

Evaluation of surface runoff conditions by high resolution terrestrial laser scanner in an intensive apple orchard

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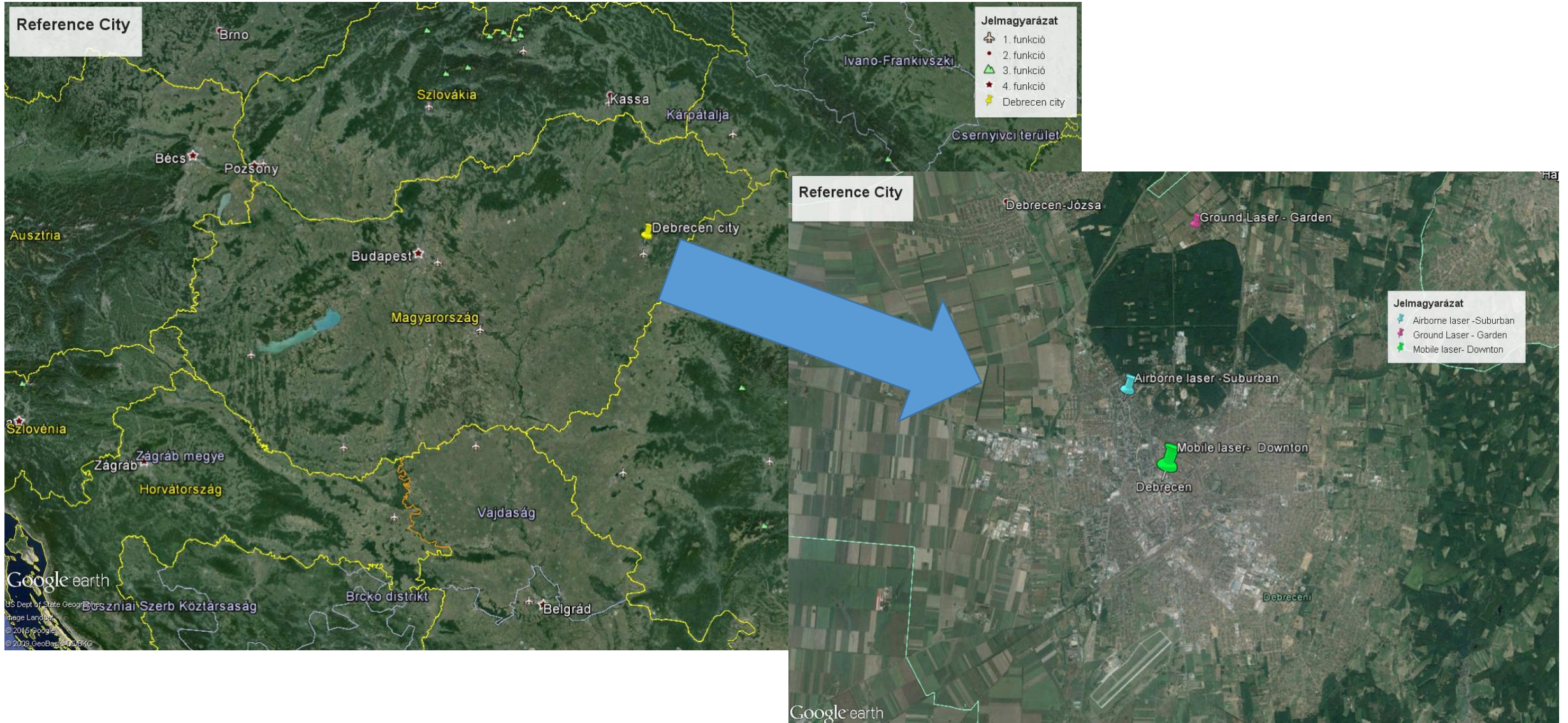
Introduction

- Rapid population growth and the overuse of natural resources that substantially occurred in the second half of twentieth century have degraded the global environment significantly.
- The main goal for sustainable urban water systems to control, collection, conveyance, and quality improvement of urban runoff in order to protect the urban environment from flooding, drought and pollution
- Elevation data are a critical element in any geoscience application. On lowland area, where relief slope is minimal value, is much more difficult to delineate urban and suburban watershed to characterize runoff process.

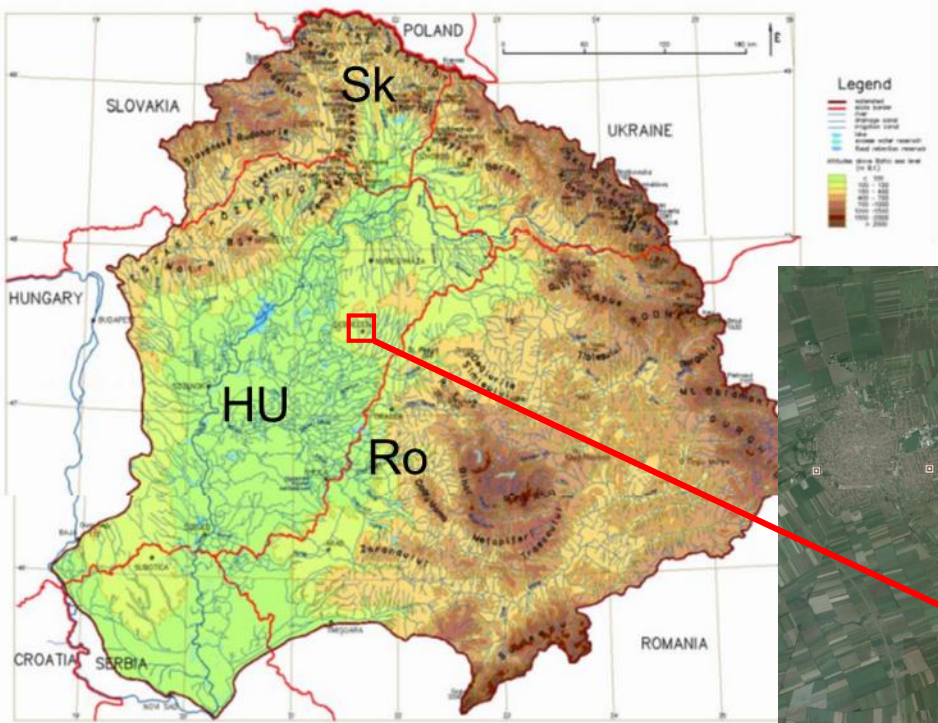
Research goals

- To evaluate different land use impacts on runoff pattern
- To compare different data sources derivated from different laser scanning platform (ground, mobile, airborne)
- To elaborate an effective process flow for object segmentation of point clouds
- Study area – Debrecen city, Hungary

Methods - Reference Sites



Study area- Intensive orchard Ground laser



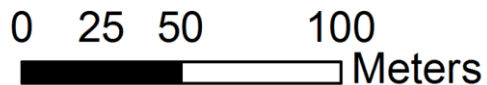
The Tisza River Basin is the largest sub-basin in the Danube River Basin, covering 157,186 km² (19.5%) of the Danube Basin

UNIVERSITY OF DEBRECEN
Study and Regional Research Farm,
Pallag

Legend

FRUIT TREES

-  Apple
-  Sweet cherry
-  Japanese plum
-  Apricot
-  Cherry
-  Plum
-  Peach



Material and methods

Leica ScanStation C10
3D laser scanner



Leica

GreenSeeker[®]
Variable Rate Application and Mapping Systems



+

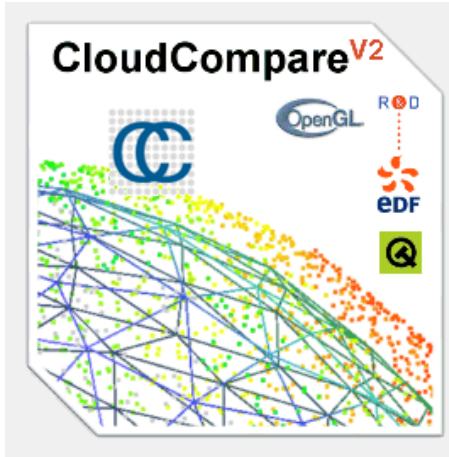
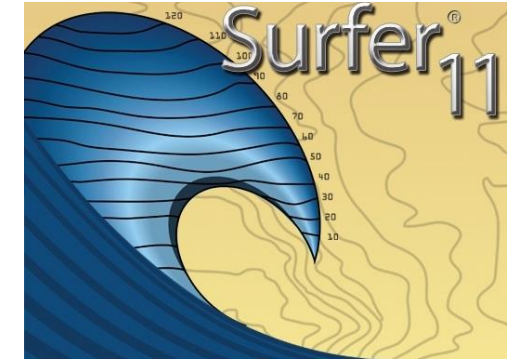
AgGPS[®] Fm™
Integrated Display



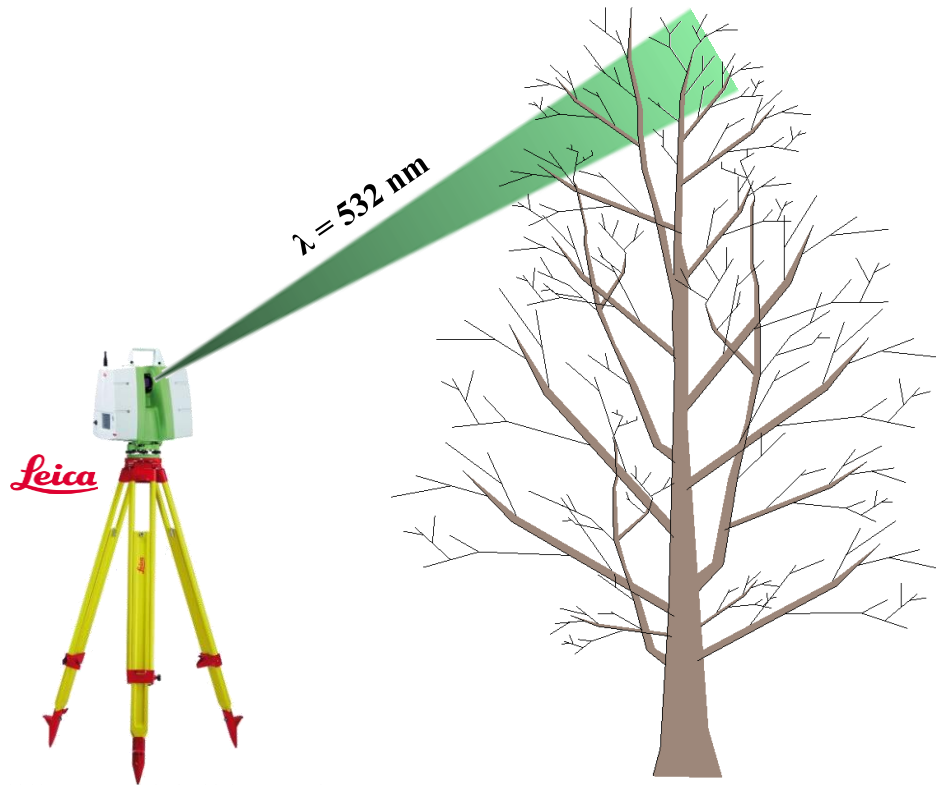
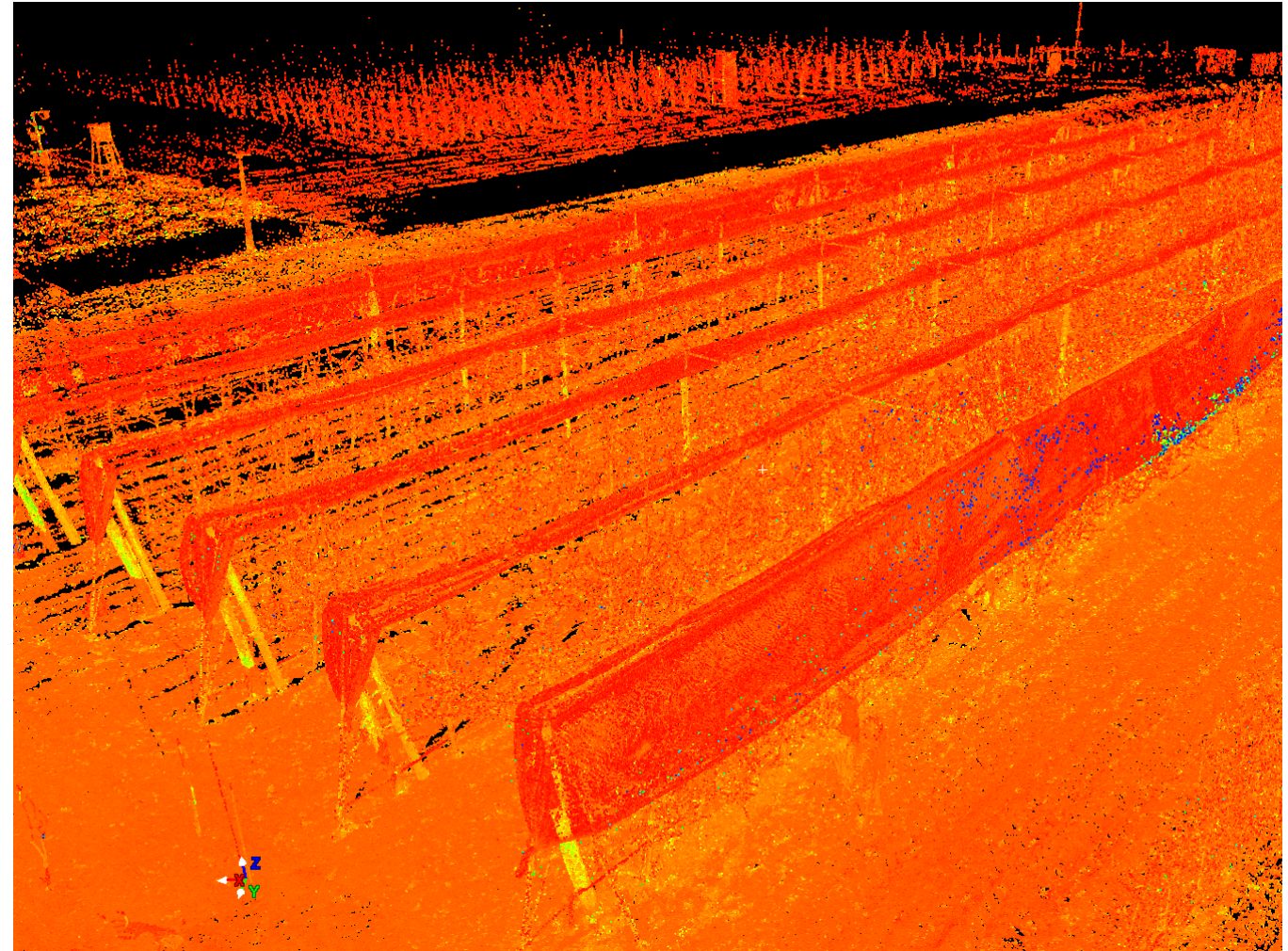
Soil penetrometer



Used software: Surveying – GIS - Hydrology



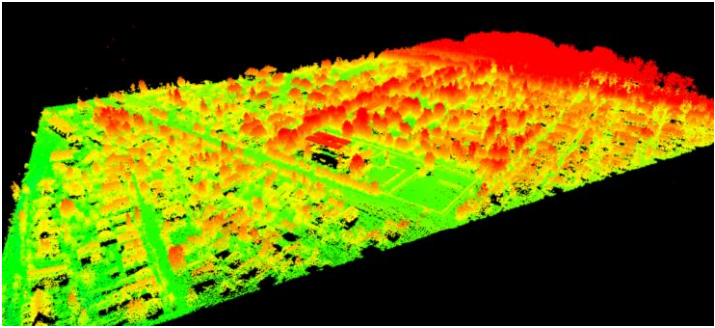
Microrelief investigation of the apple plantation



http://hds.leica-geosystems.com/thumbs/originals/MRQN_2620.jpg

Deriving Hydrologically Useful Information from Digital Elevation Models

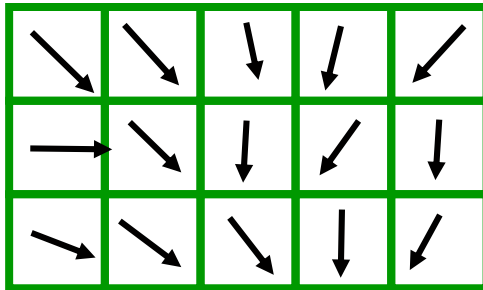
Raw DEM



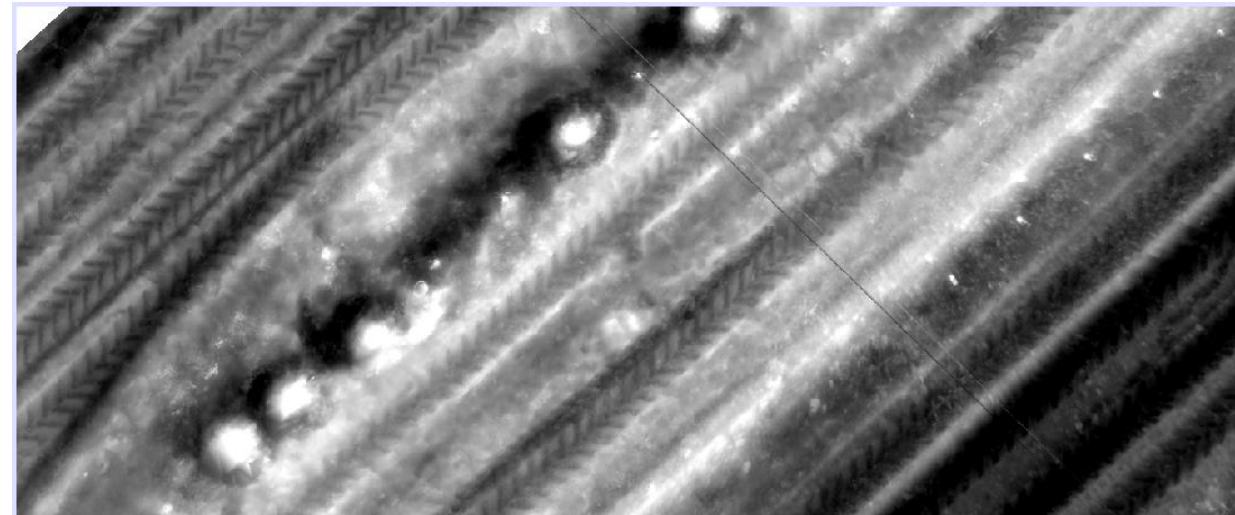
Pit Removal



Flow Field



Flow Related Terrain Information

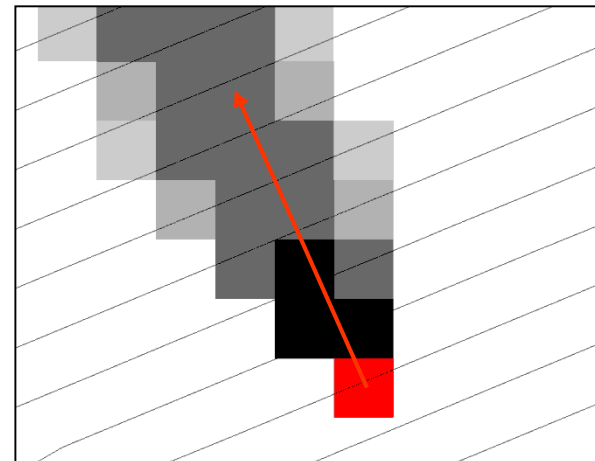
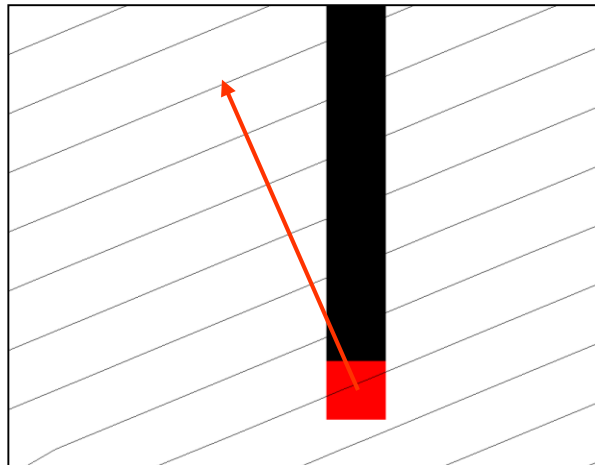
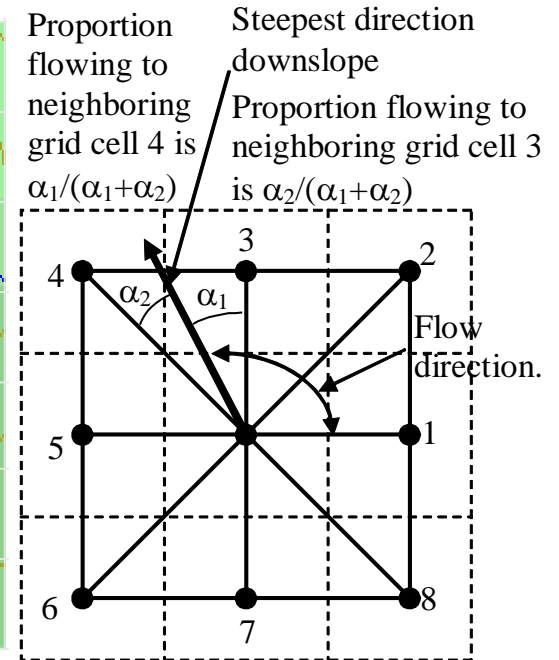
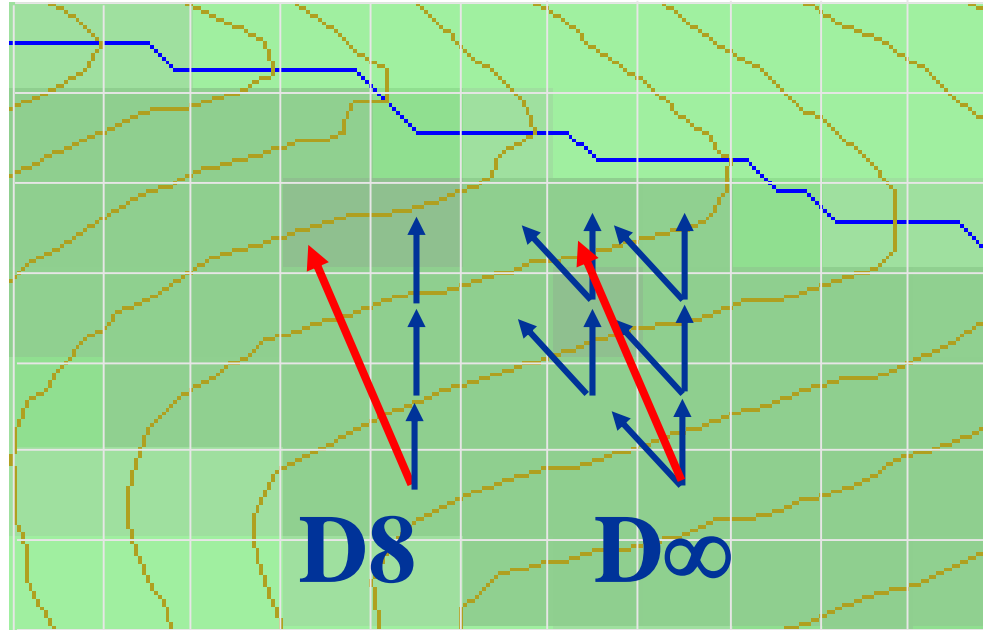


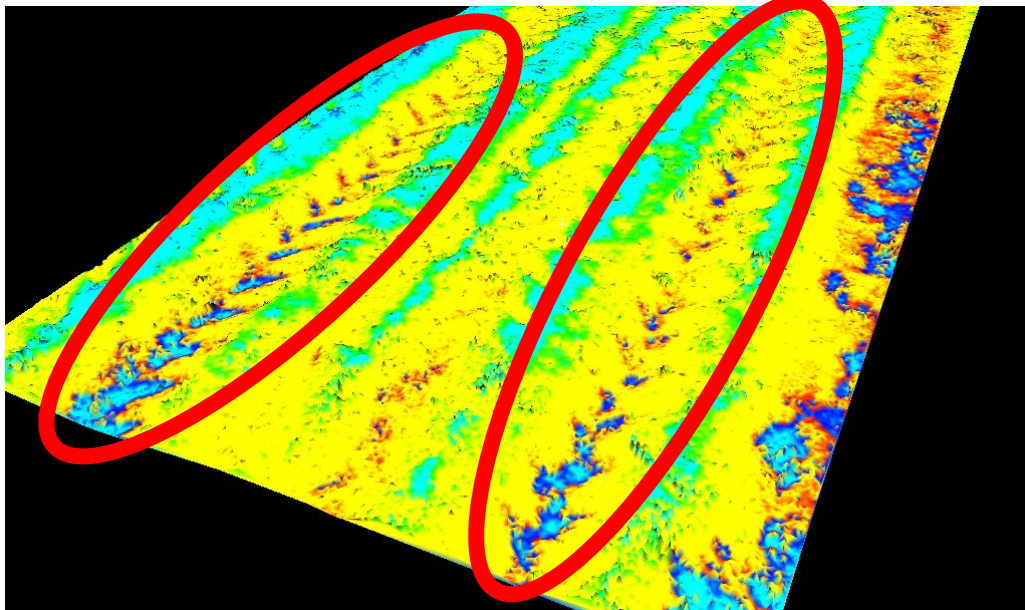
Representation of Flow Field

Steepest
single
direction

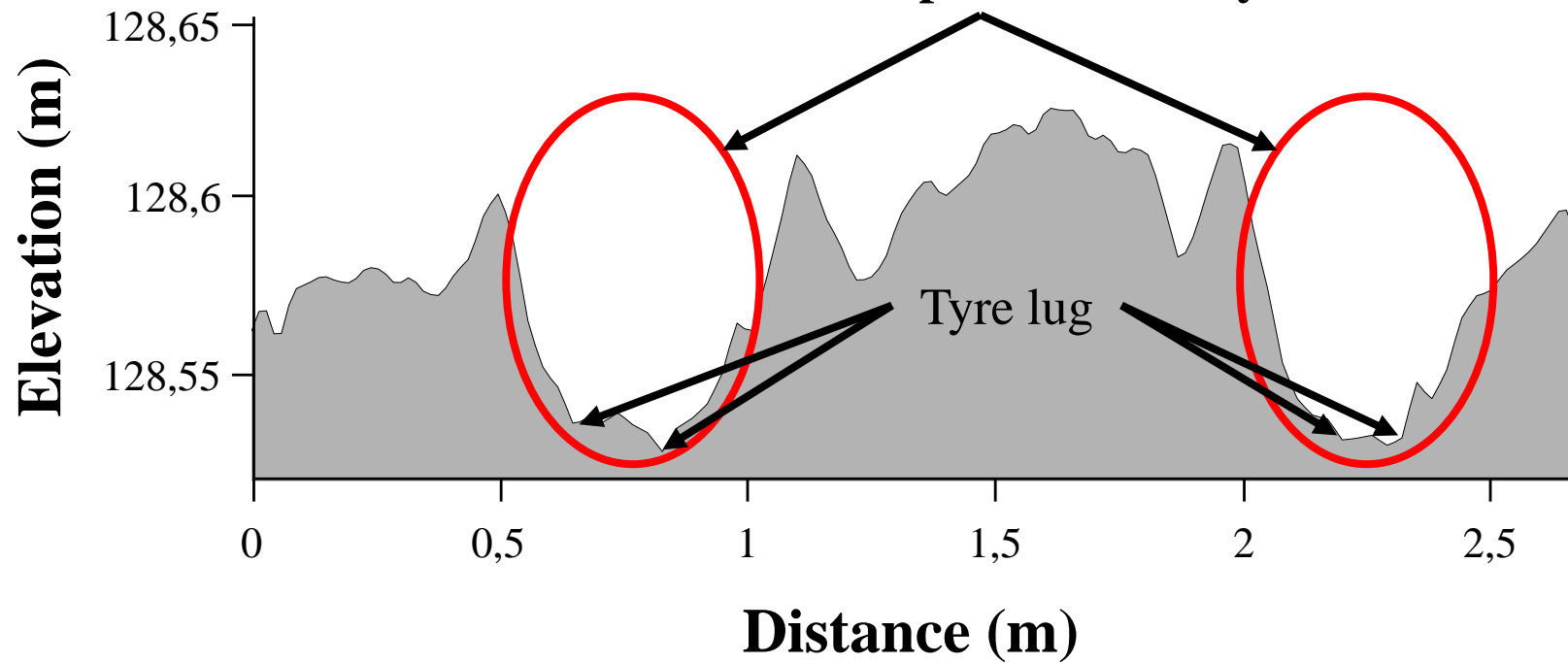
48	52
56	67

$$\frac{67 - 52}{30} = 0.50$$

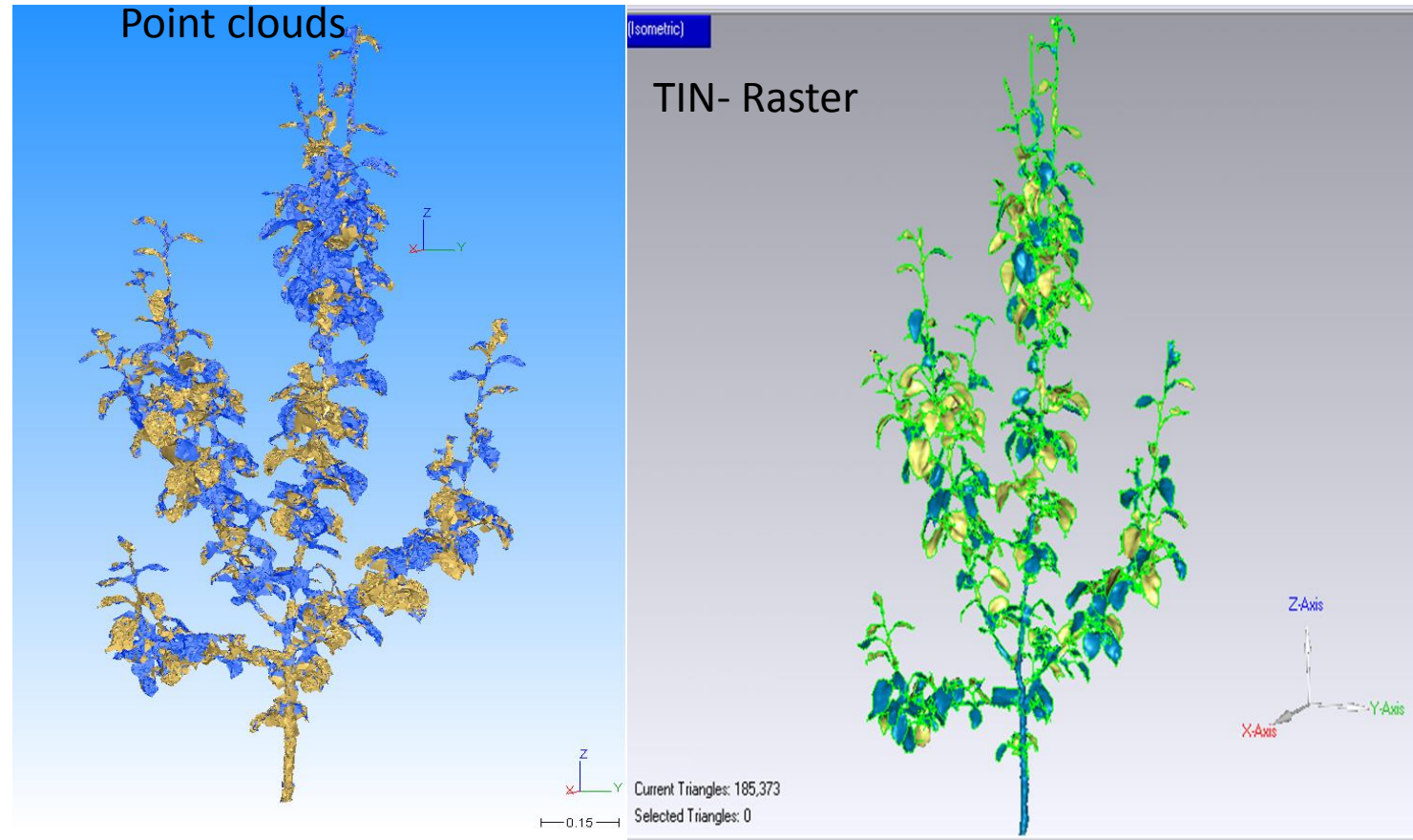
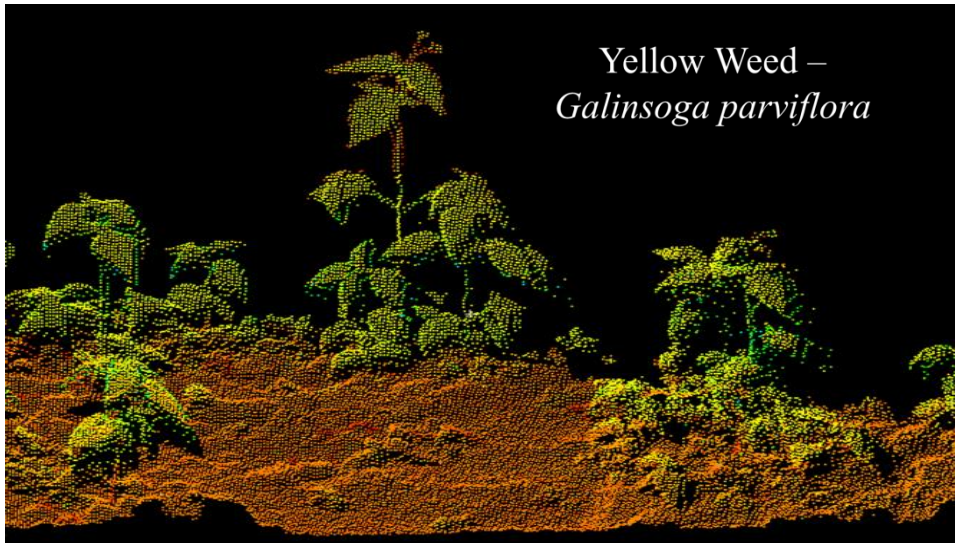
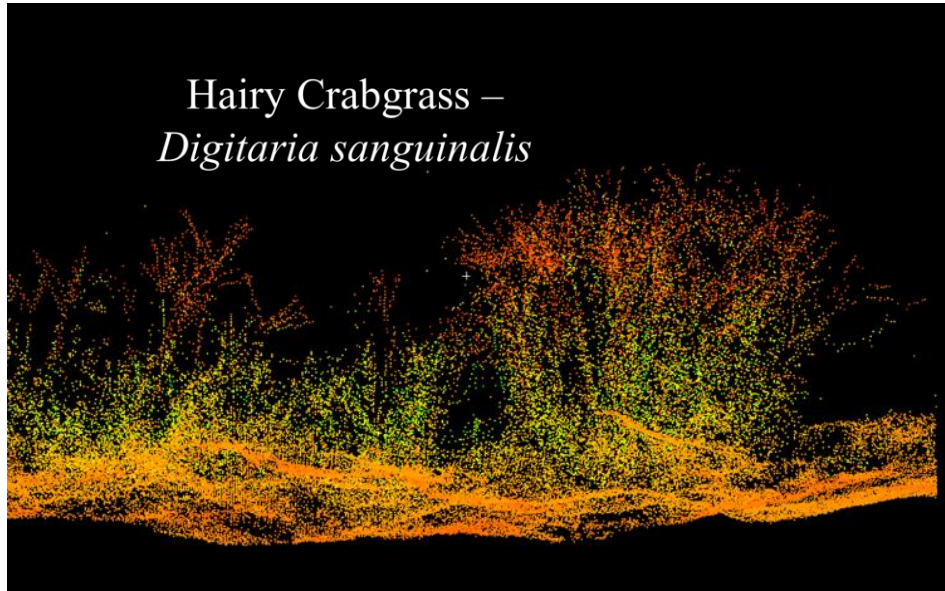




Mechanical compaction zone by wheel

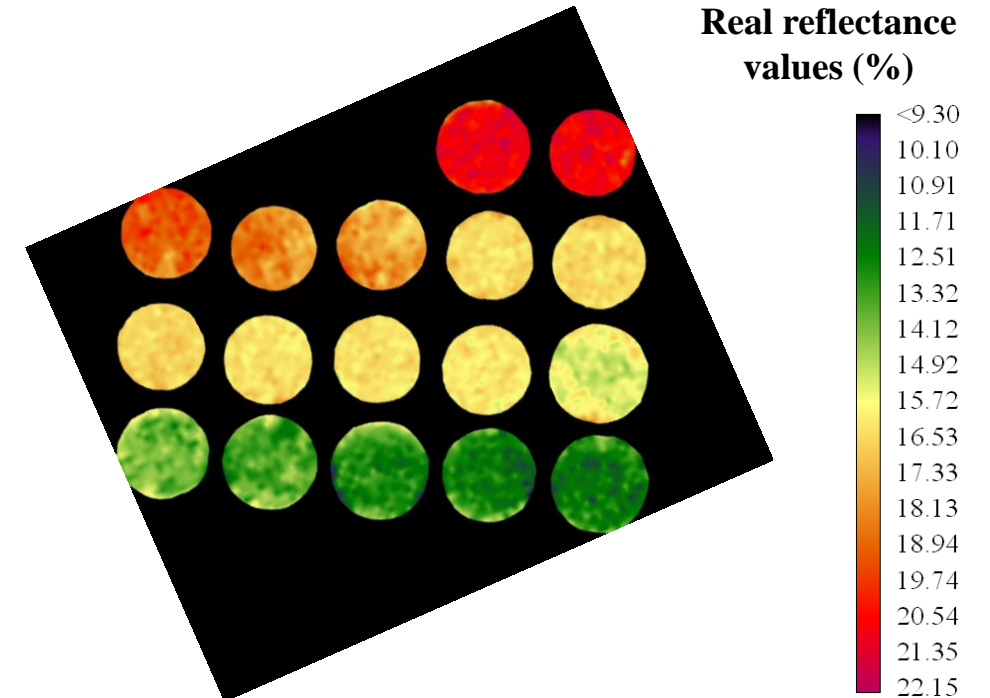
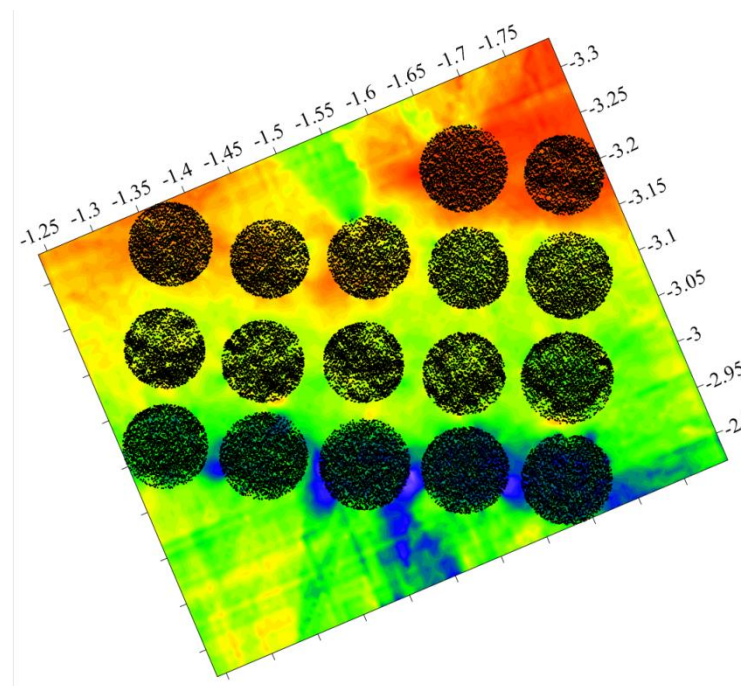
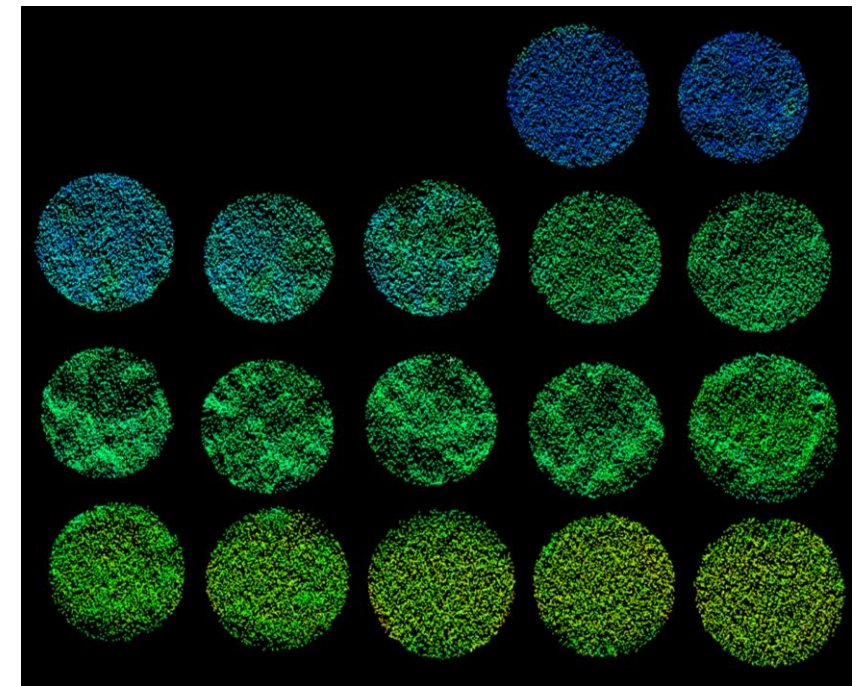
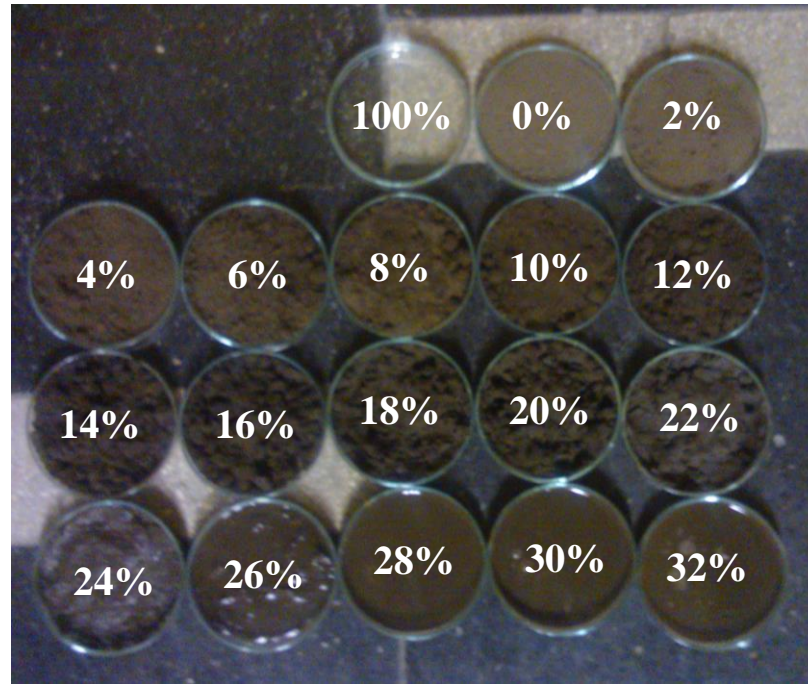


Vegetation

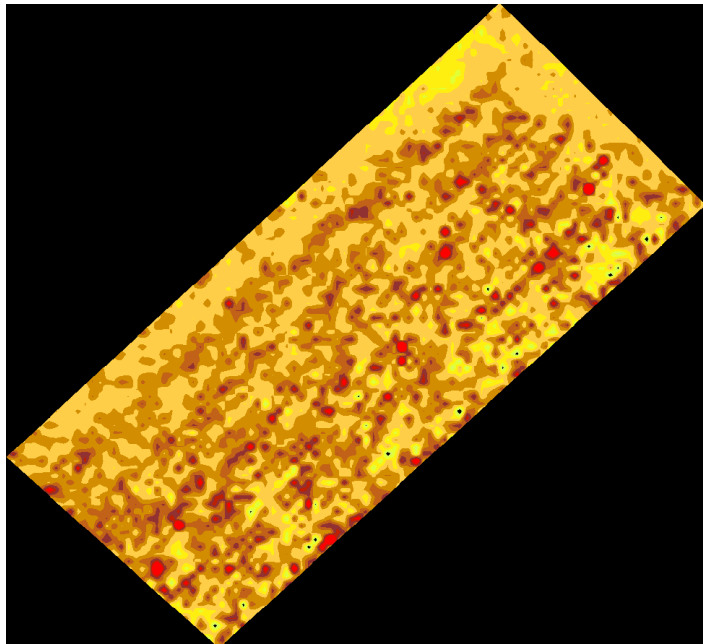
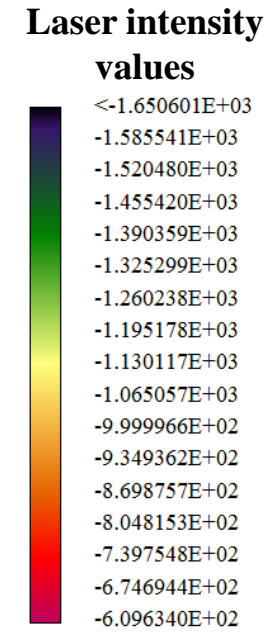
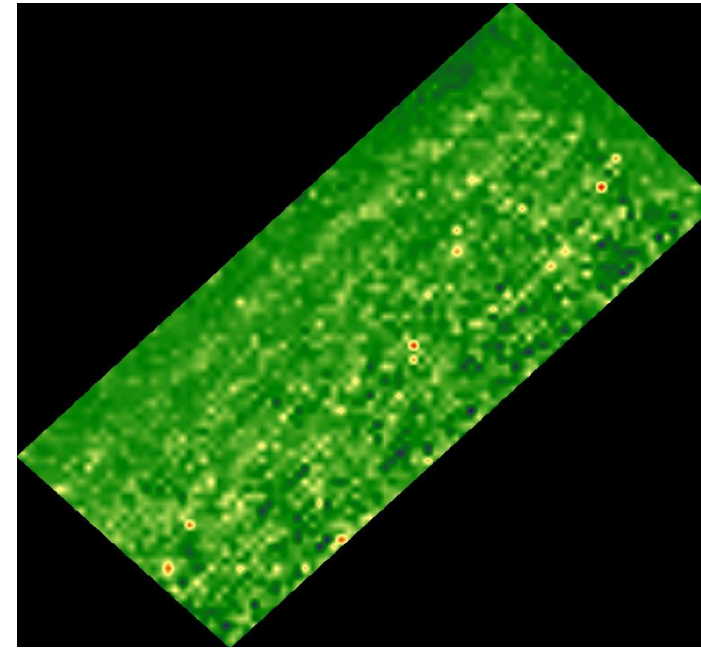
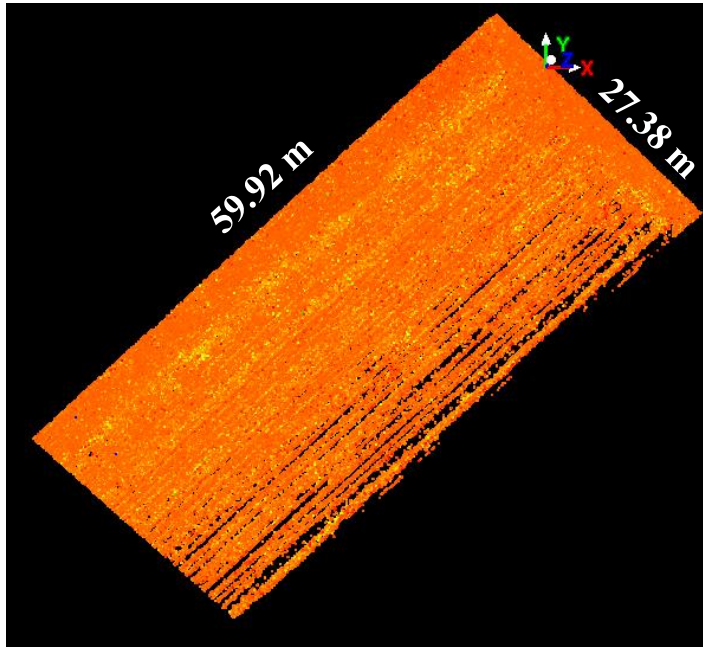


Range: 20 m,
Accuracy 0,2 mm; Measuring time: 15-20 min

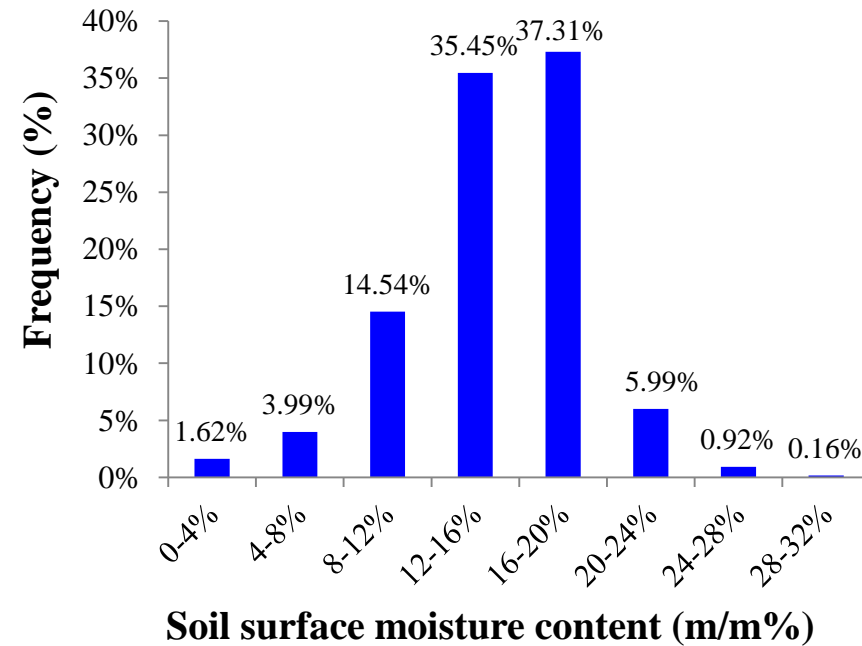
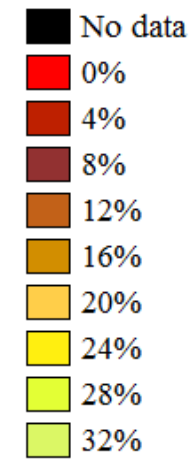
Soil surface moisture investigations



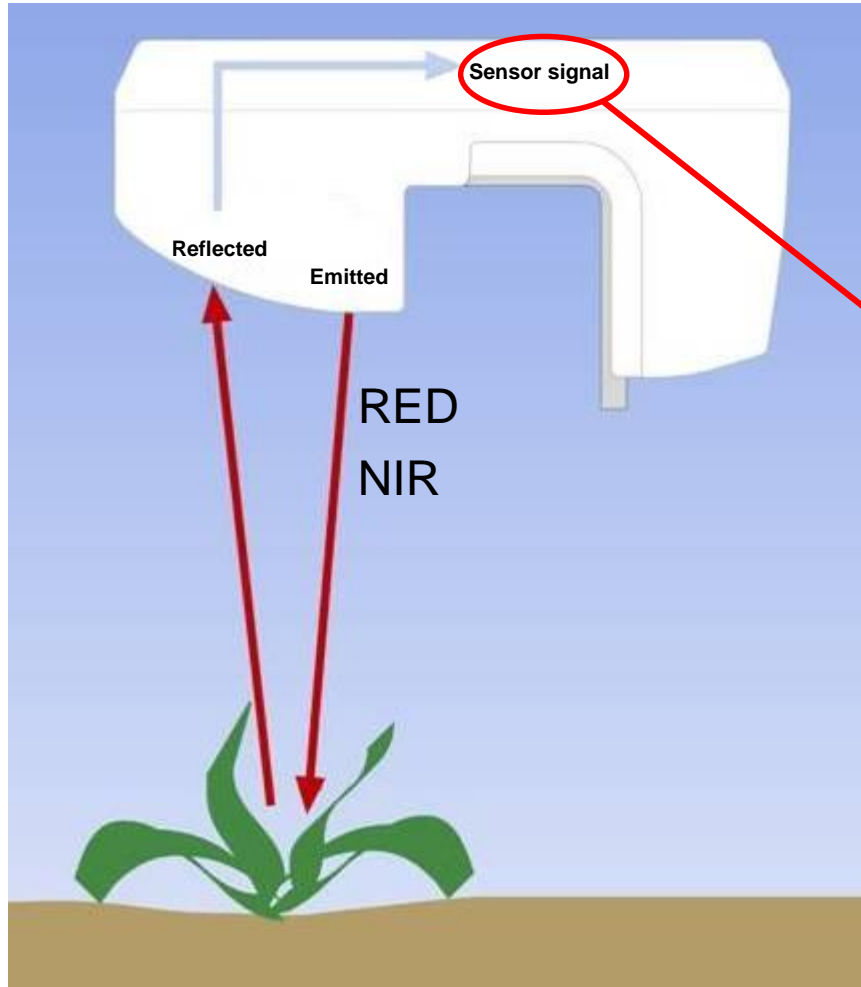
Soil surface moisture conditions of the 09/03/2012 surveying



Moisture careteries



GreenSeeker 505 vegetation indexmeter

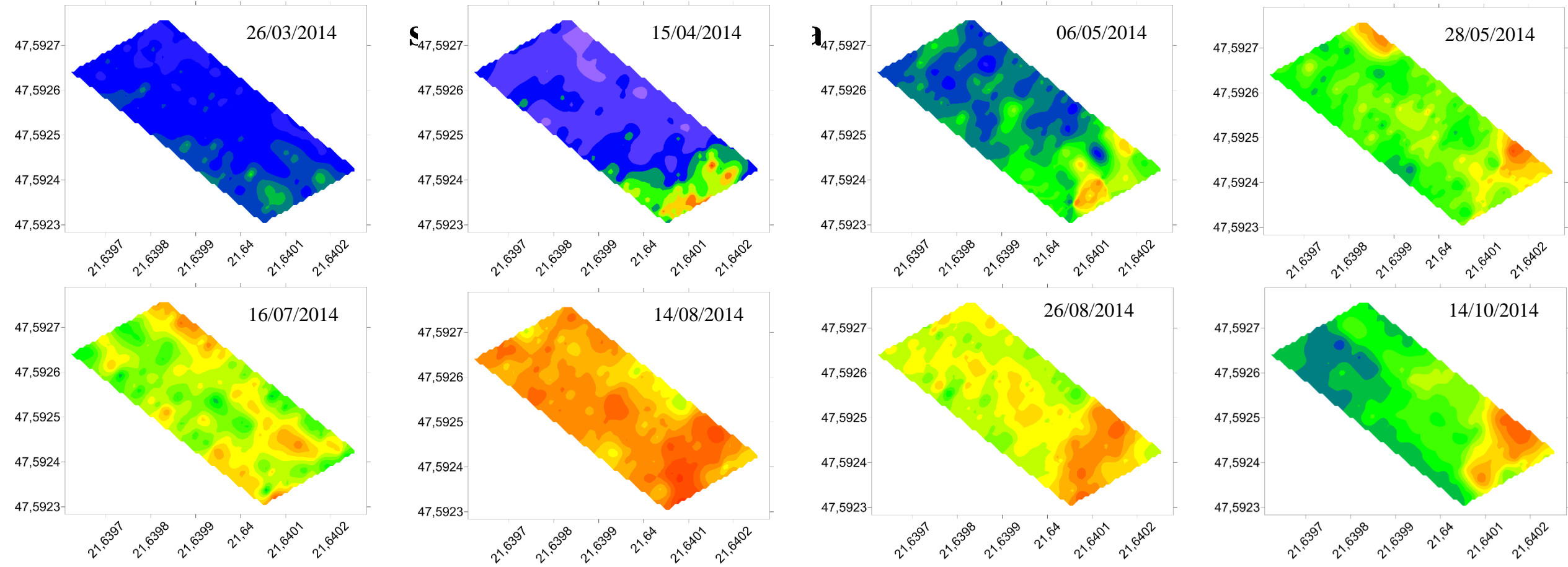


$$NDVI = \frac{NIR_{774nm} - RED_{656nm}}{RED_{656nm} + NIR_{774nm}}$$

Soros adatbevitel

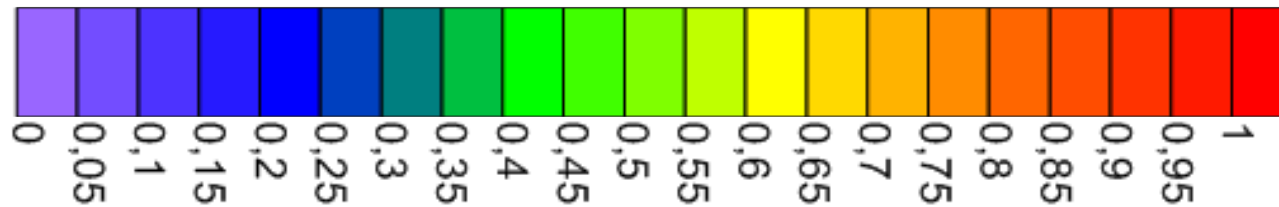
Csatlakozó port	B (külső GPS)
Baud sebesség	38400
Paritás	Egyiksem
Adat bitek	8
Stop bitek	1
Előtag	
Toldalék	\0D\0A
Adatrögzítési intervallum	1.00 s

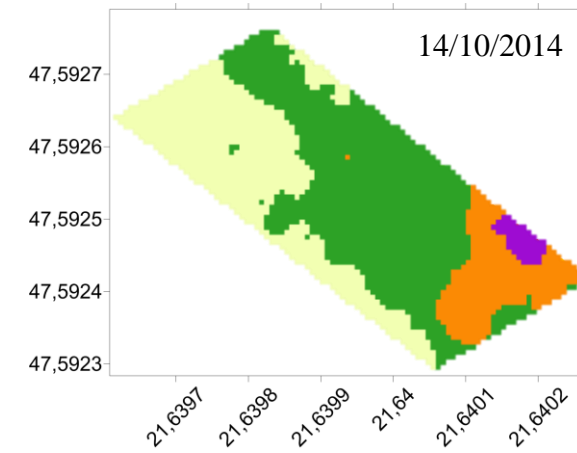
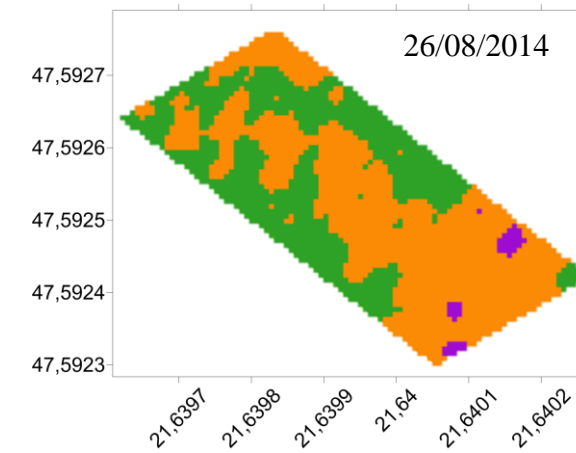
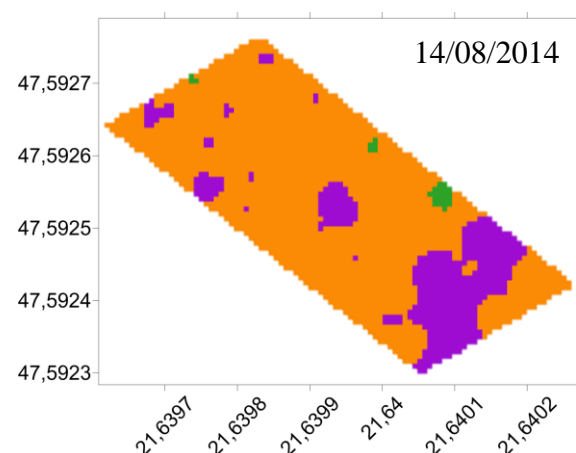
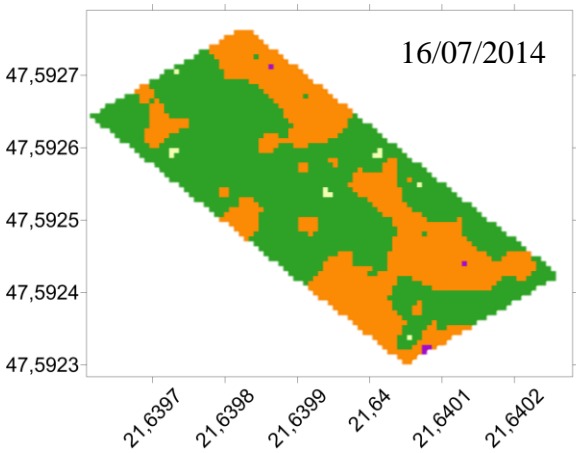
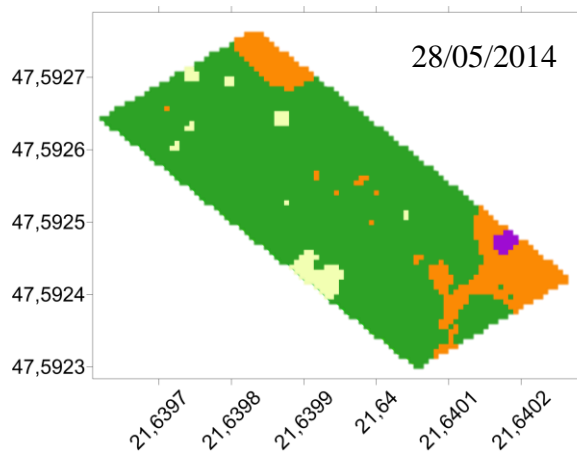
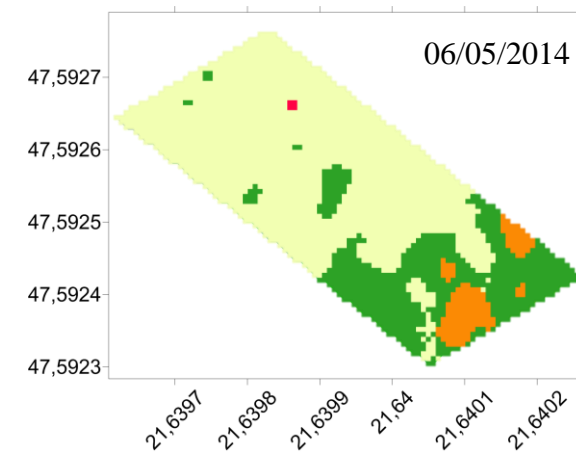
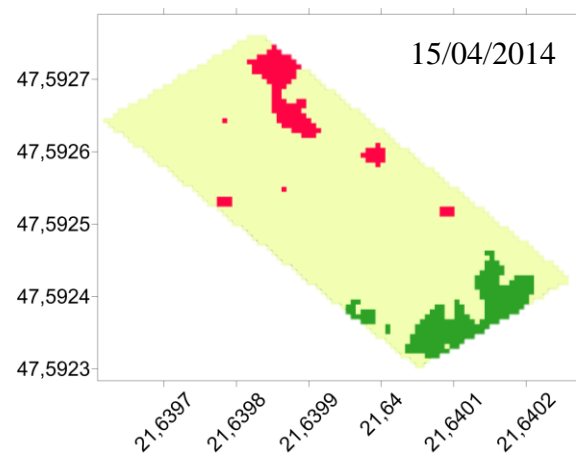
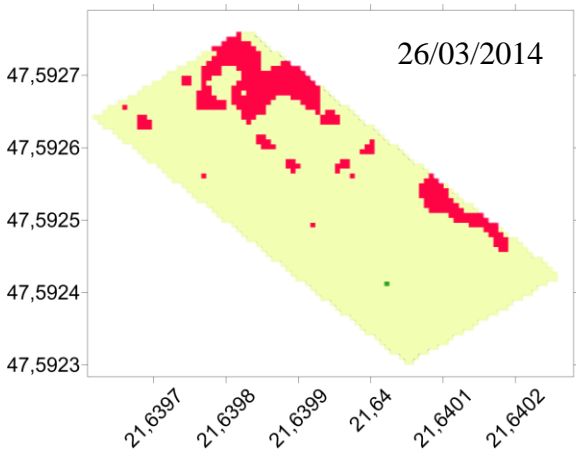
Törlés 375610, 001, 3747, **0.160** 0.724 OK



Time Series Data sources - Vegetation

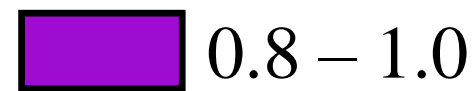
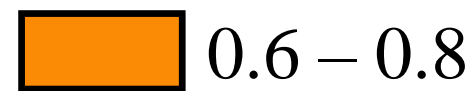
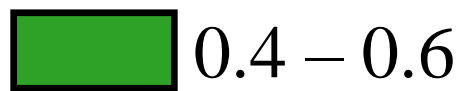
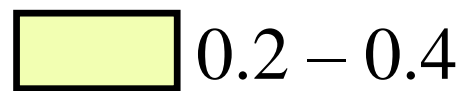
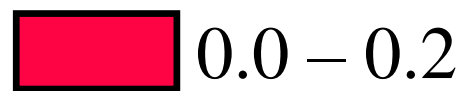
NDVI color scale

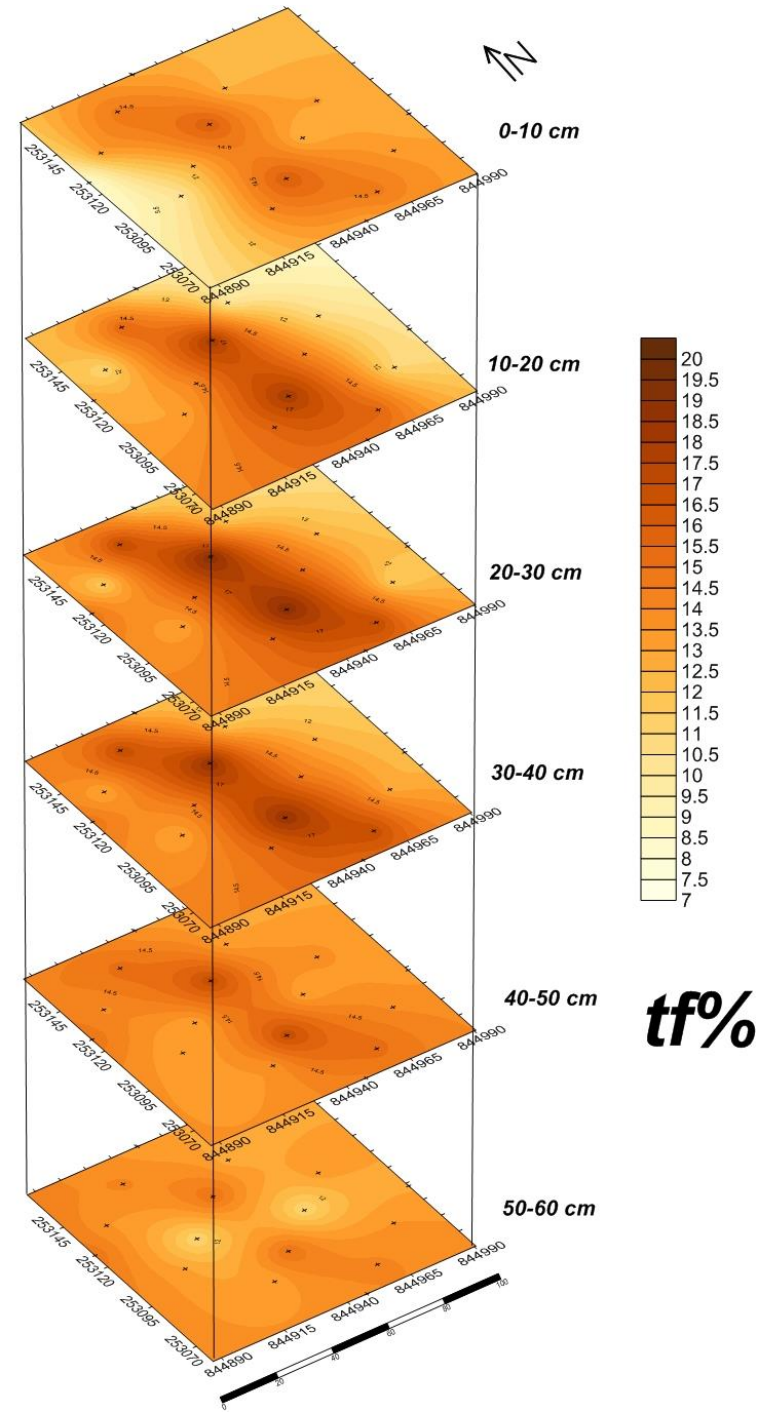
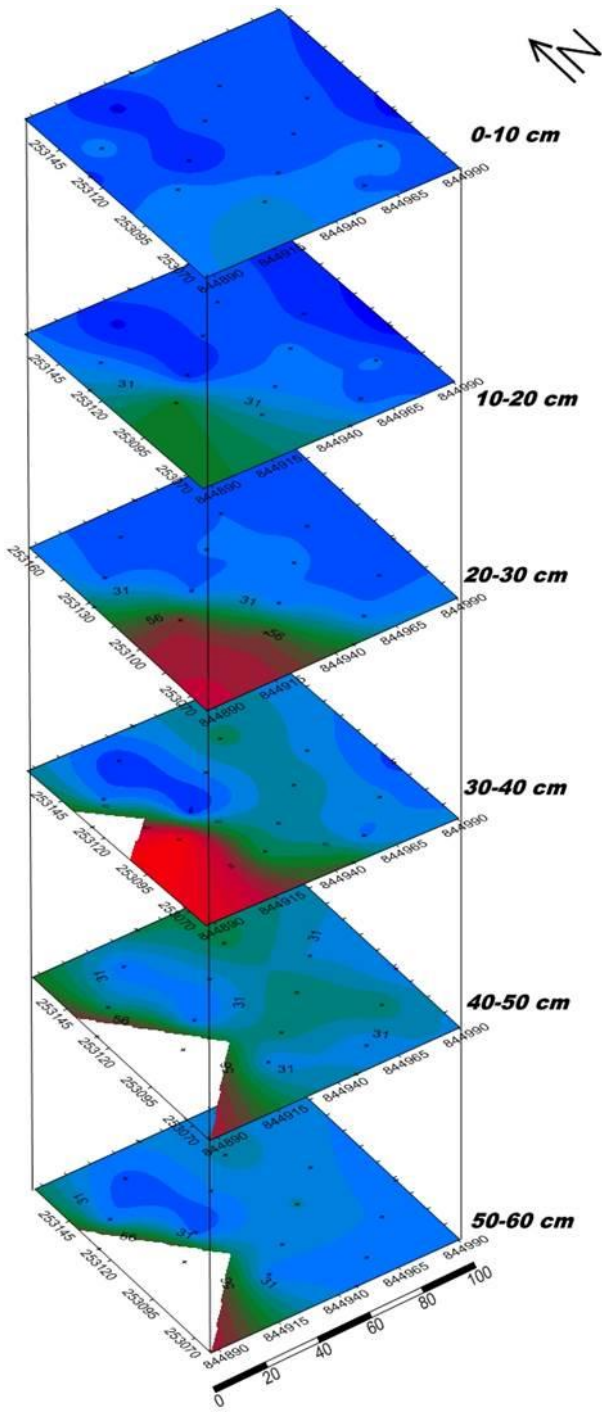


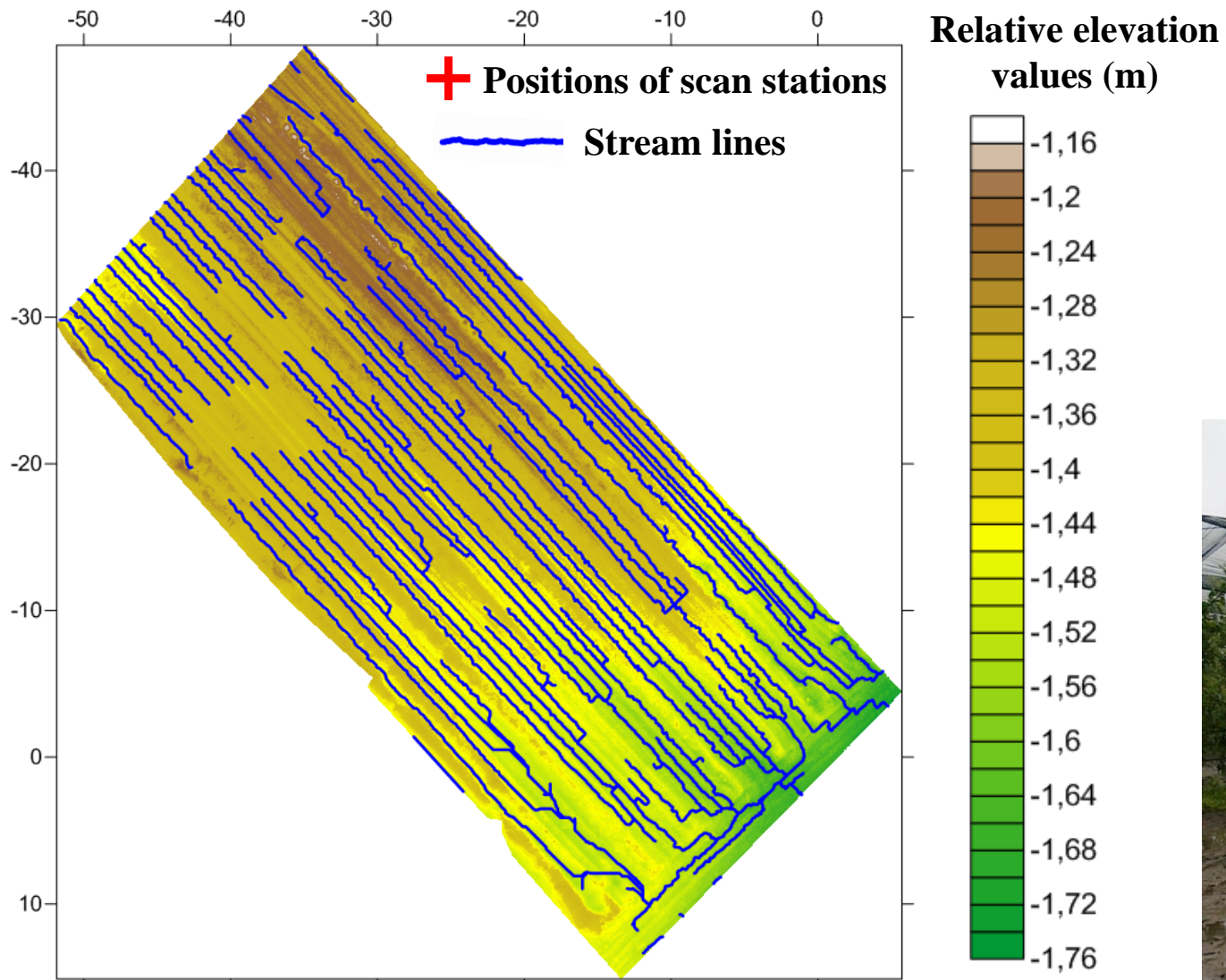


NDVI categories

Dense, high, moderate, low,
No vegetation





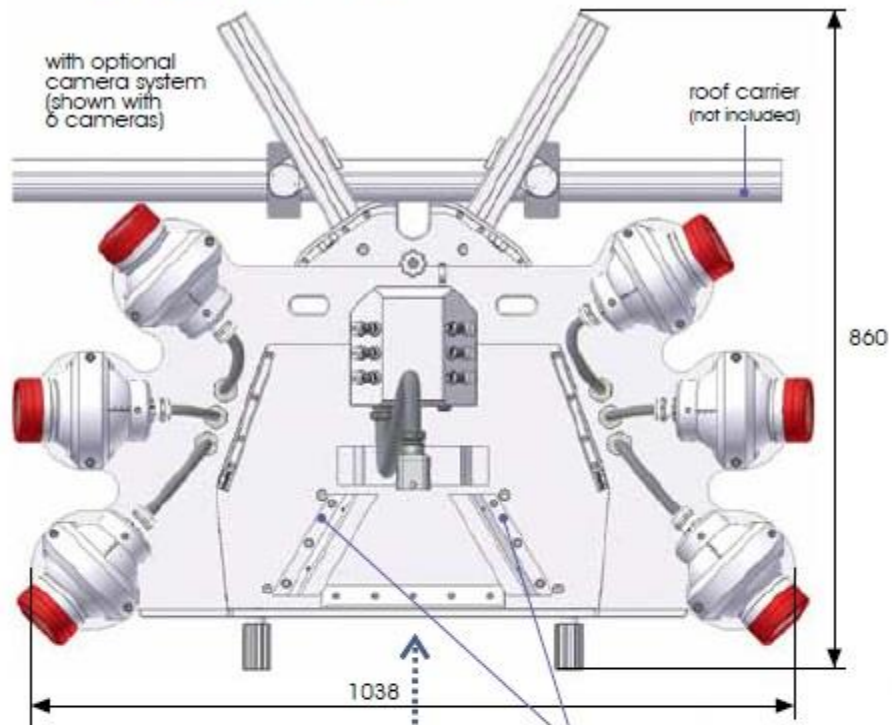


Urban mobile laser surveying with RIEGL VMX-450



Source: Hungarian Geodetic and Mapping Company Ltd.

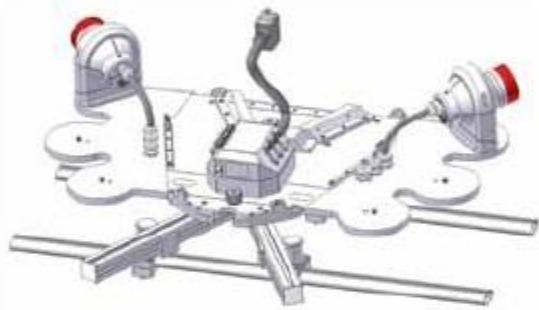
VMX-450-RM Roof Mount



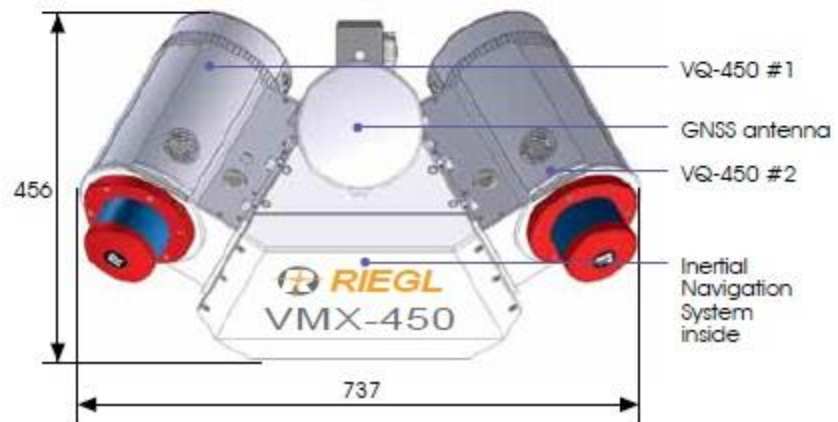
without camera system



with optional camera system (shown with 2 cameras)



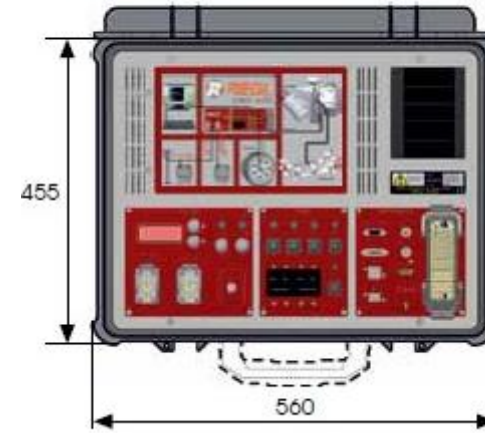
VMX-450-MH Measuring Head



with optional camera system (typical configuration with 4 cameras) and protective cover



VMX-450-CU Control Unit



VMX-450-MC Main Cable



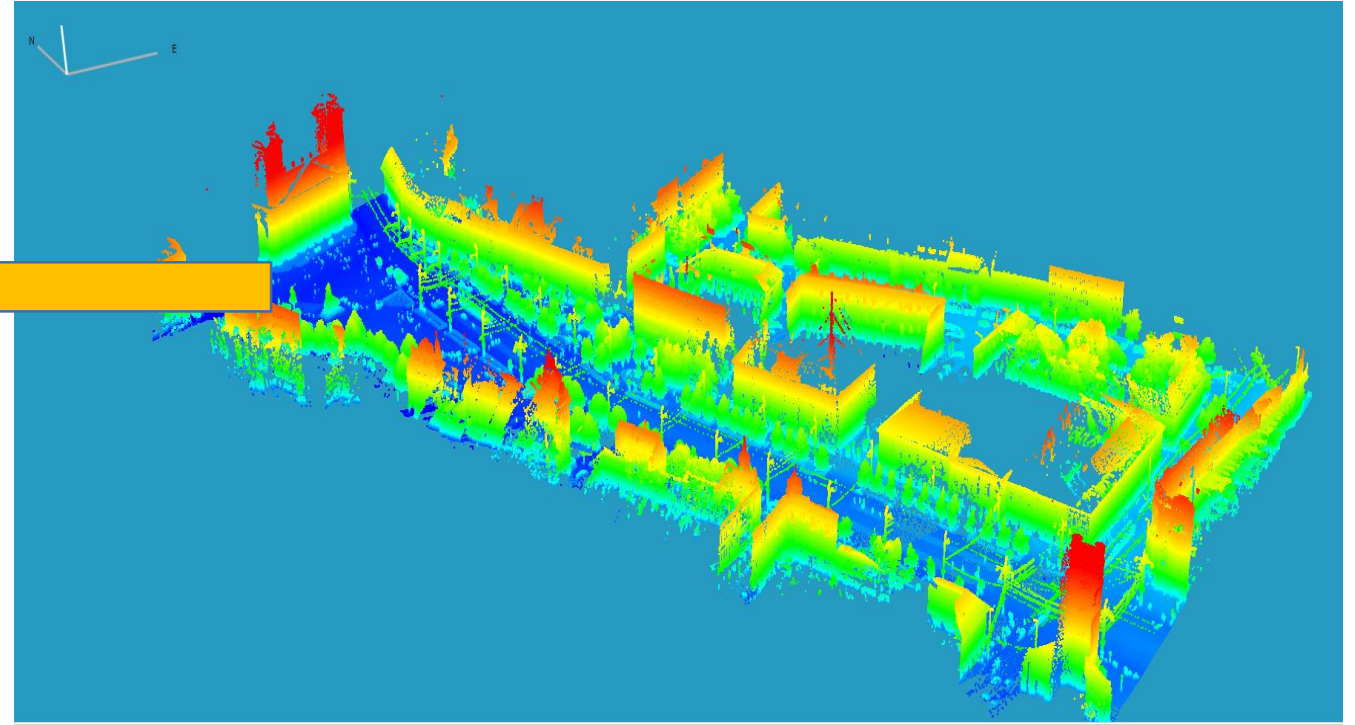
Odometer

VMX-450-DMI Distance Measurement Indicator



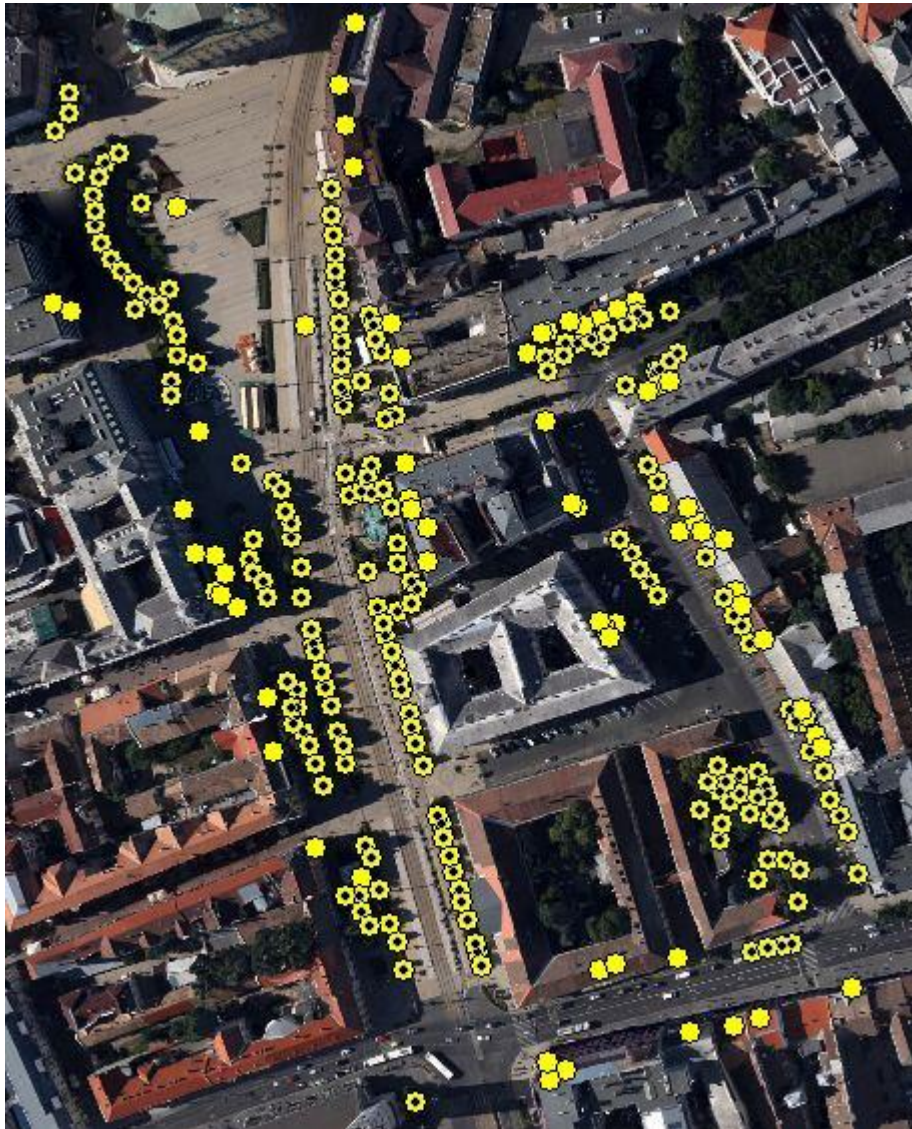
all dimensions in mm

Colored point cloud of the Great Church

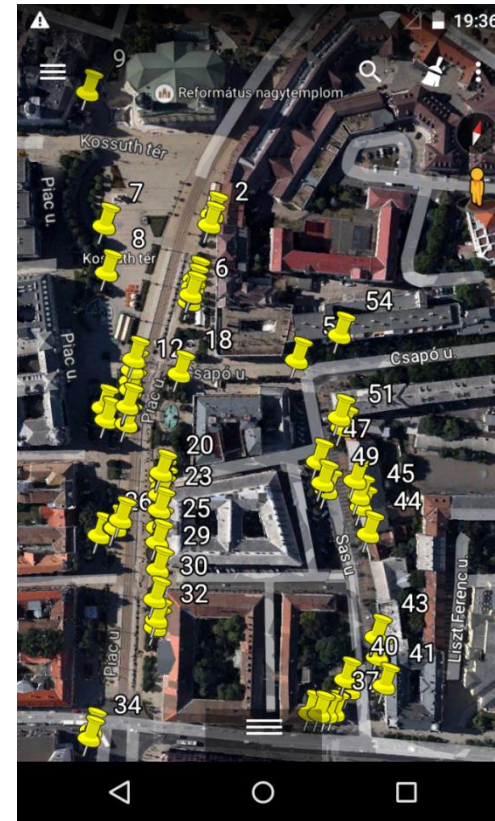


Source: Tóth, K. (2015): Mobil laser scanning – Point cloud based modeling of downtown of Debrecen (in Hungarian). MSc thesis. Debrecen. 58 p.

Automated tree recognition algorithm with ENVI LiDAR 3.2

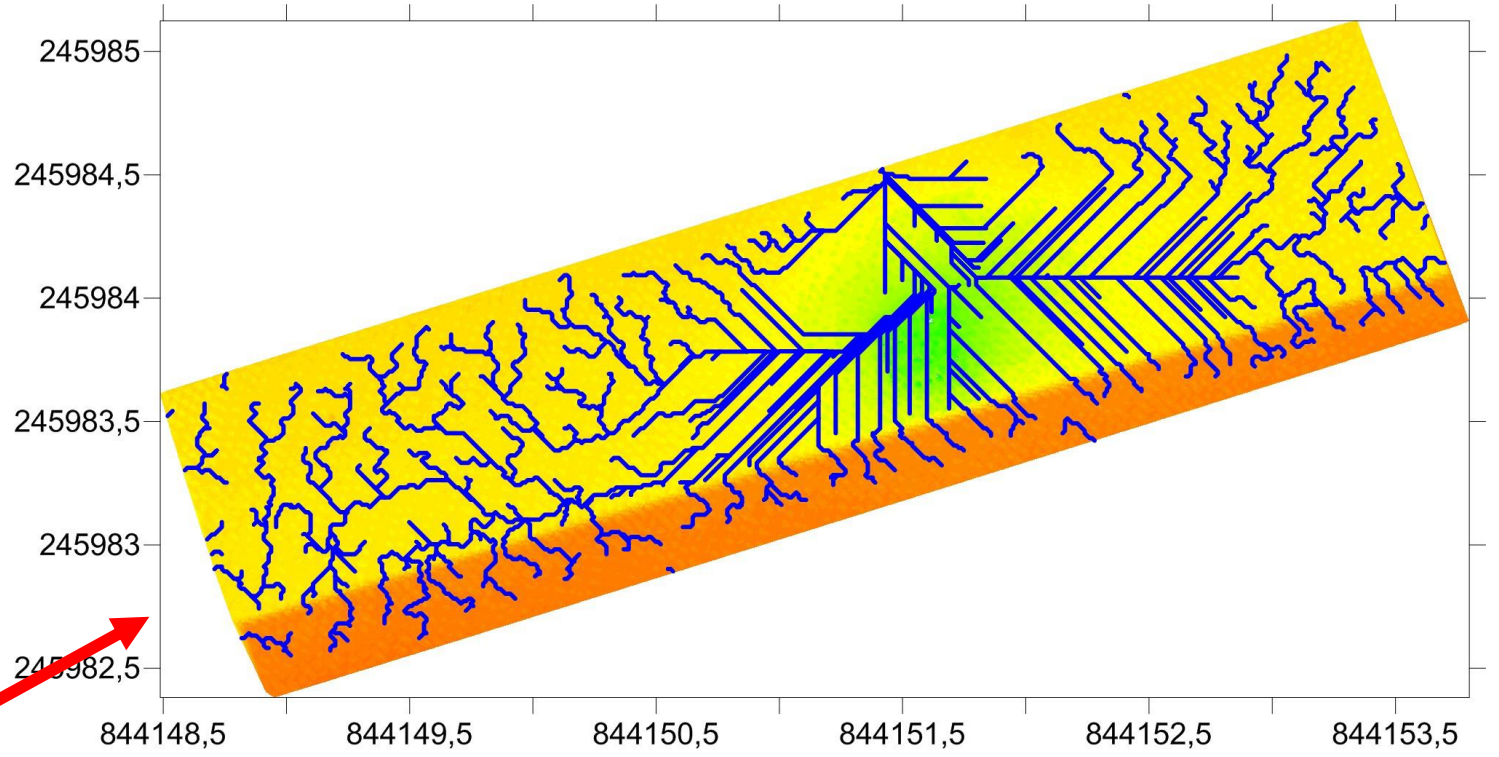
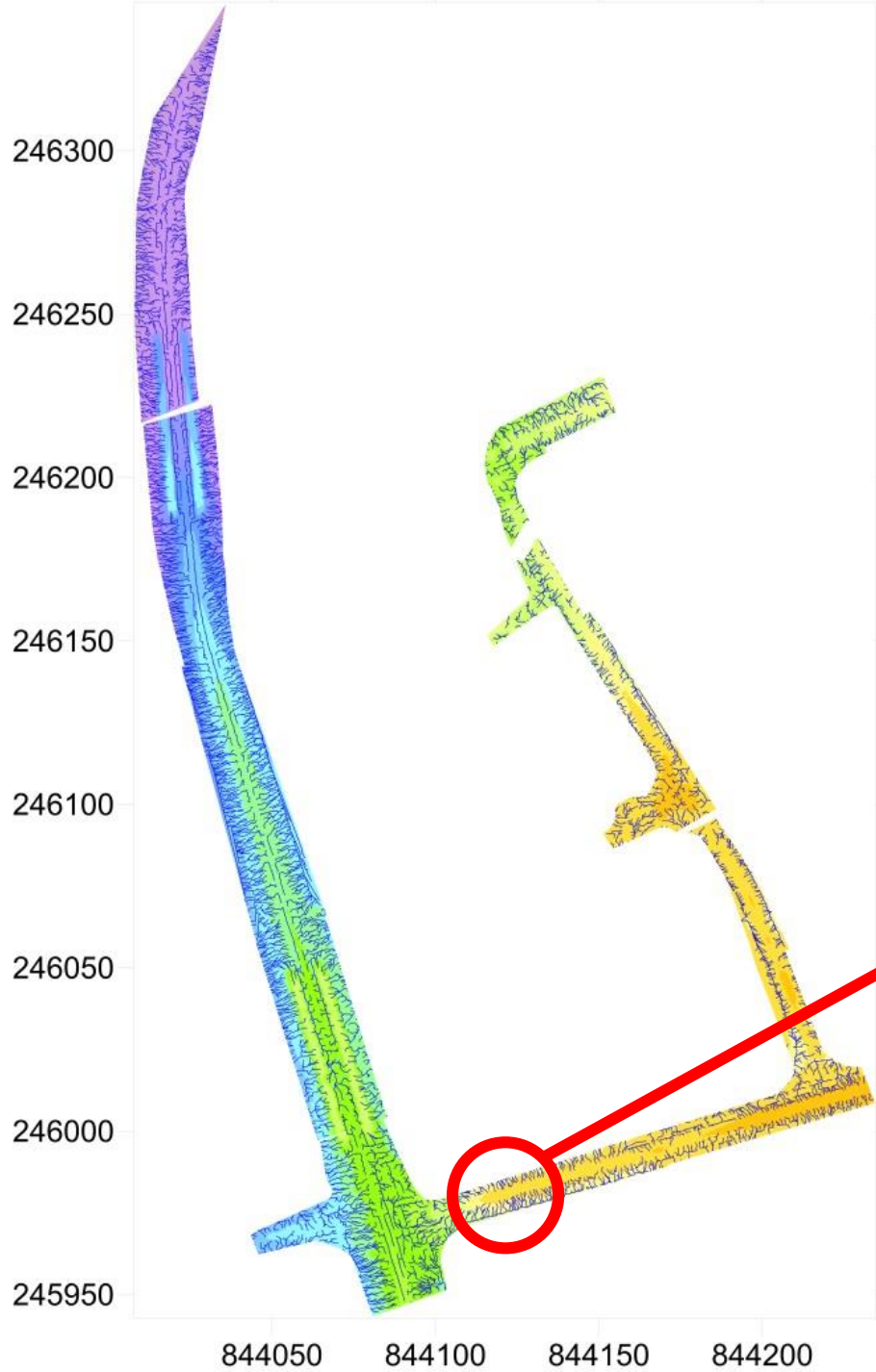


**Field measurement
for validating**

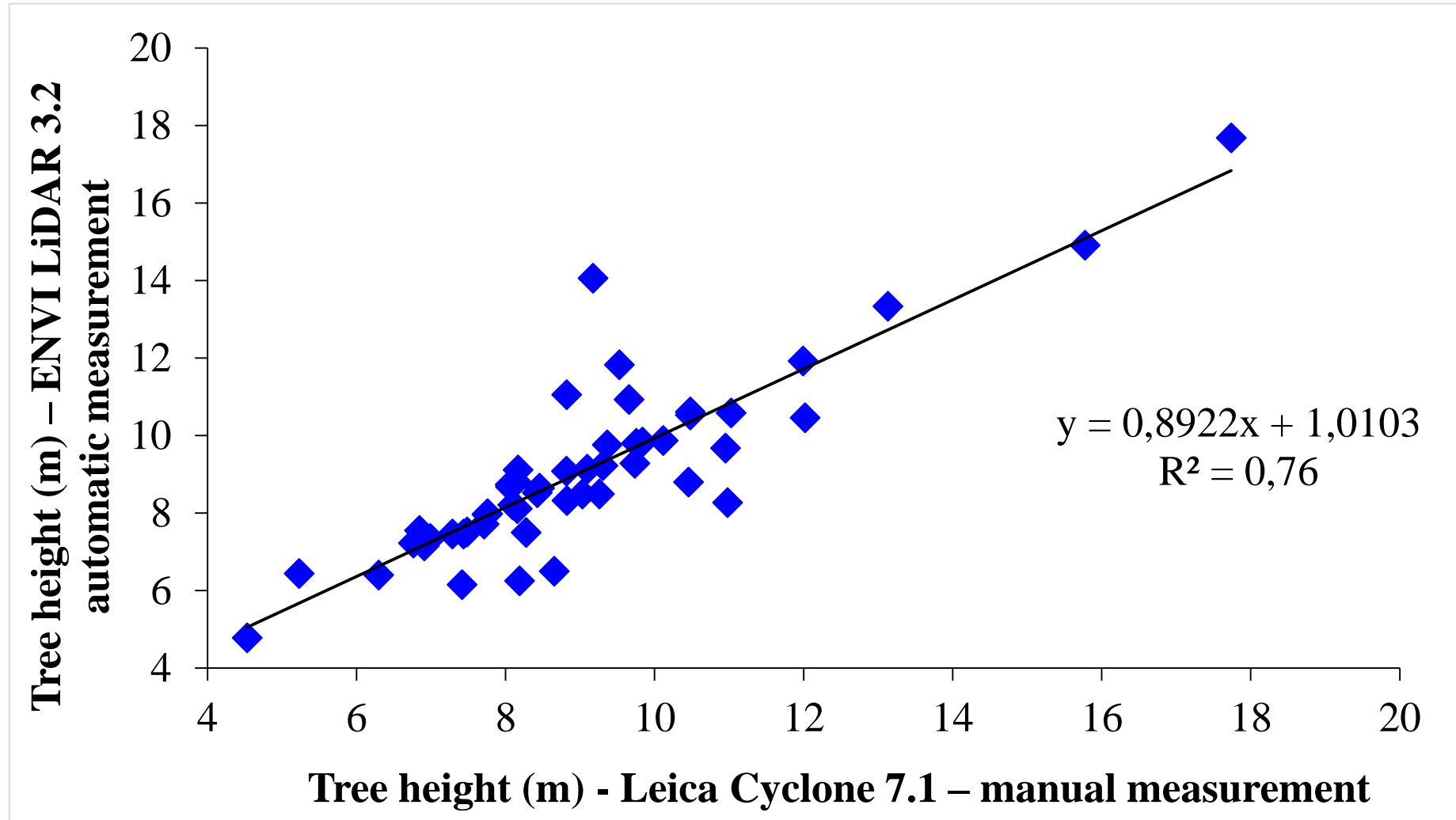


Source: Tóth, K. (2015): Mobil laser scanning – Point cloud based modeling of downtown of Debrecen (in Hungarian: Mobil lézershkennelés – Debrecen belvárosának pontfelhő alapú modellezése). MSc thesis. Debrecen. 58 p.

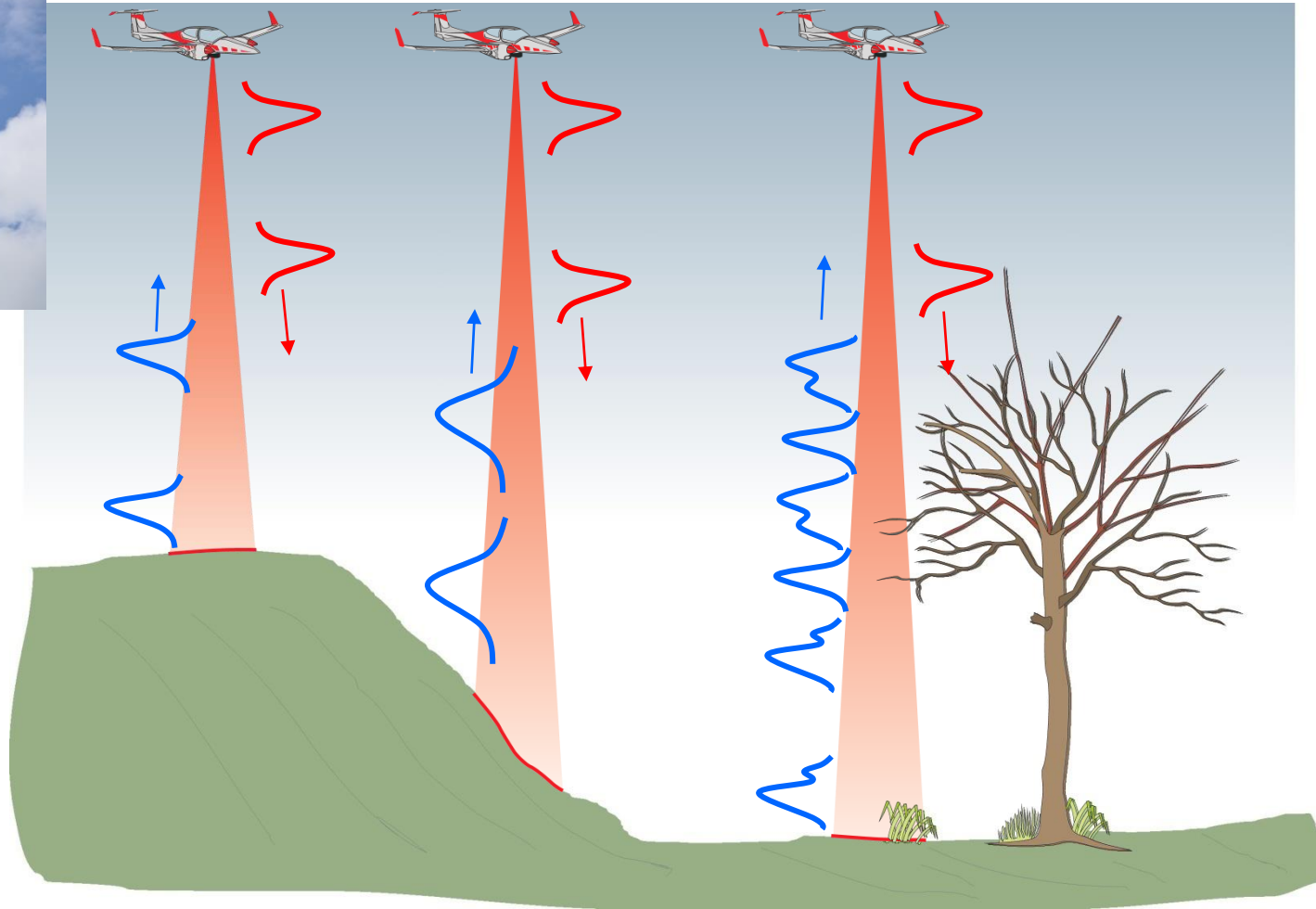
Runoff pattern of main square



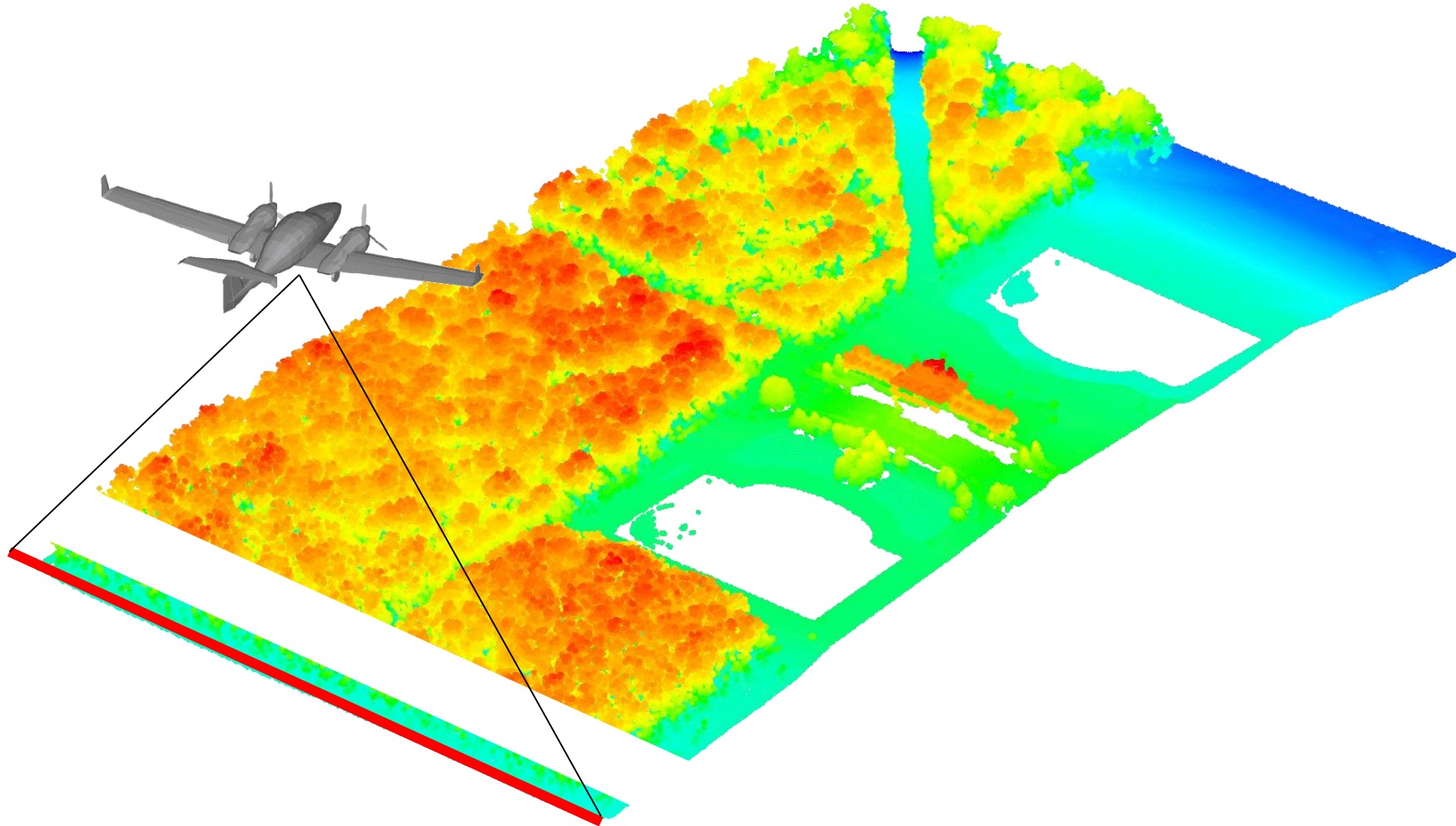
Correlation between automatic and manually tree height measurement



Airborne Laser Scanning

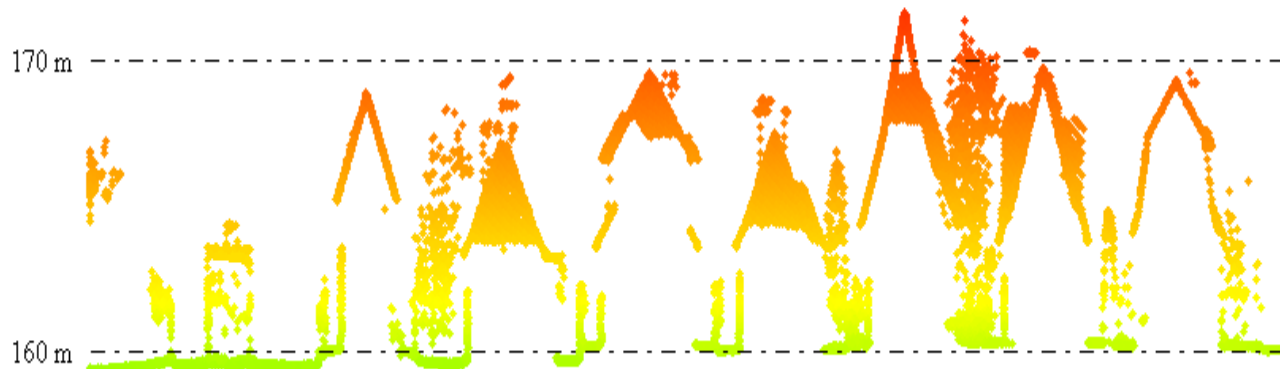


Visualization of
Laser Scan Data



Quality Assessments

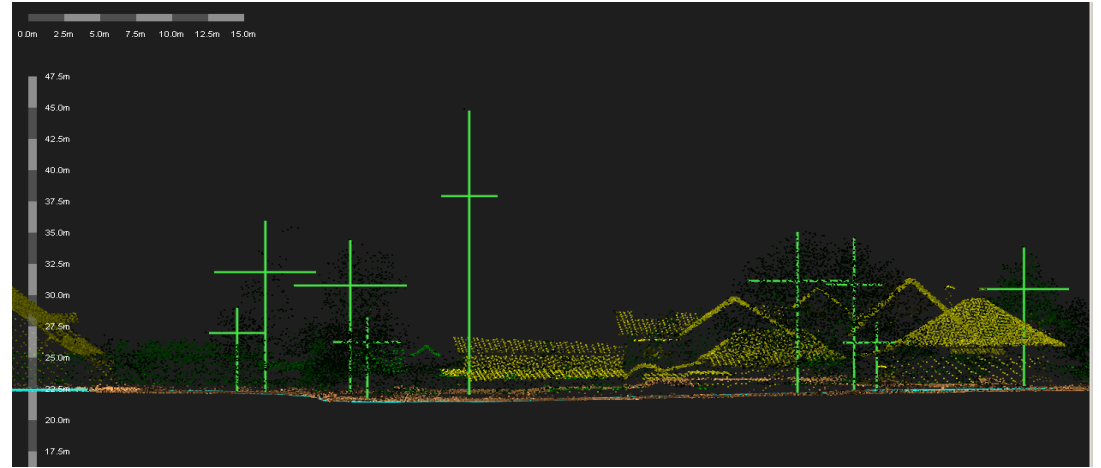
From Pos: 47° 33' 39.1381" N, 21° 36' 32.4545" E



LIDAR POINT COUNT=9,792,189
LIDAR POINT DENSITY=32.11 samples / m²
COVERED AREA=48.844 hectares
MIN ELEVATION=134.936 METERS
MAX ELEVATION=160.415 METERS

To Pos: 47° 33' 21.6655" N, 21° 36' 29.0405" E





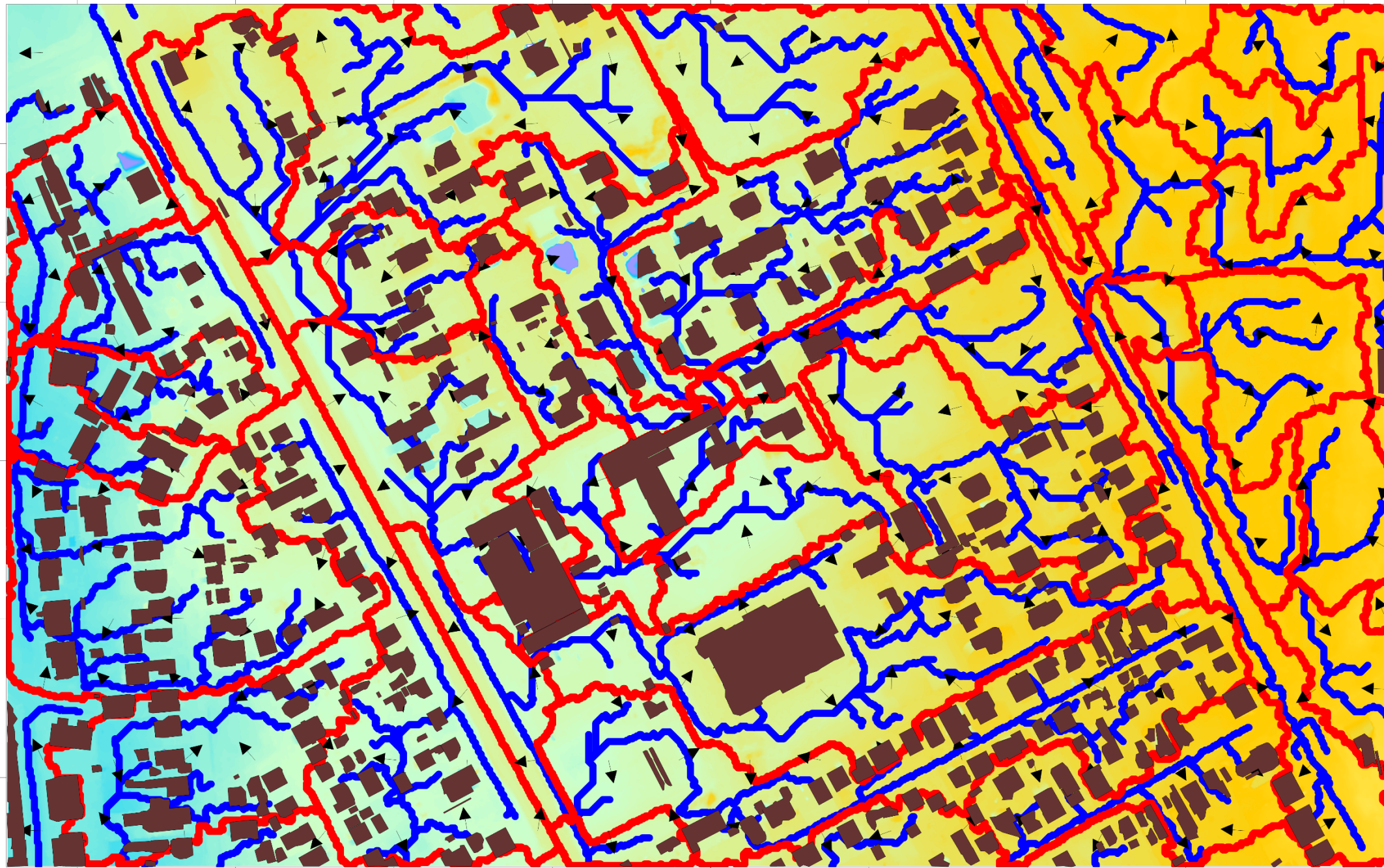
5267800

5267700

5267600

5267500

5267400



Summary

- The laser scanning methods offer very accurate input DSM to hydrological modeling
- The object segmentation from laser scanned point clouds is a complex process where to evaluate an error propagation spatial uncertainty is real time consuming task.
- The most commonly used solution is to create a raster DEM at lower resolution, followed by an additional editing of the DEM with the available noise removal, smoothing and interpolation algorithms.
- However, this procedure is accompanied by a loss of detail, and has an important impact on the elevation-derived parameters.

THANK YOU FOR ATTENTION

Acknowledgements: Hungarian OTKA FUND – OTKA project K 105789