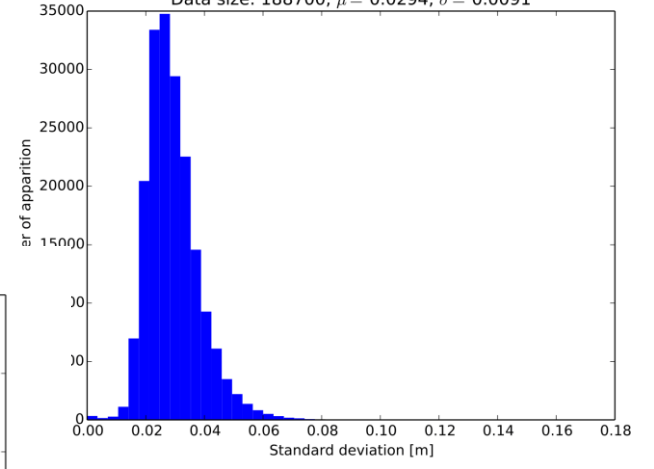
Data size: 248077, $\mu = 0.025$, $\sigma = 0.0079$



Bare soil

Frequency of standard deviation

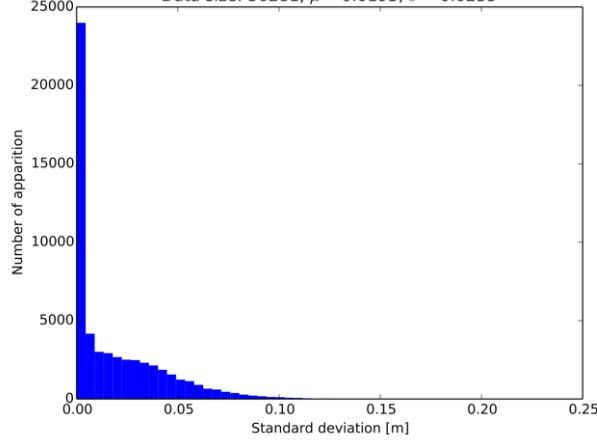
Data size: 188700, $\mu = 0.0294$, $\sigma = 0.0091$



Soil under vegetation

Frequency of standard deviation

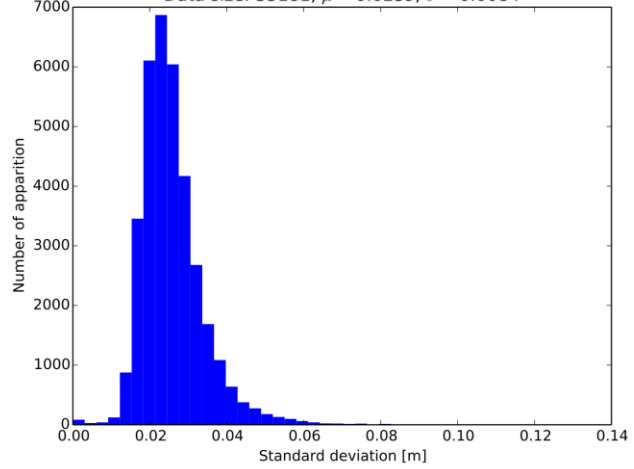
Data size: 56281, $\mu = 0.0193$, $\sigma = 0.0235$



Water

Frequency of standard deviation

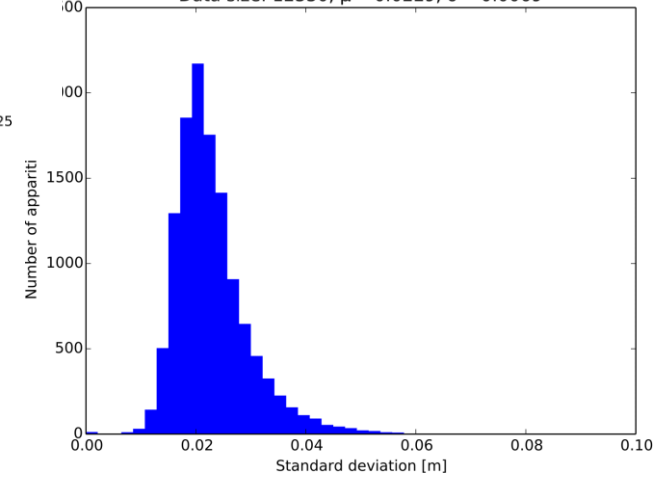
Data size: 35181, $\mu = 0.0259$, $\sigma = 0.0084$



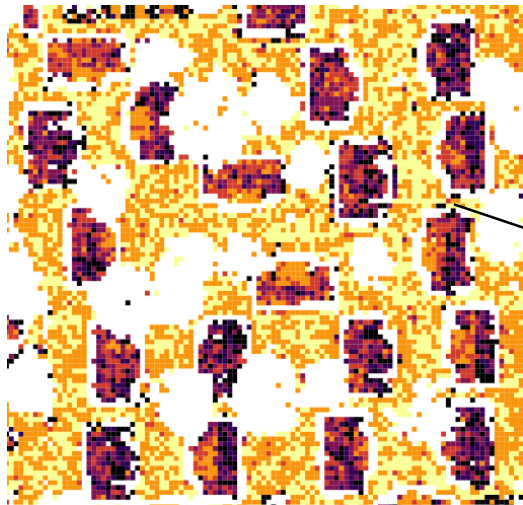
Urban soil

Frequency of standard deviation

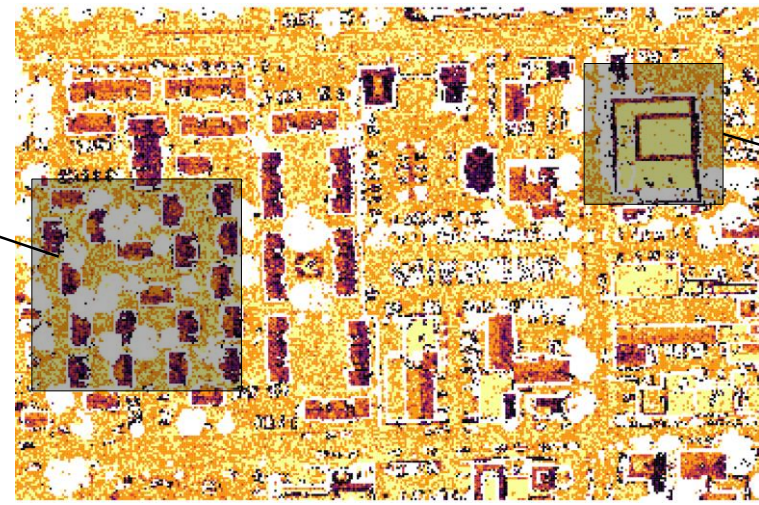
Data size: 12330, $\mu = 0.0229$, $\sigma = 0.0069$



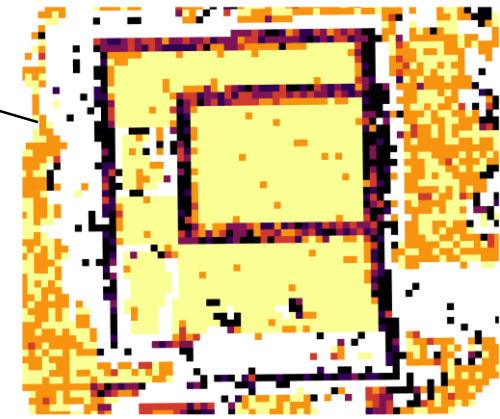
Roads/ Car parks



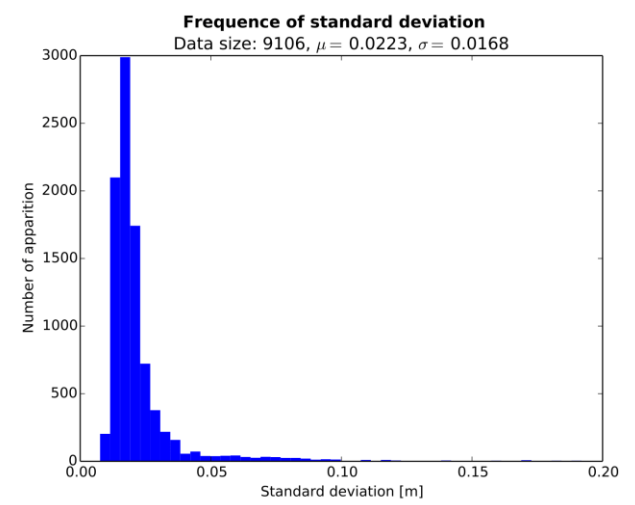
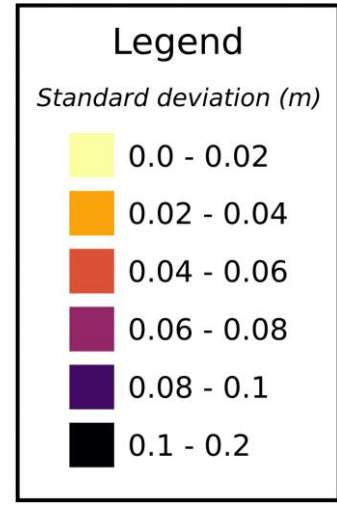
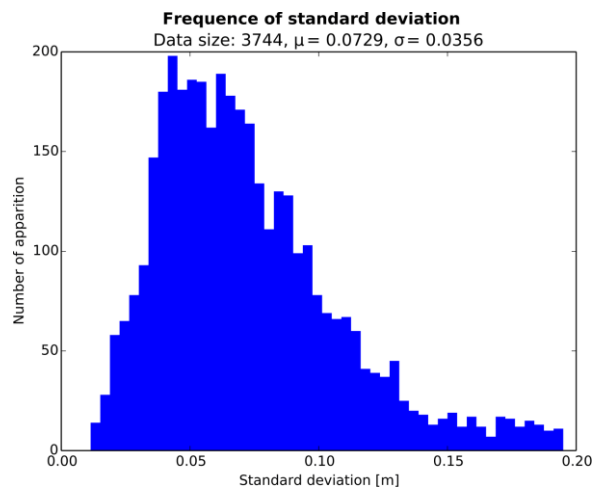
Sloped roofs

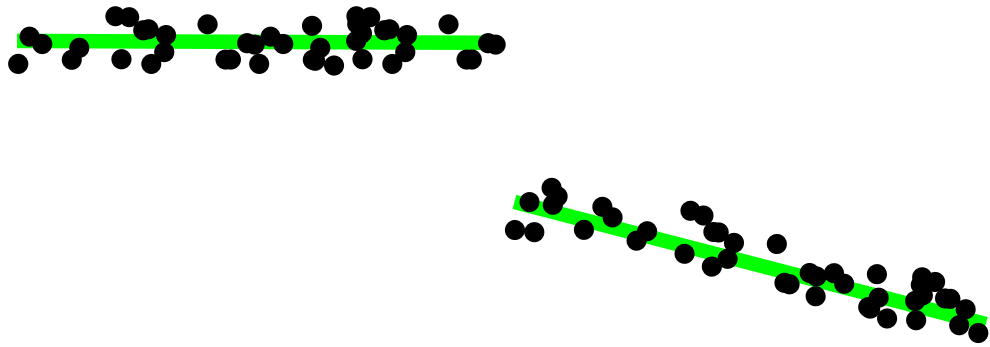


100m

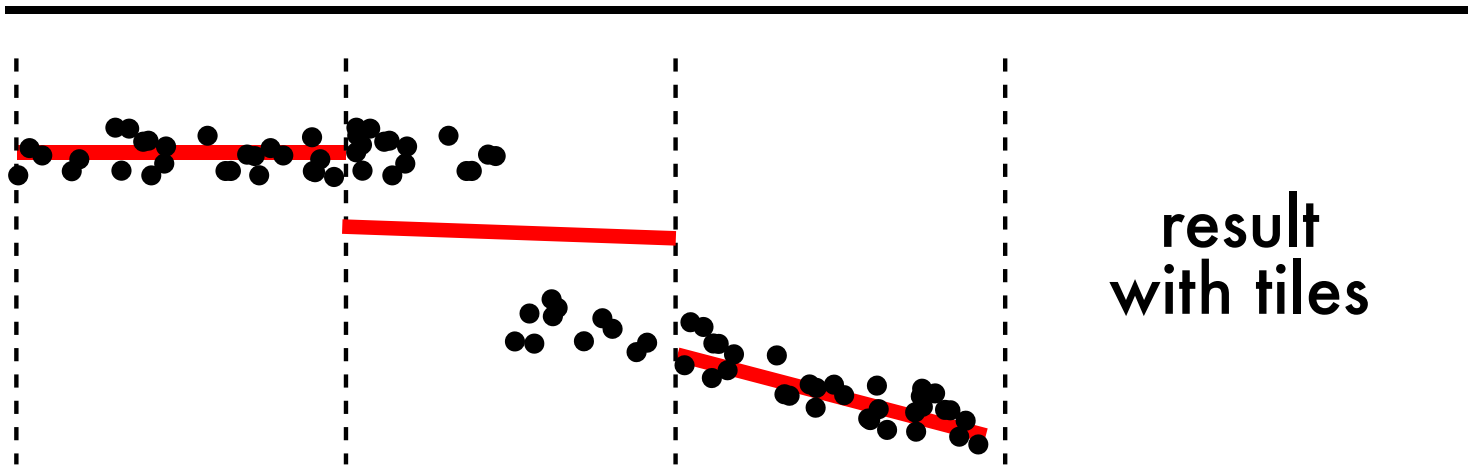


Flats roofs

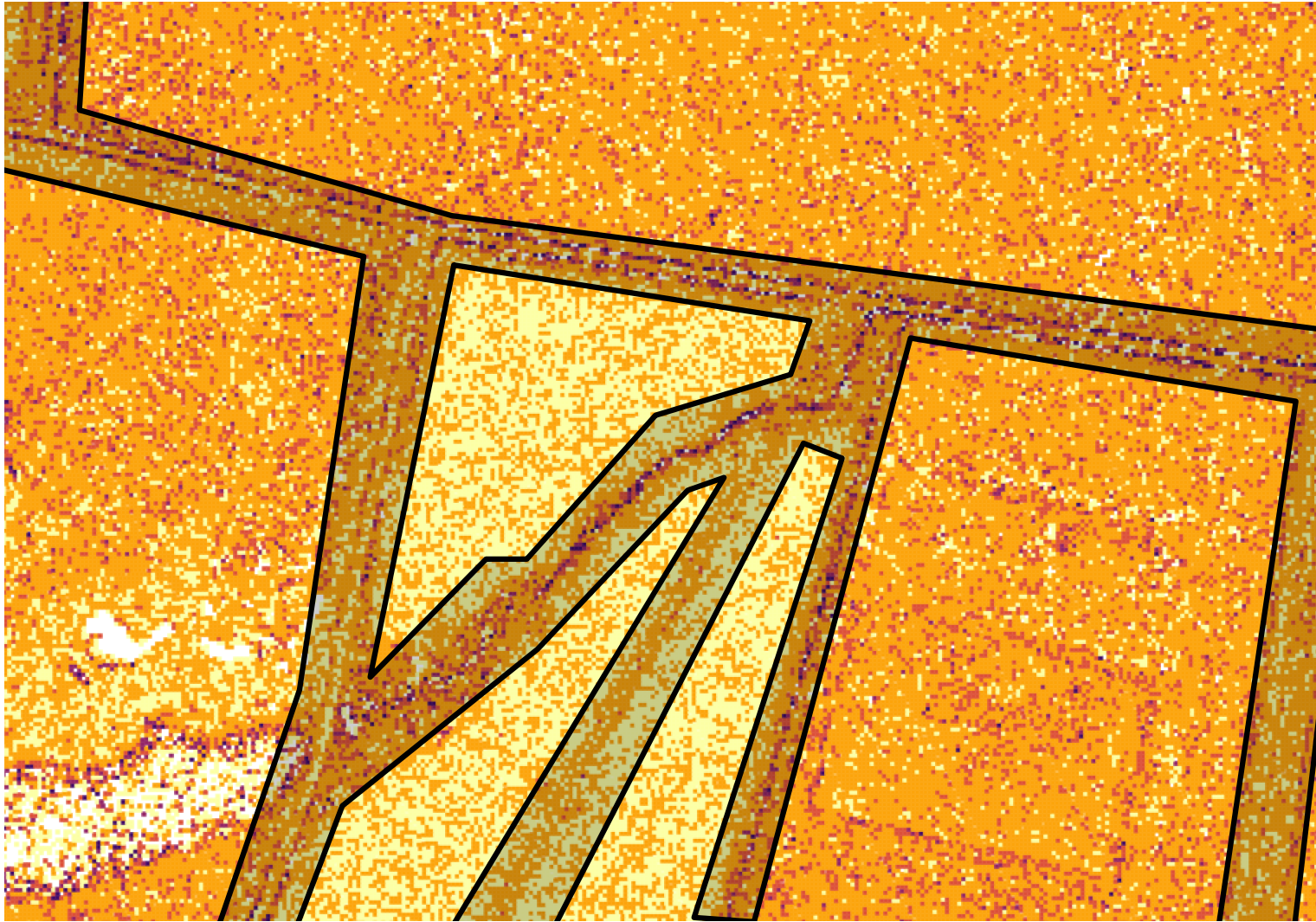




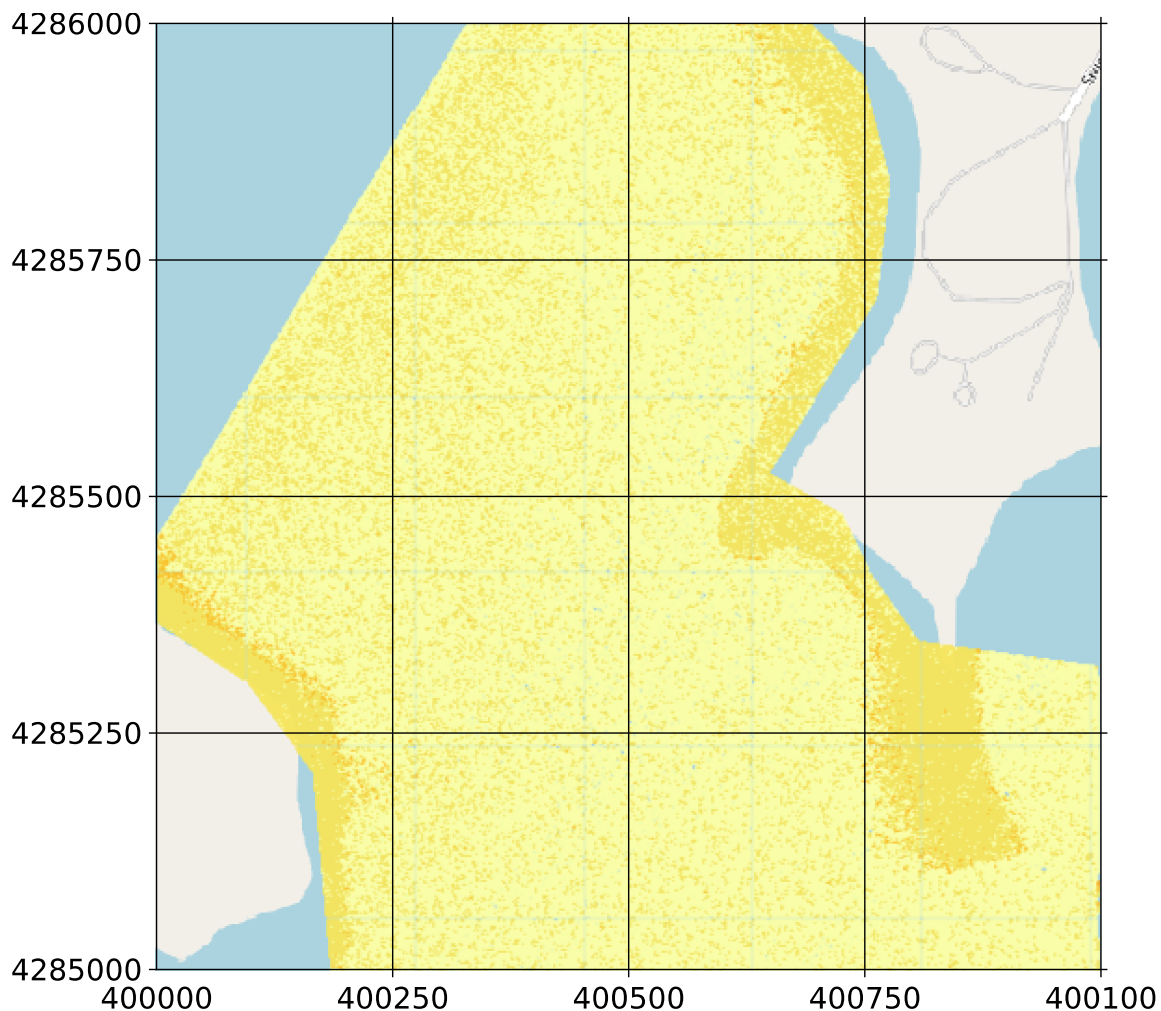
perfect
result



result
with tiles



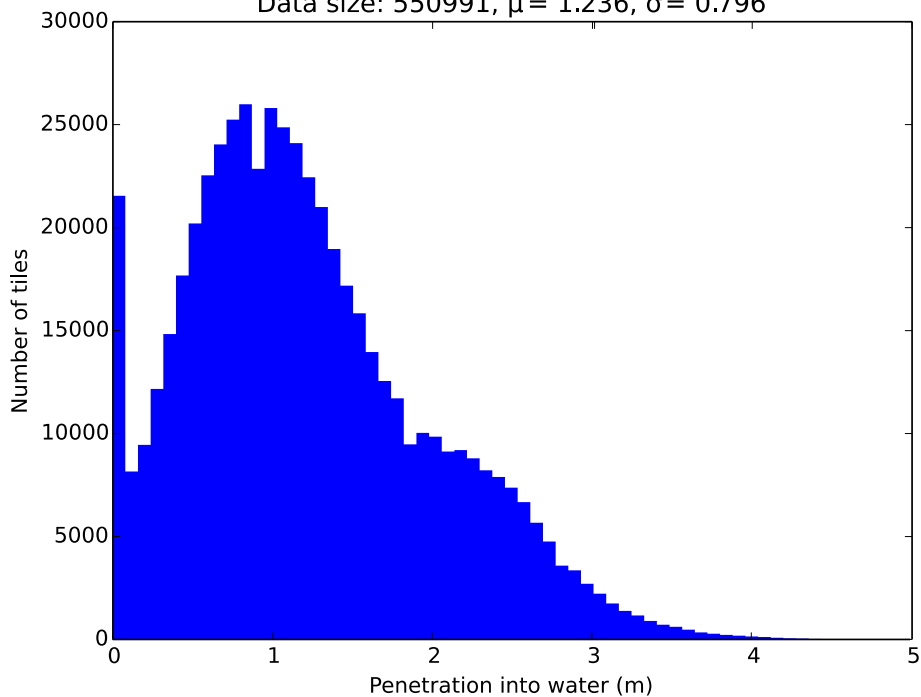
Water penetration



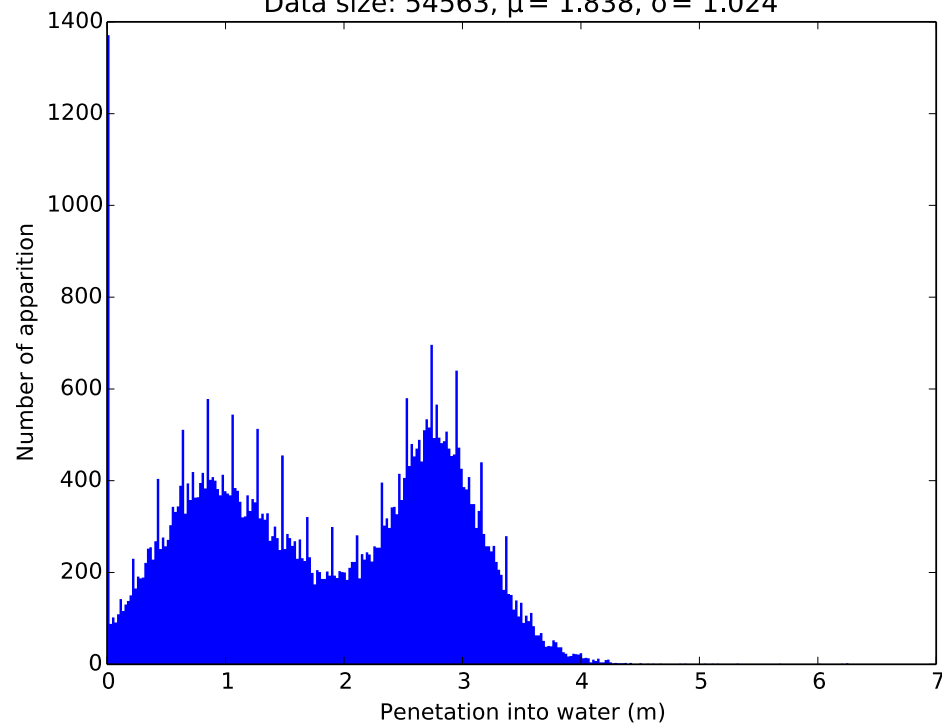
Penetration into water

Penetration into water

Data size: 550991, $\mu = 1.236$, $\sigma = 0.796$



Data size: 54563, $\mu = 1.838$, $\sigma = 1.024$



Conclusions

- Density of 55 pts/m² from a flying height of 3750 m
- Speed of acquisition: 750 km²/h
- Precision : c. 2-3 cm

- Water penetration not considered important, but has potential to be used for bathymetry. Lack of analysis for water composition

Acknowledgements

- Poul Nørgård, Chief Product Manager, Leica Geosystems for provision of data
- EuroSDR for supporting the study
- Jon Mills, for helping me during the study