hrvatsko kartografsko društvo
croatian cartographic society

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Cartography and Geoinformation

Zagreb, October 10-12, 2014

Use of LiDAR data in cartography

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CONTENT

Three years ago…

Updating topographic data using arborne laser scanning

Savings in particular maps production → (partly) automation

LiDAR data for 3D maps

Terrestrial laser scanning – mapping „hidden“ places

Conclusions (predictions)

3. hrvatski NIPP i INSPIRE dan i 7. savjetovanje Kartografija i geoinformacije
Split, 14-16. rujna 2011.
hrvatsko kartografsko društvo
croatian cartographic society

USE OF AIRBORNE LASER SCANNING DATA FOR UPDATING TOPOGRAPHIC MAPS AND DATABASES

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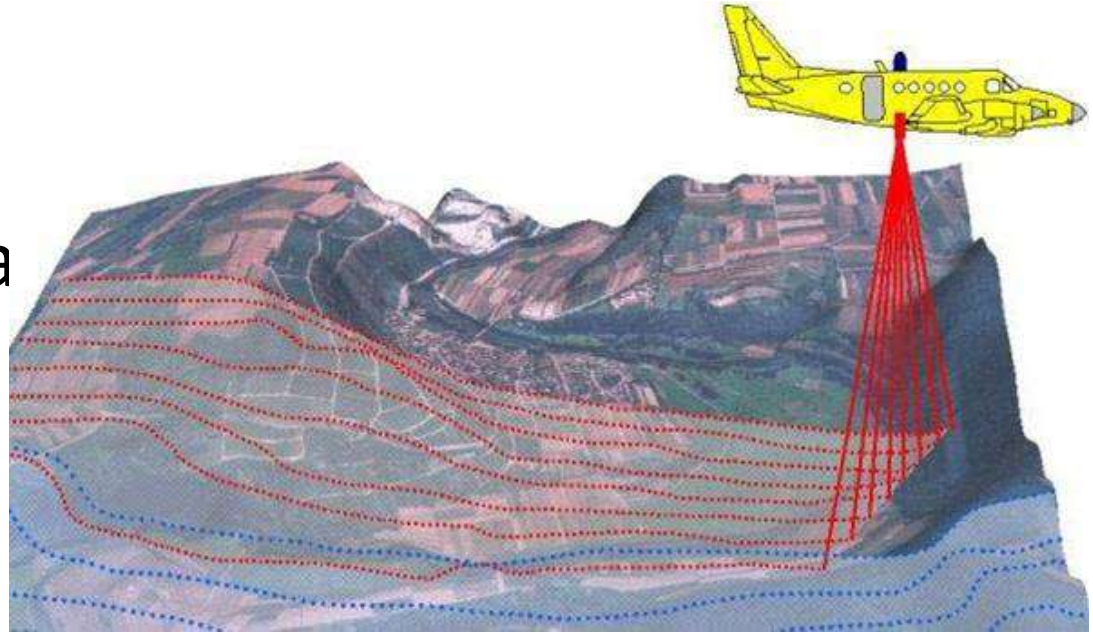
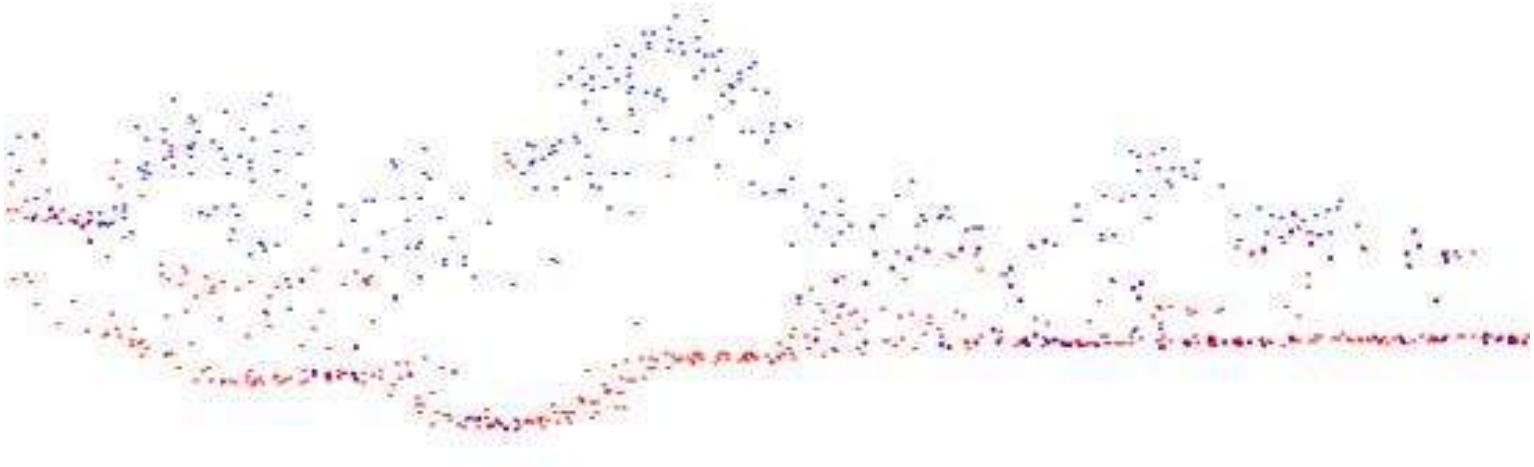
The airborne laser scanning data - promising source data for deriving different topographic data

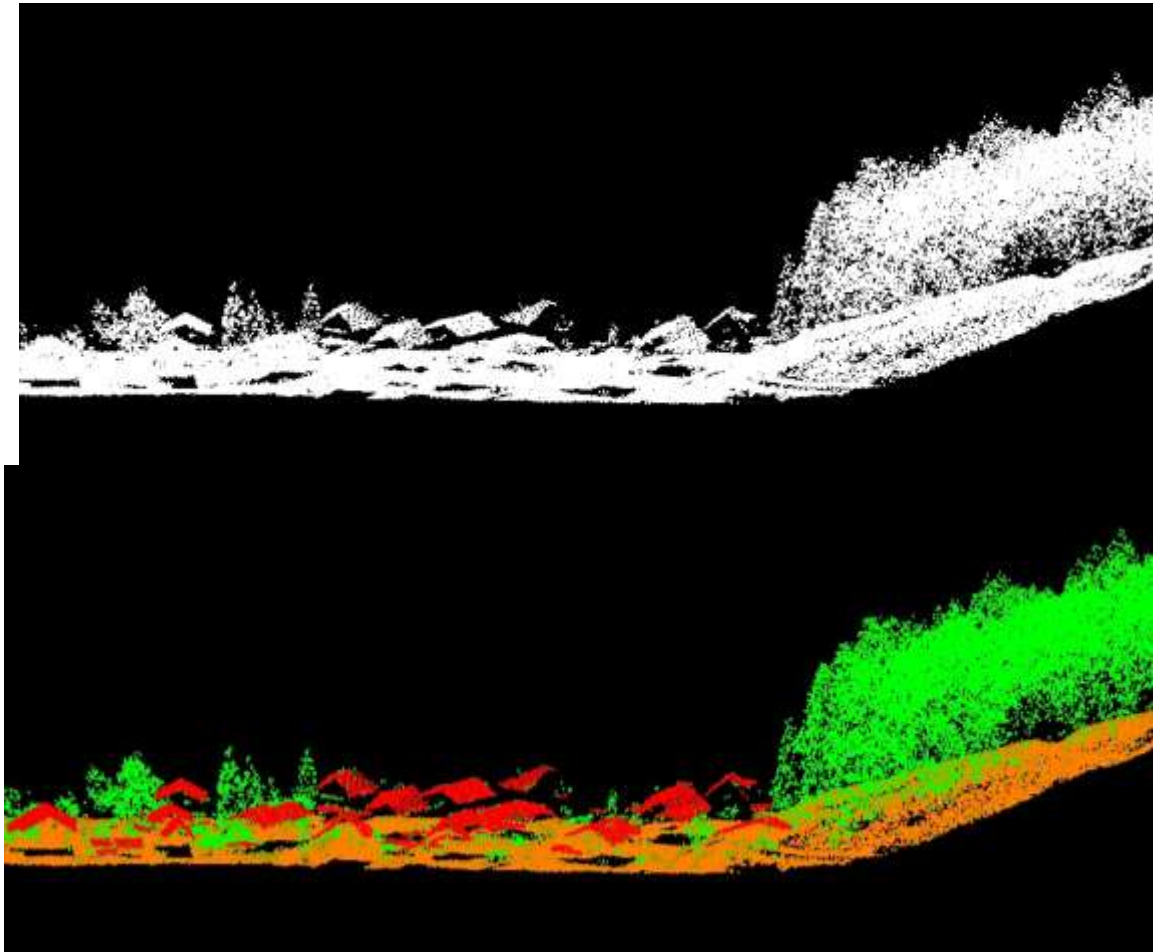




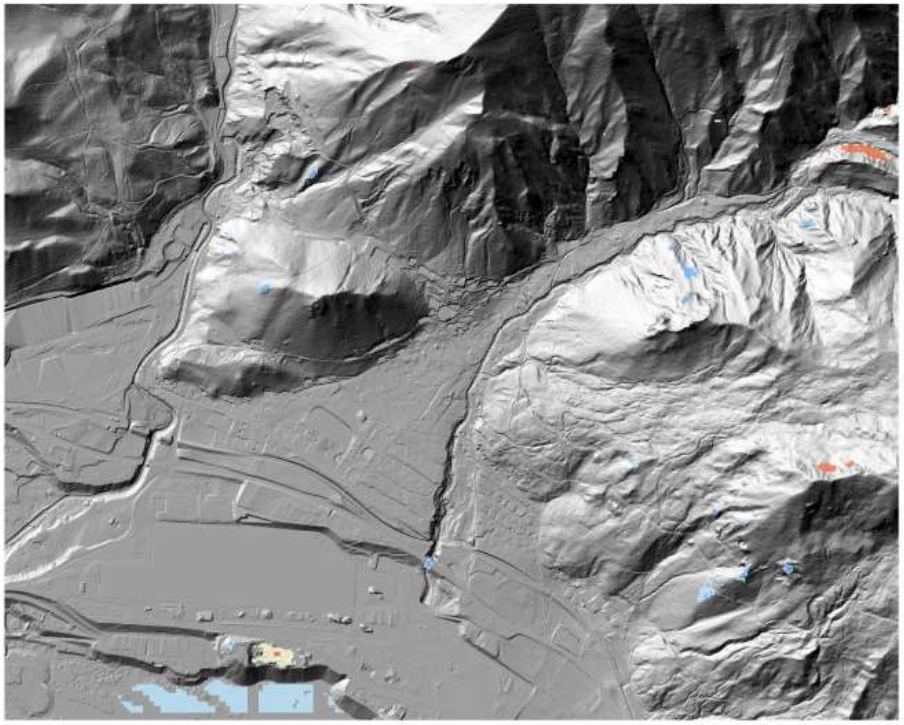
Deriving data from ALS:

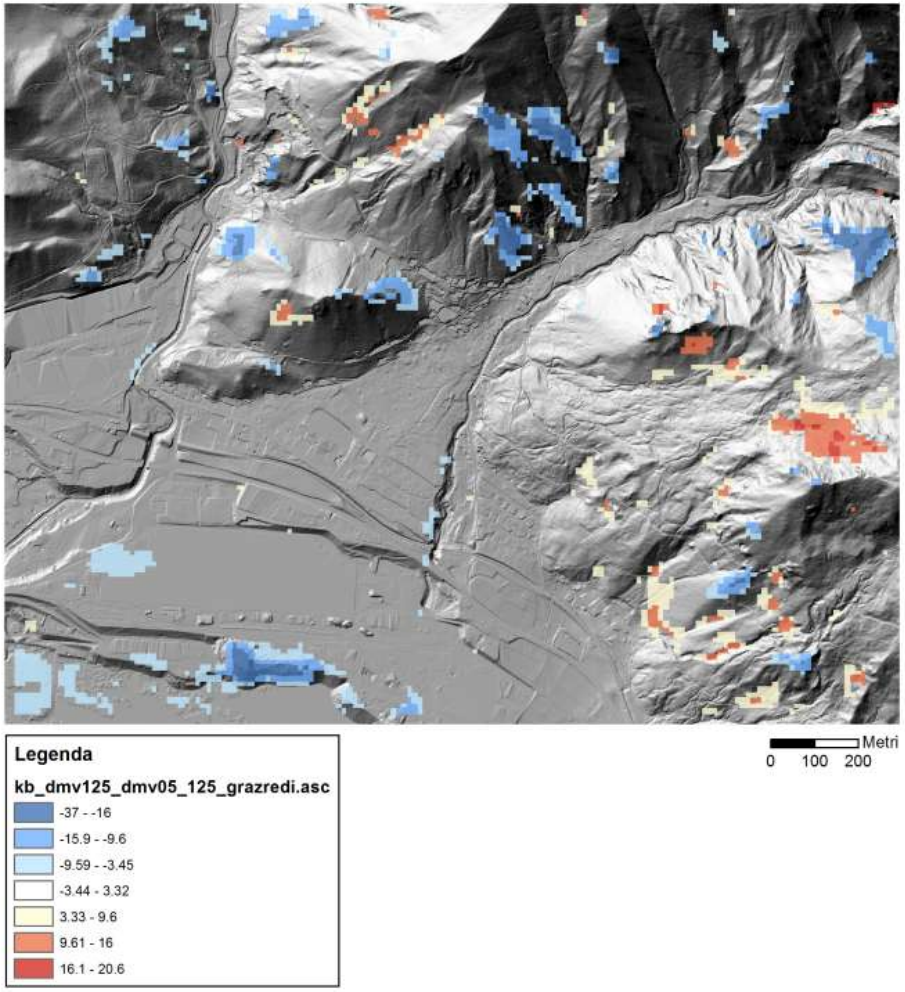
- clasification
- automated (urban environment or forestry)
- manual recognition

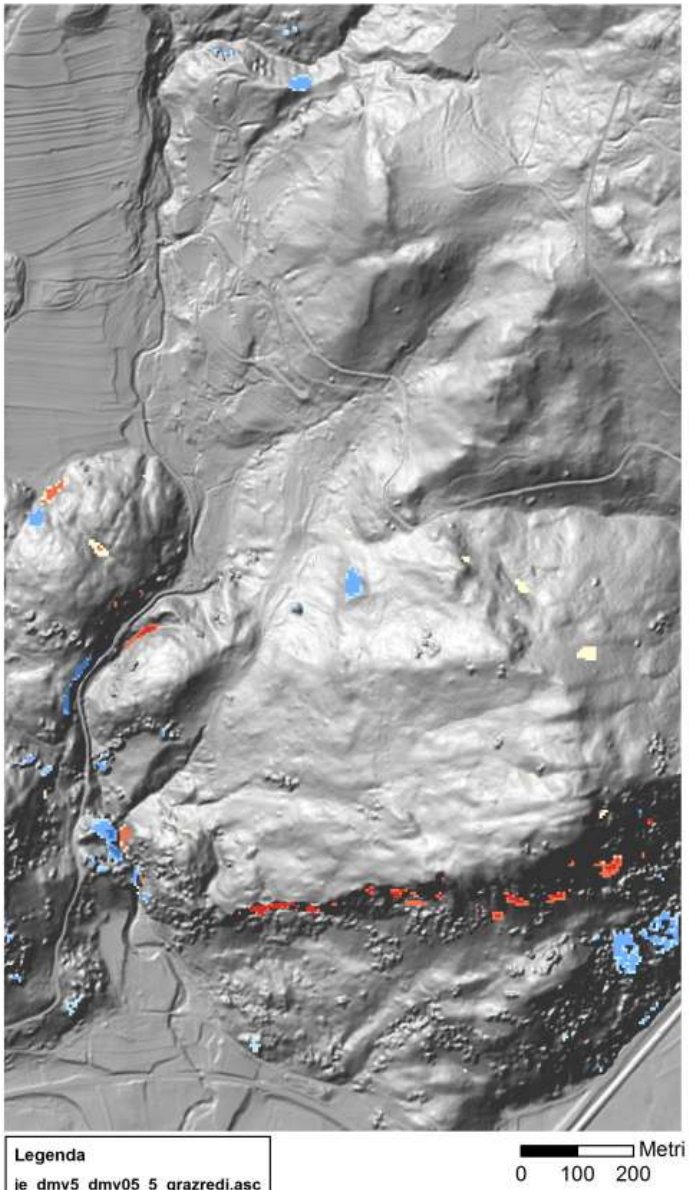
from derived presentations (eg. hillshading)

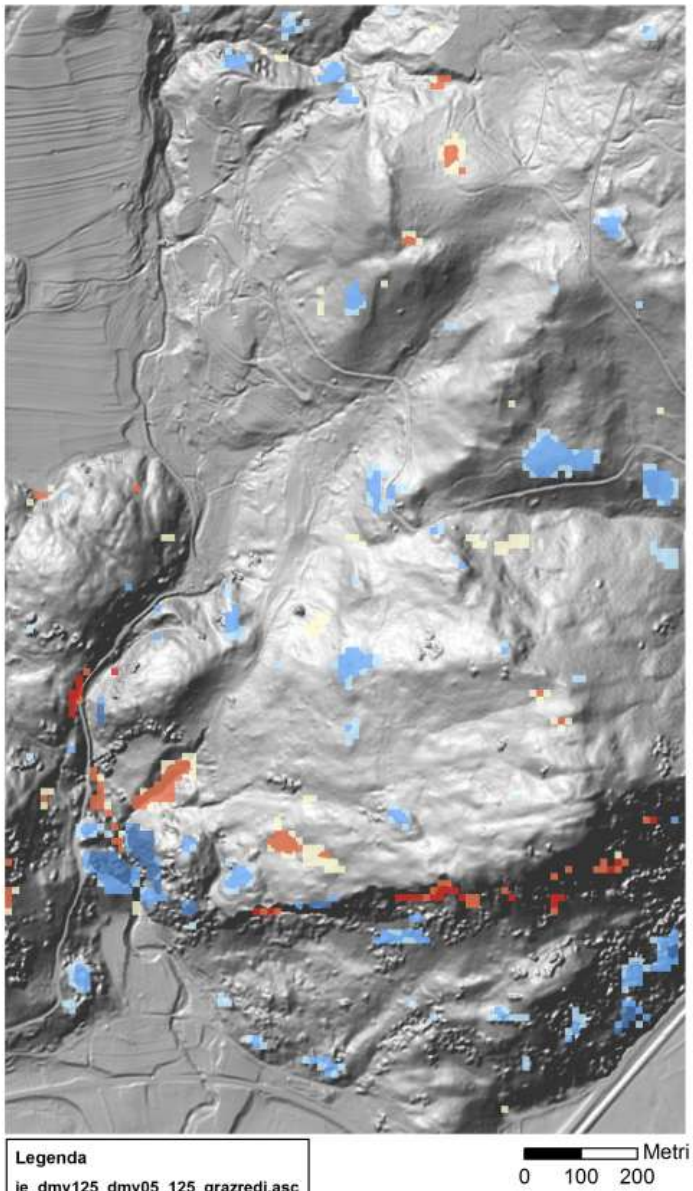


area Koroška Bela (KB), 2 × 1,6 km, DMV 0,5 m
5/2009, flying height 1000 m, Flycom, purpose flood risk



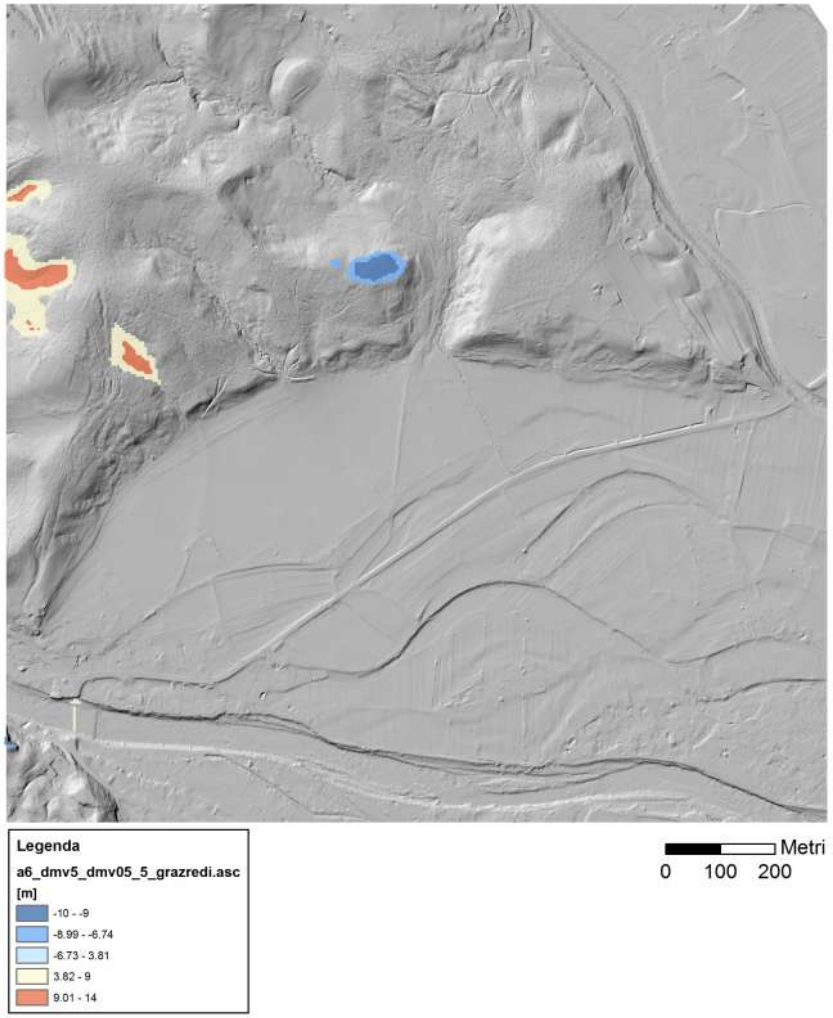


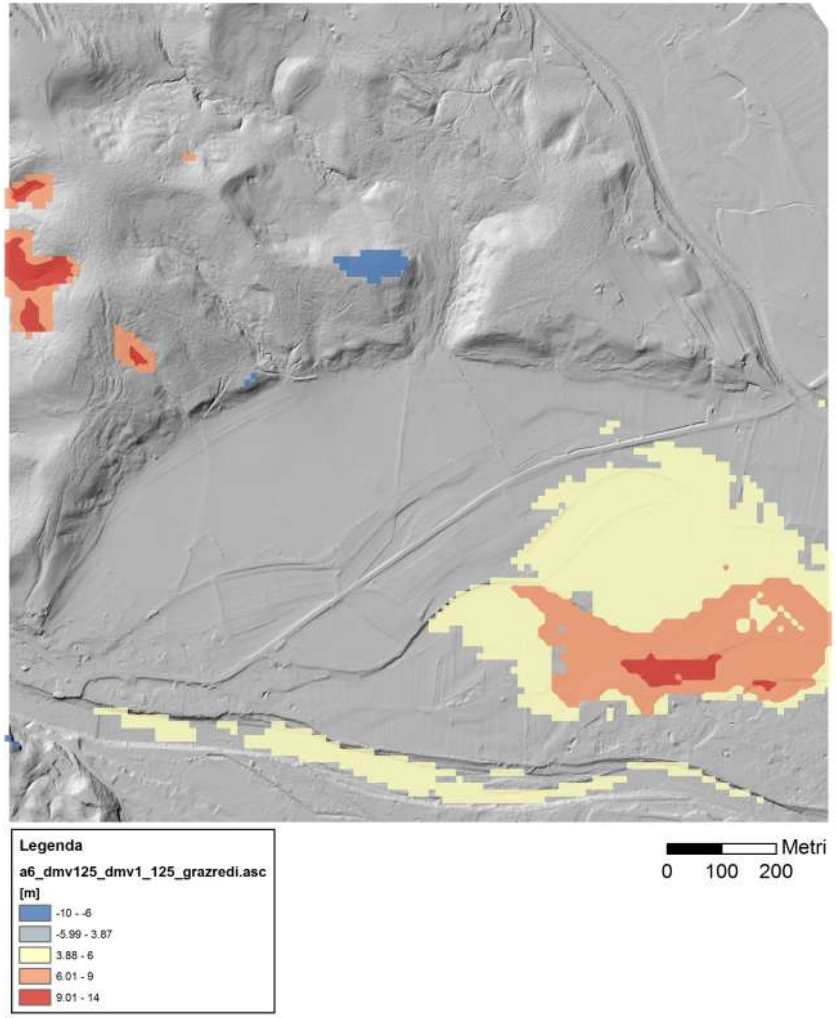


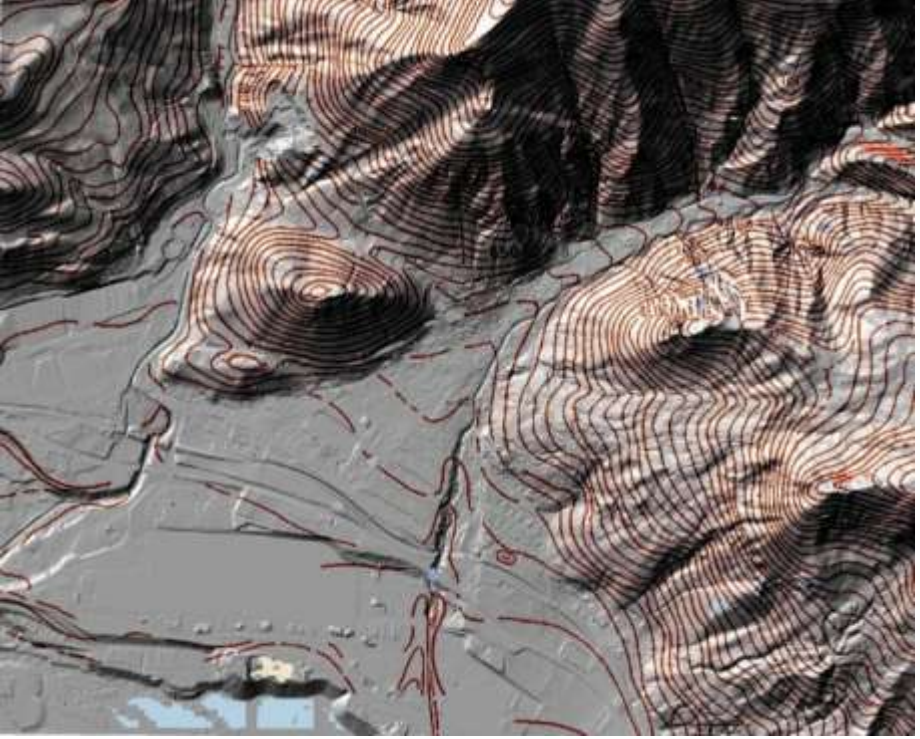


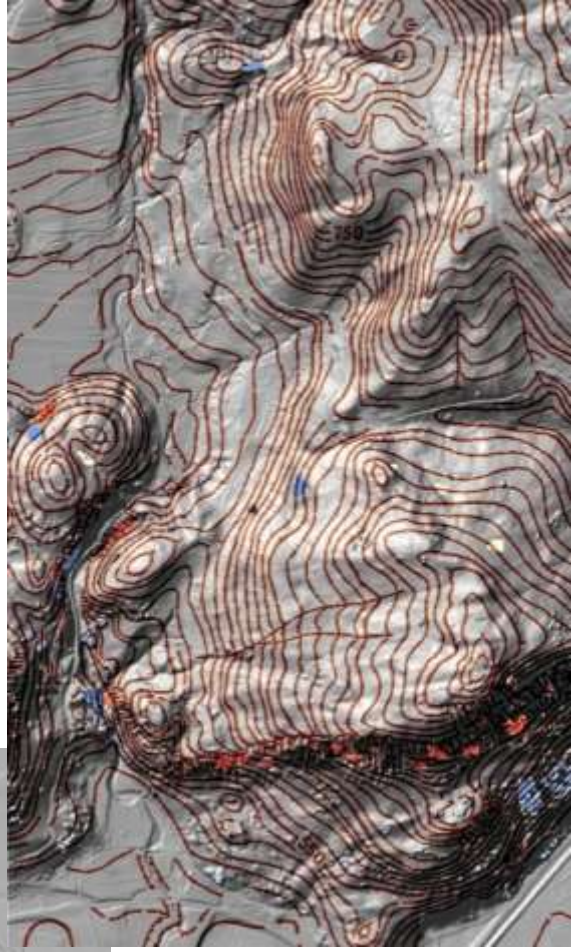
area Jereka (JE), 2 × 1,2 km,
clissified point cloud ~ 12 pt/m^2
7/2008, flying height 500 m,
Flycom, purpose power lines

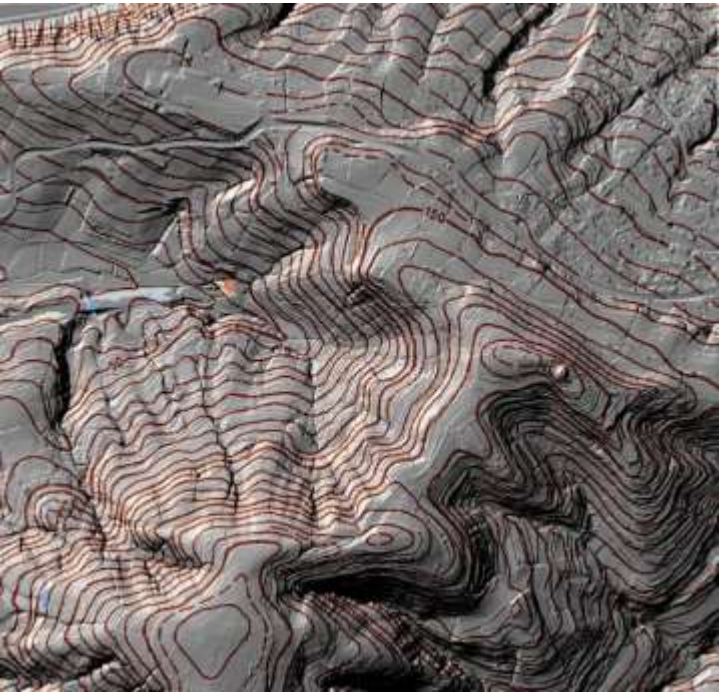
area A6, Letuš (LE), 1,5 × 1,5 km, DMV 1 m
5/2011, Geoin, sistematic capturing for Slovenia

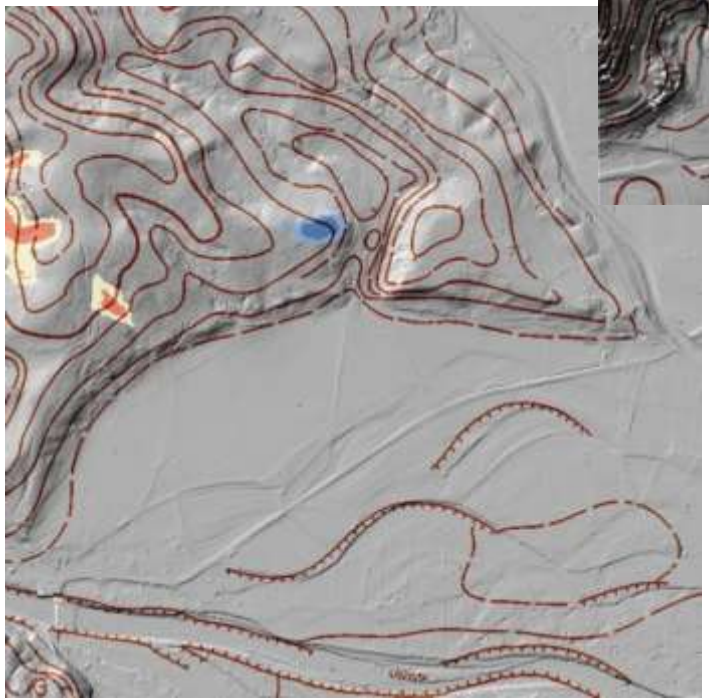












Extraction of linear objects (water streams, ridges and ditches)

- natural objects, depend on relief characteristics

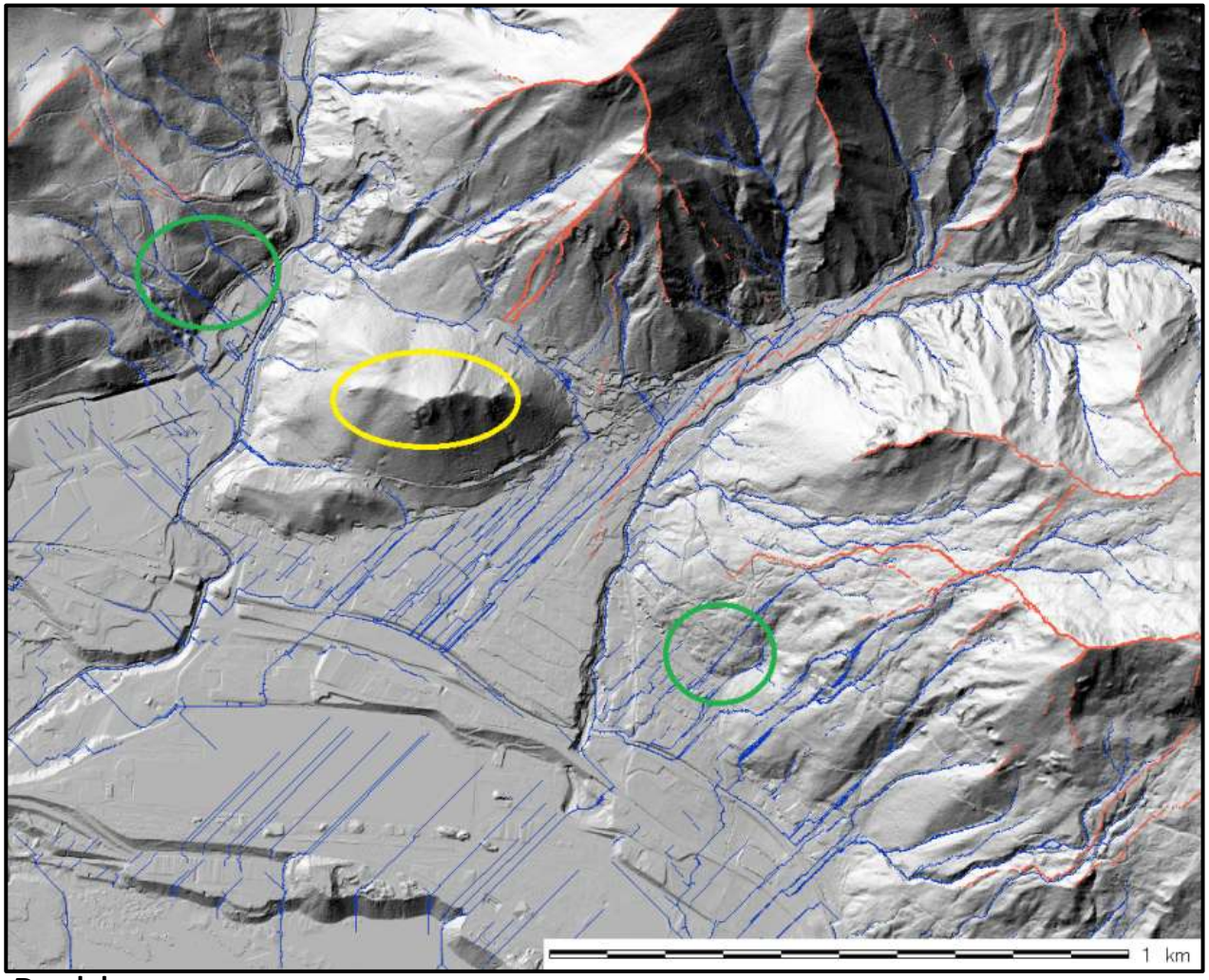
Water streams, ditches

- Hydrological tools were used:
  - Multiple Flow Detection model
  - Flow accumulation
  - Setting appropriate threshold
  - Coverting to vector

Ridges

- Inverting DEM
- The same procedure as above
- Different threshold

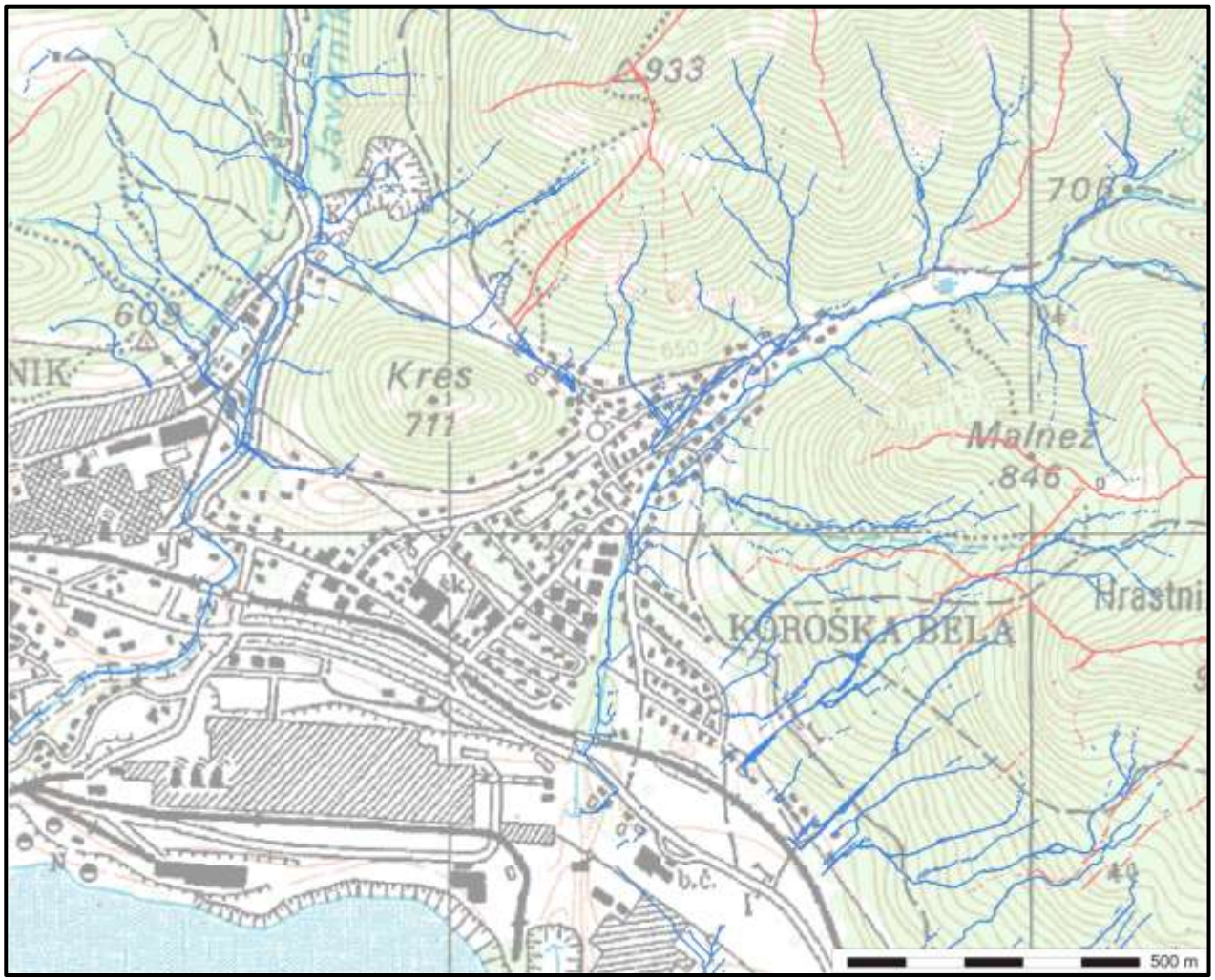
Results: water streams, ridges, ditches



Problems

- yellow: the ridge was not detected
- green: problems with detecting ditches at the junctions with paths

Comparison to existing data (DTK 25): ridges, ditches

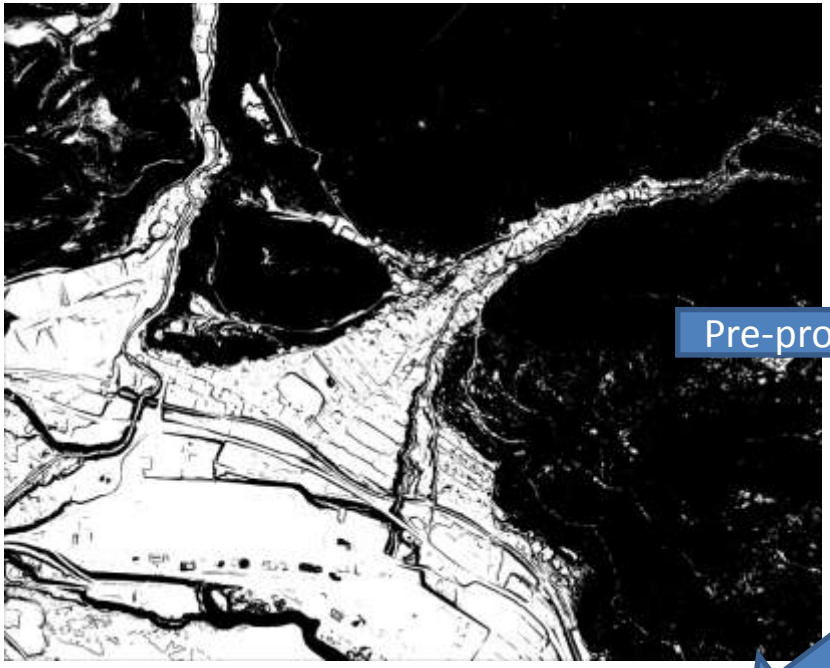


Extraction of linear objects (roads and paths)

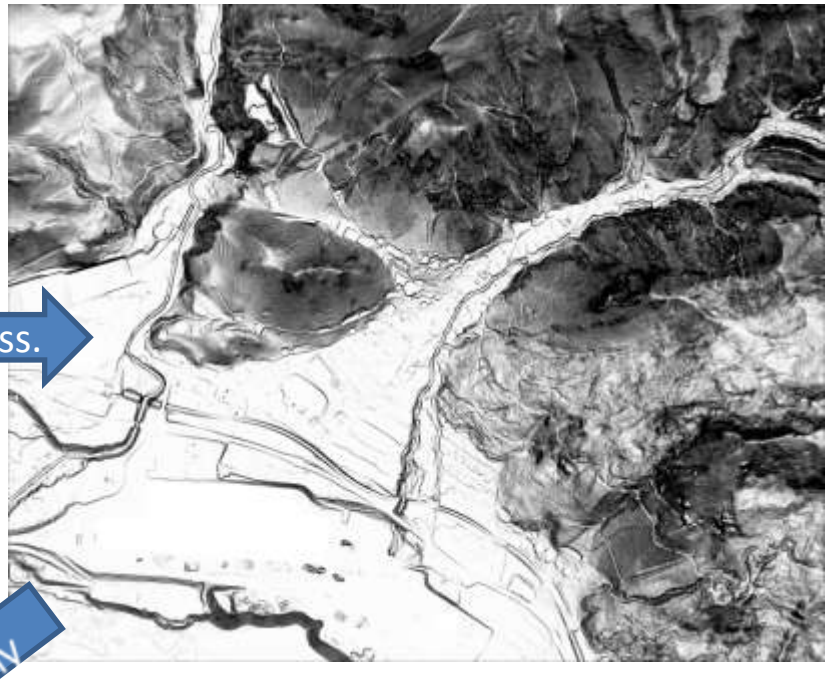
Focus on extraction of paths in the slopes

Workflow:

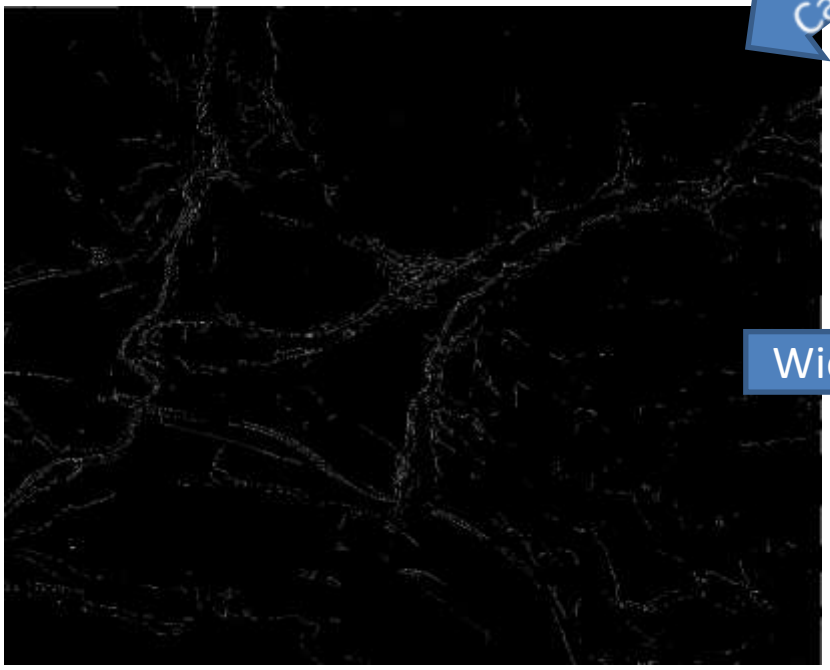
- slope, aspect, curvature and derivatives in x- and y- directions from DEM
- hillshading with vertical angle 90°
- pre-processing of the image (noise reduction, more contrast)
- image processing tools:
    - edge detection with canny method
    - improving the results with Wiener filter;
    removing short segments



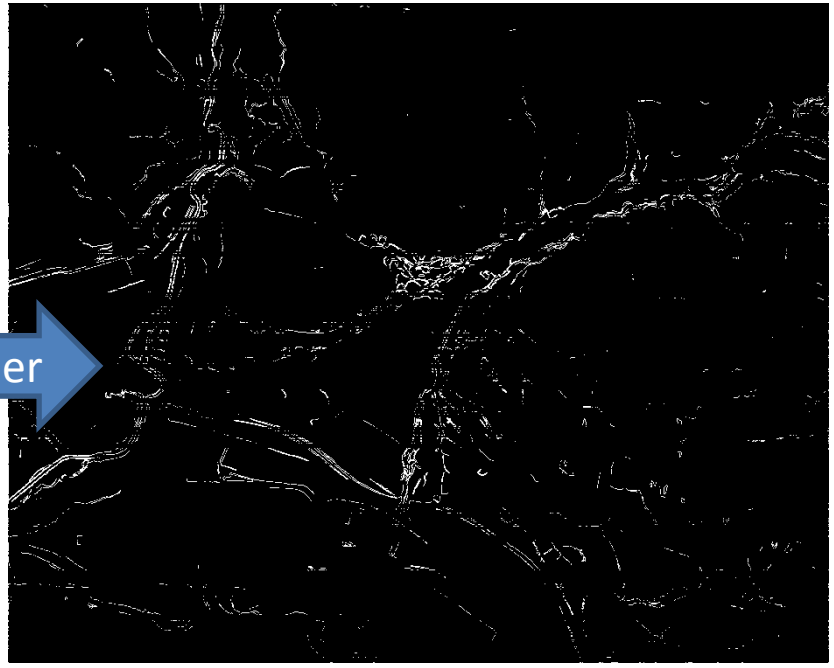
Pre-process.



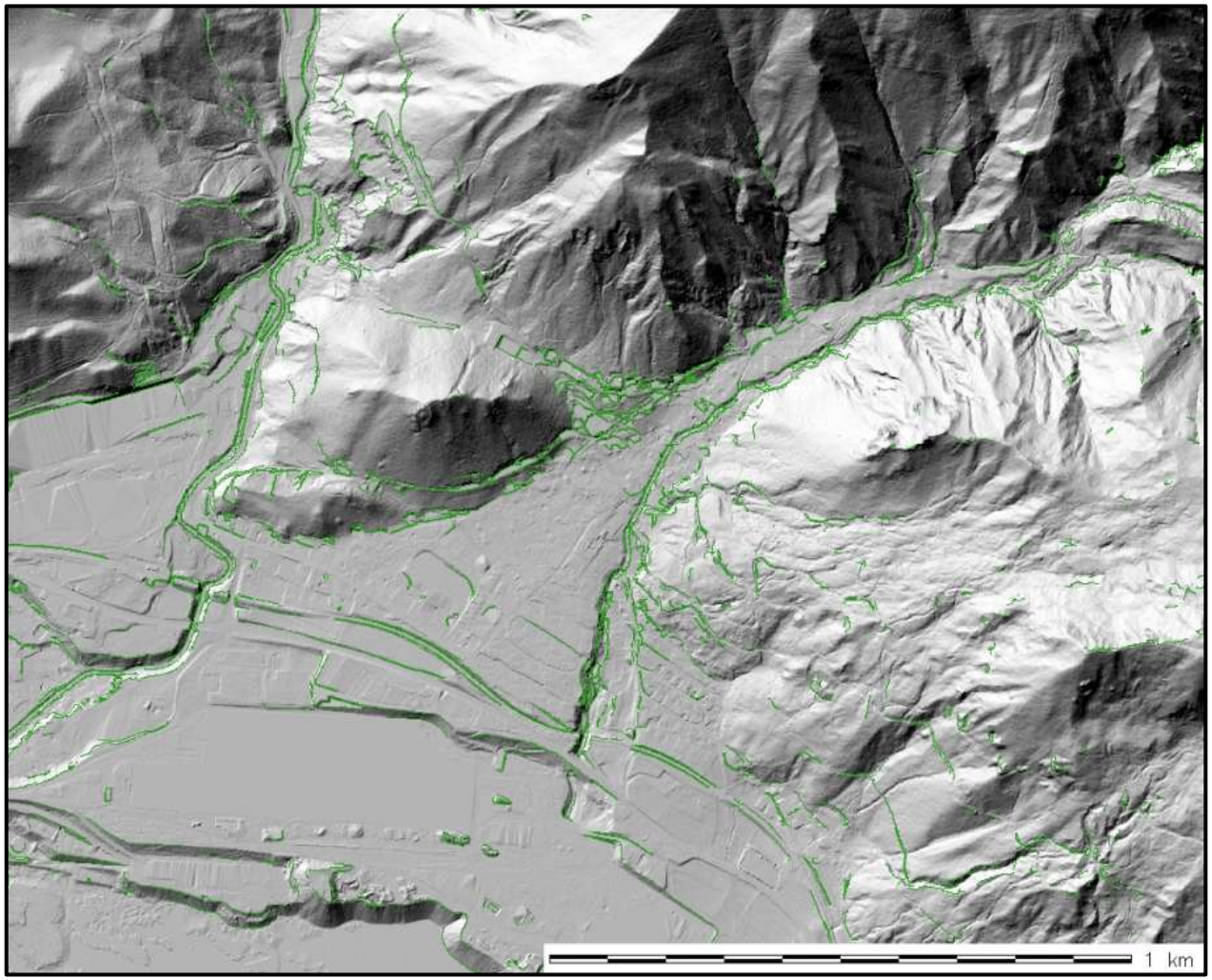
Canny



Wiener



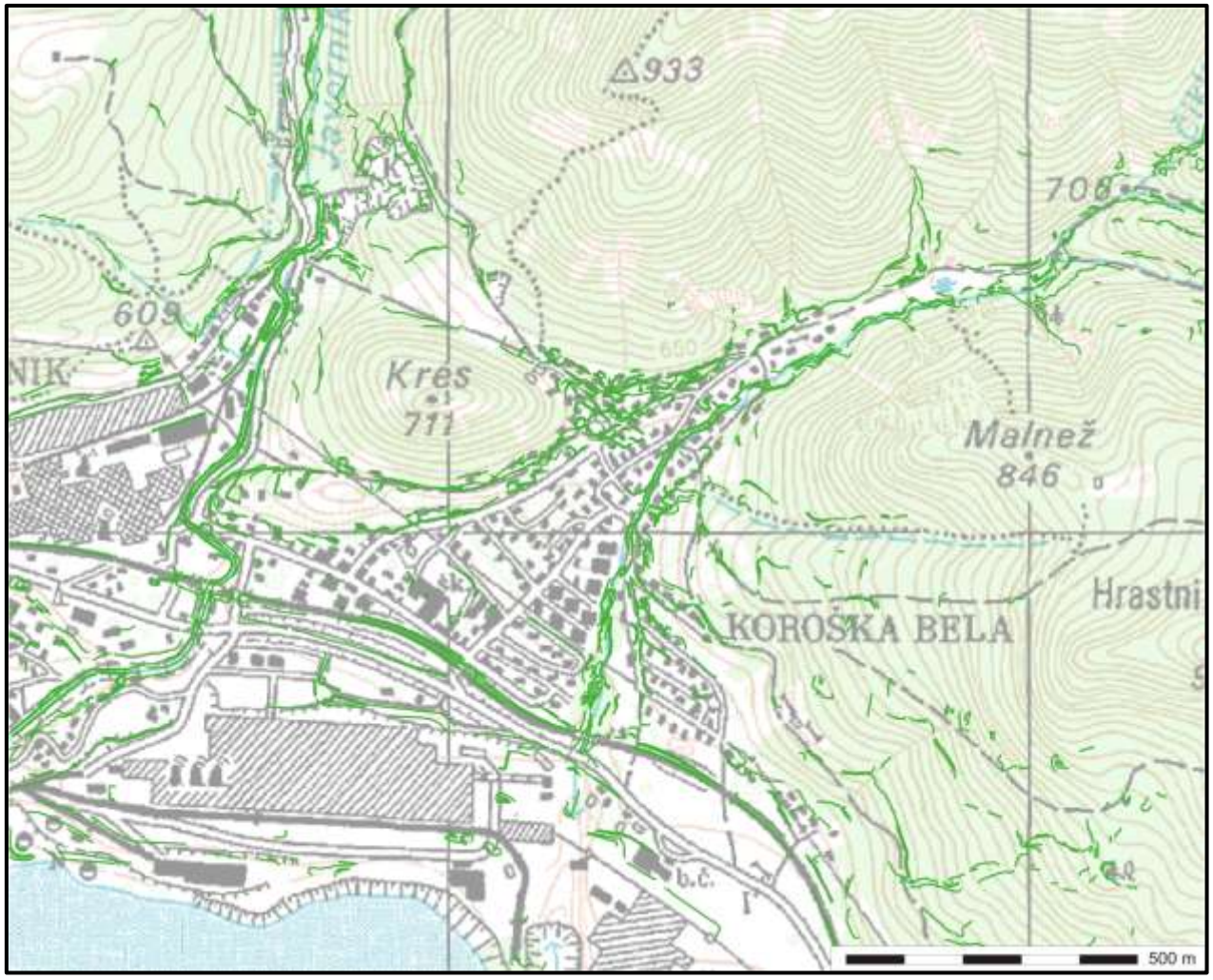
Results: roads, paths



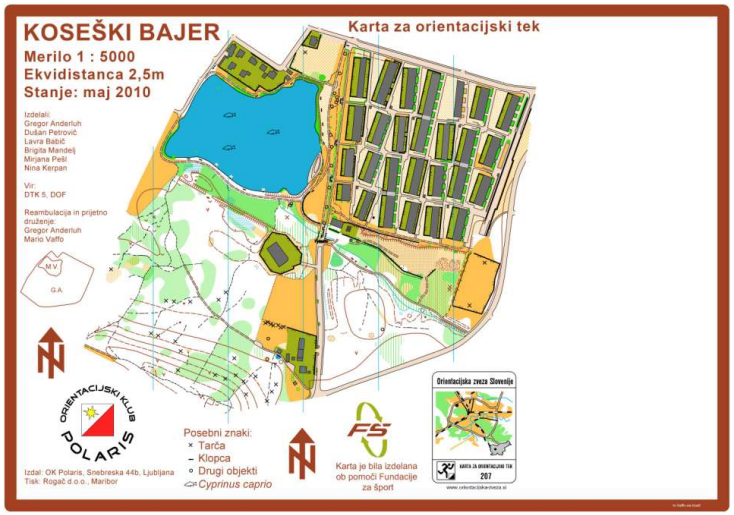
Problems:

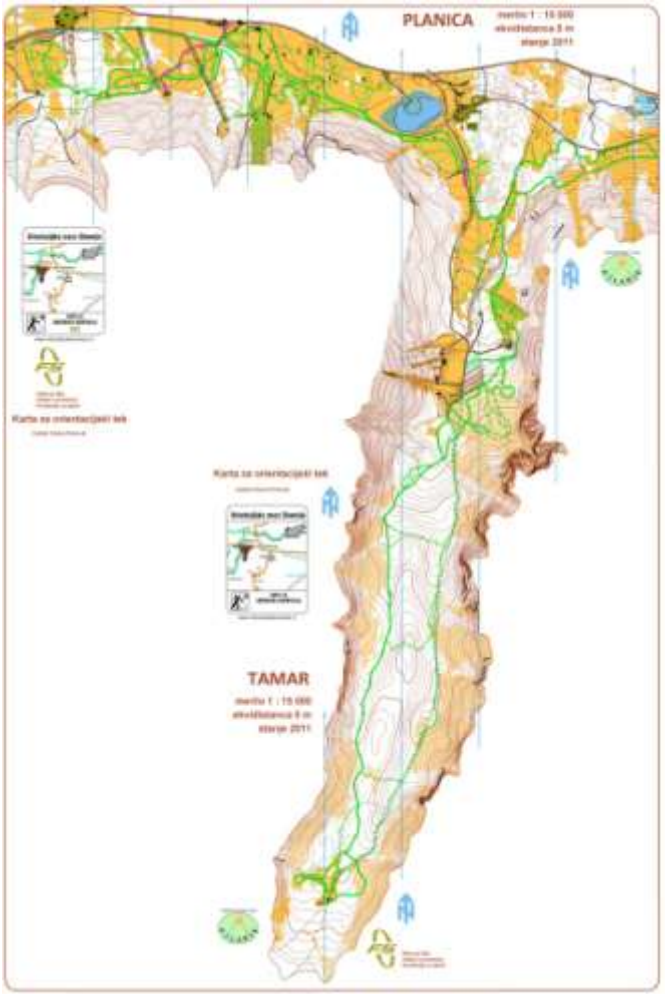
- other sharp relief edges were also detected: riverbeds, edges of shores…

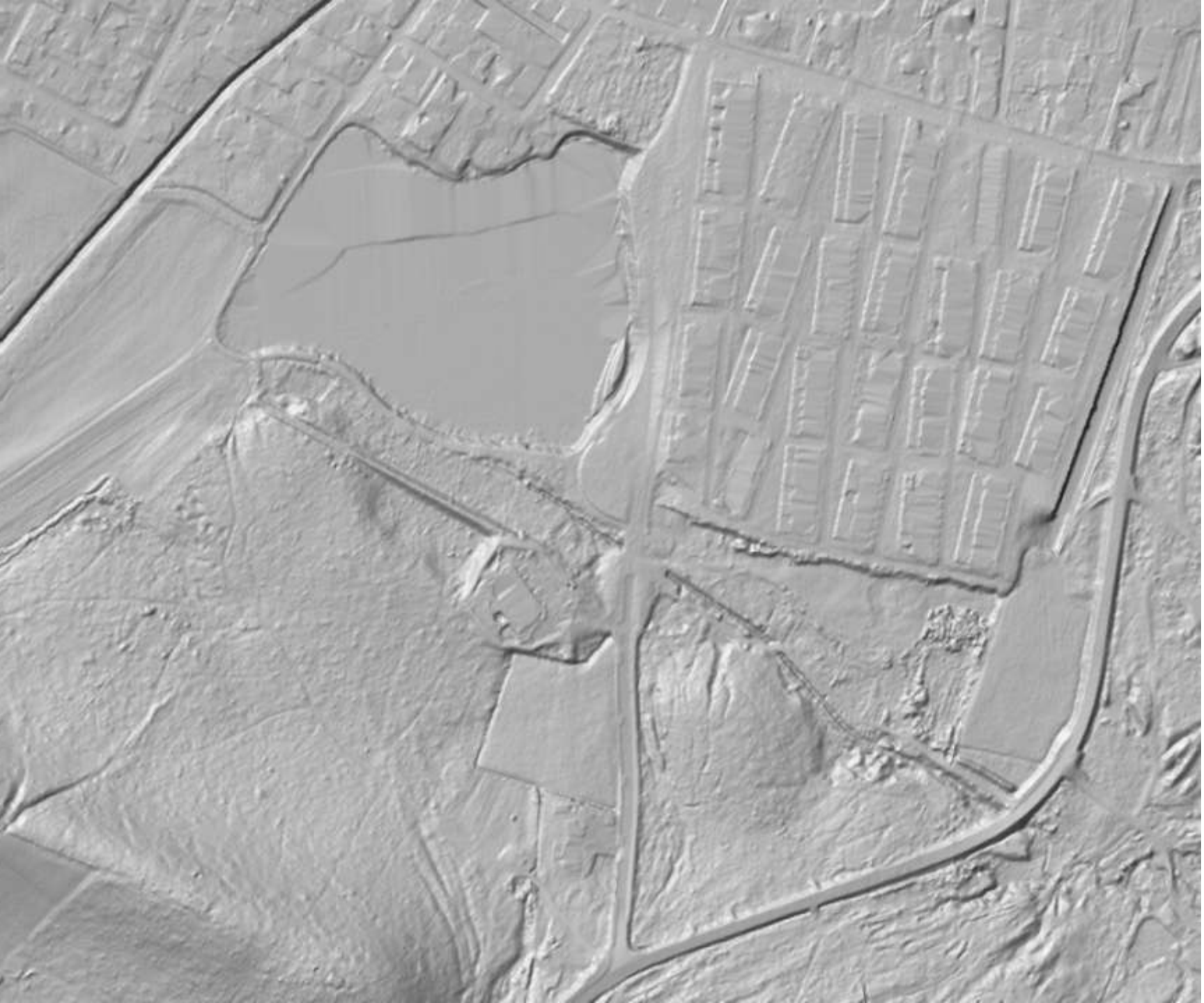
Comparison to existing data: roads, paths

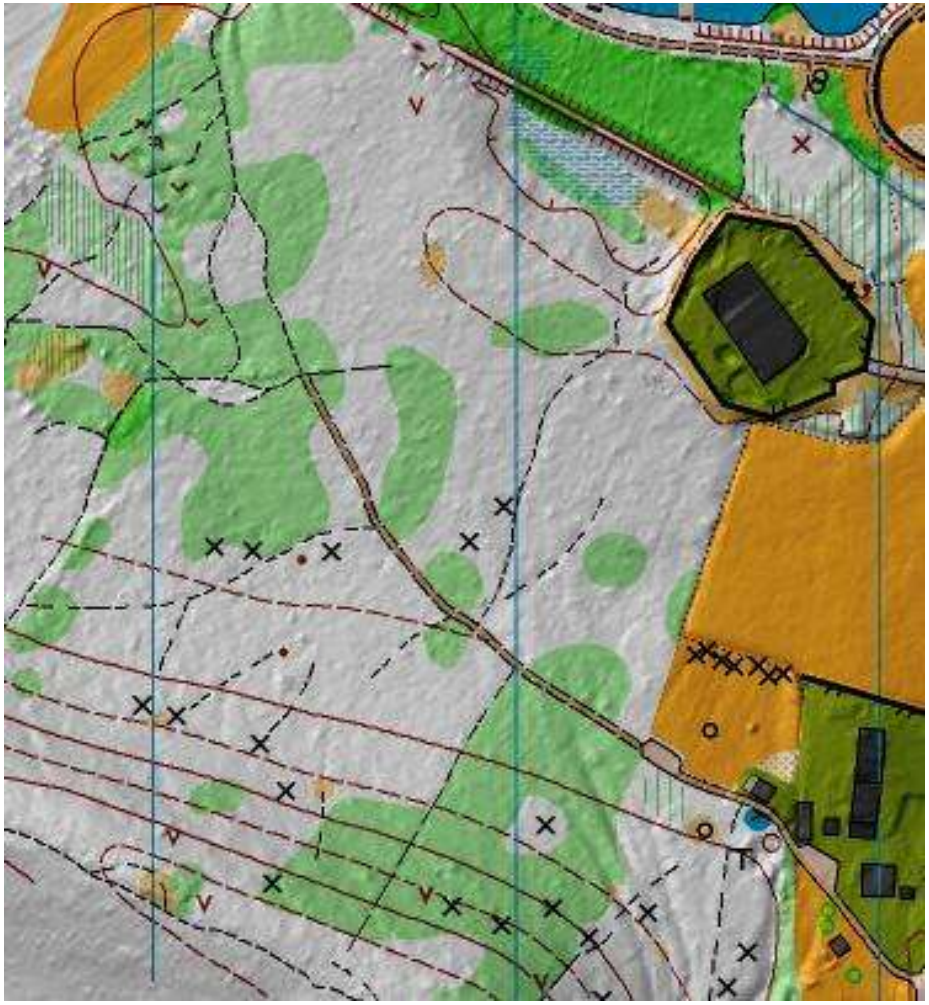


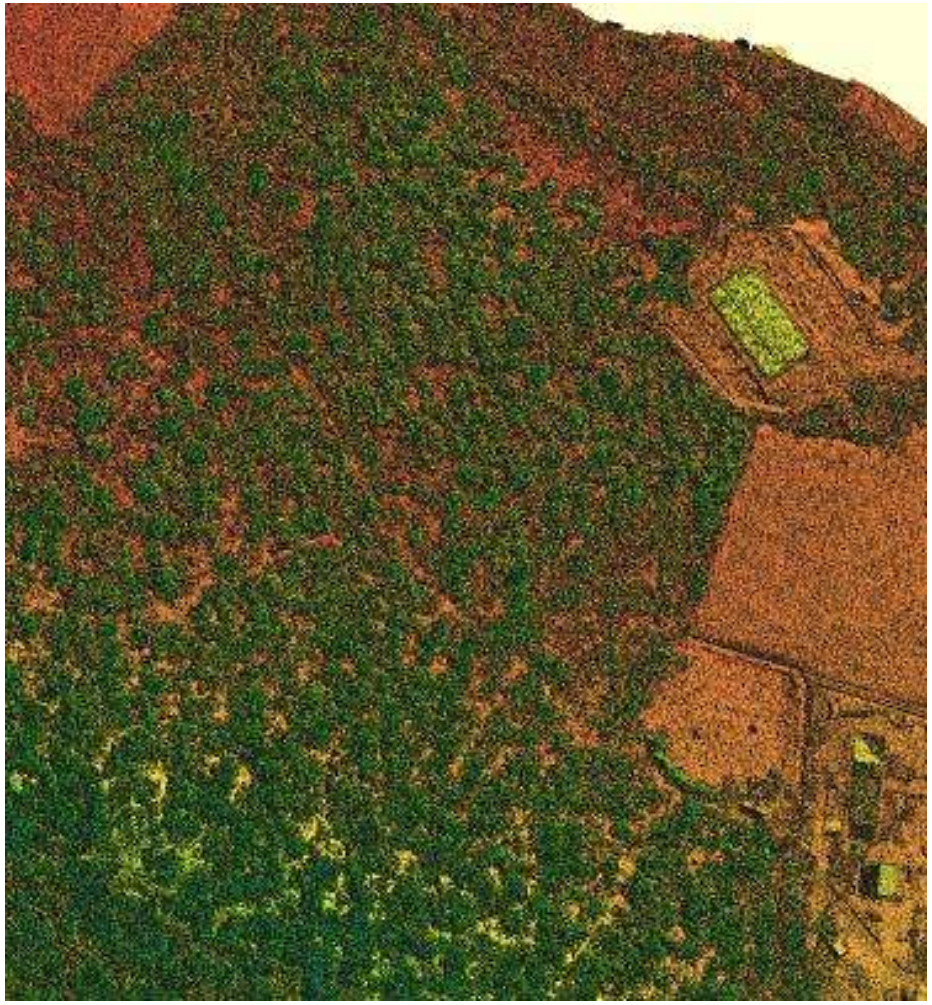
Maps made using LiDAR data



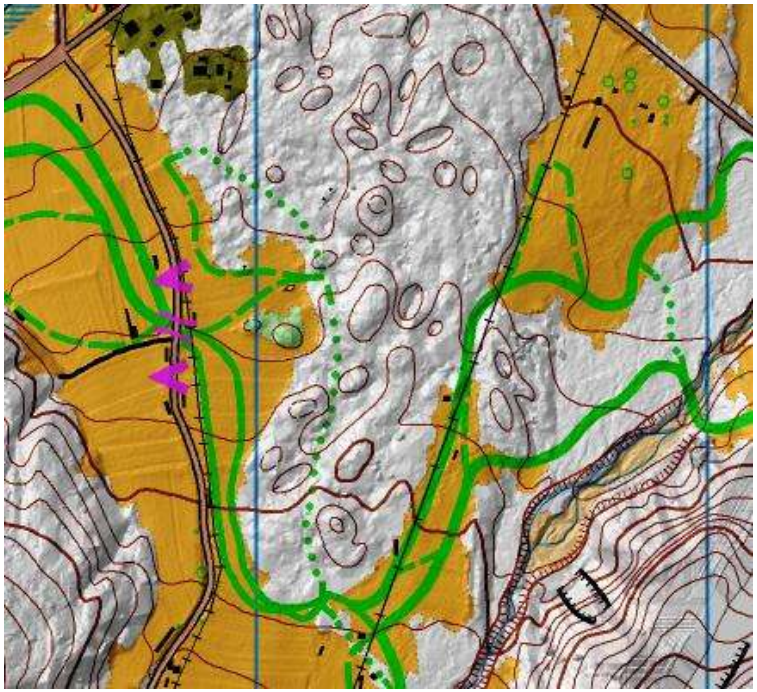


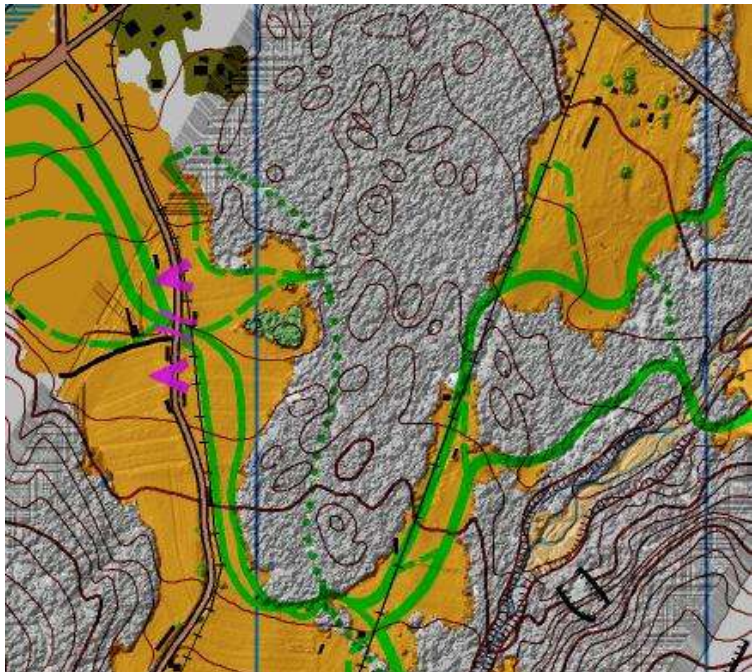




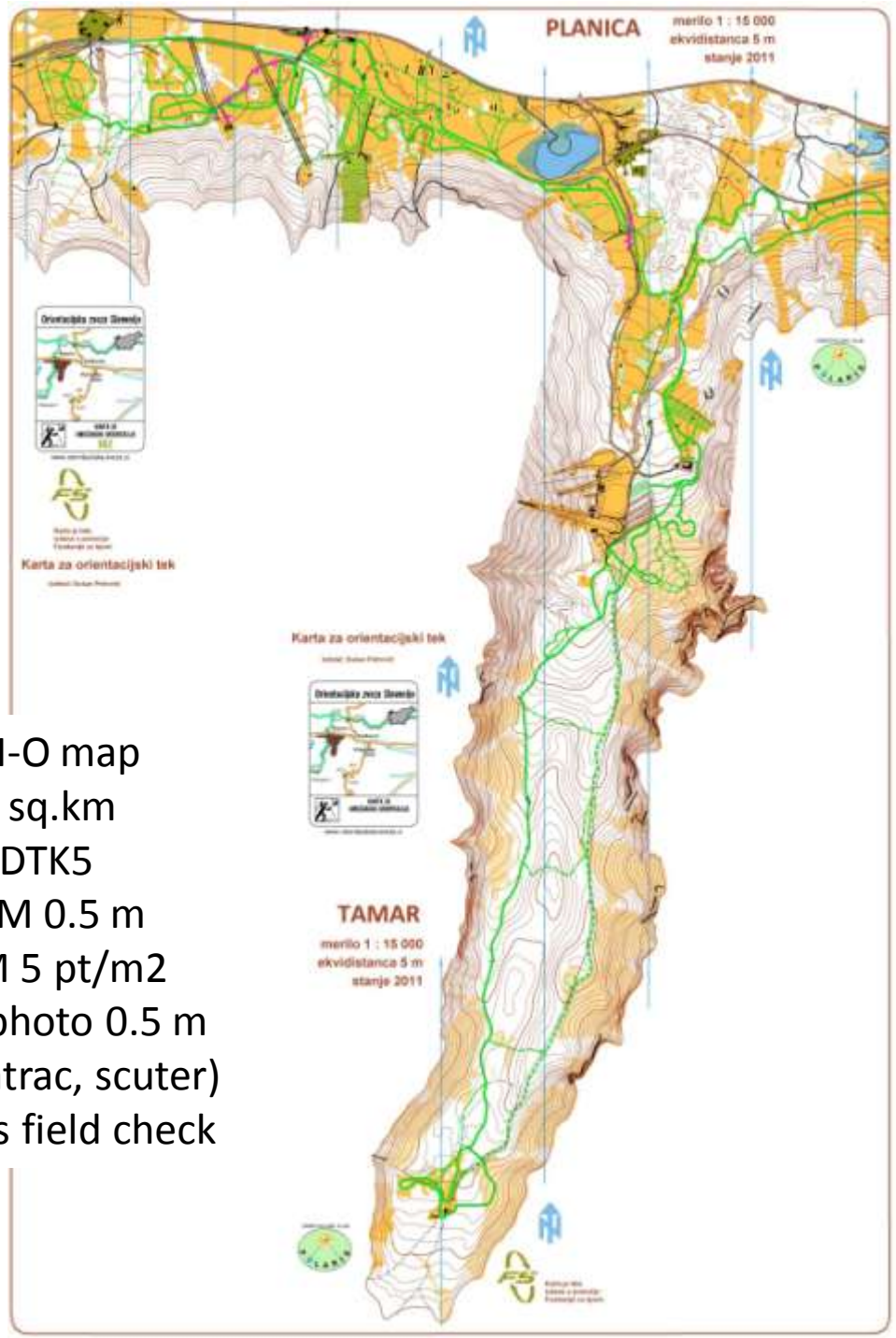


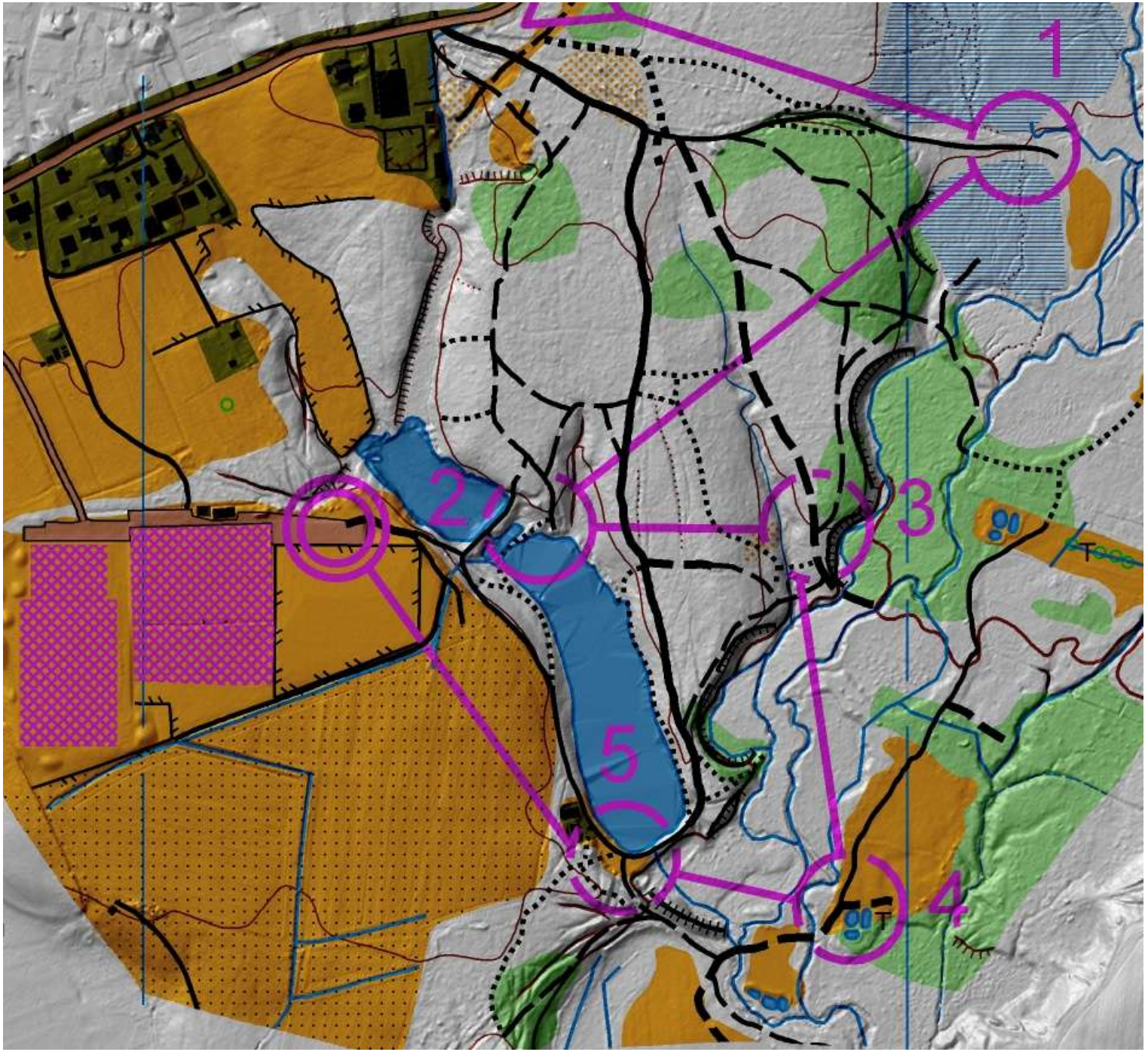
Sprint map (ISSOM)
DEM 0.5 m
50% time





SKI-O map
8 sq.km
DTK5
DEM 0.5 m
DSM 5 pt/m2
orthophoto 0.5 m
GPS (ratrac, scuter)
2 hours field check



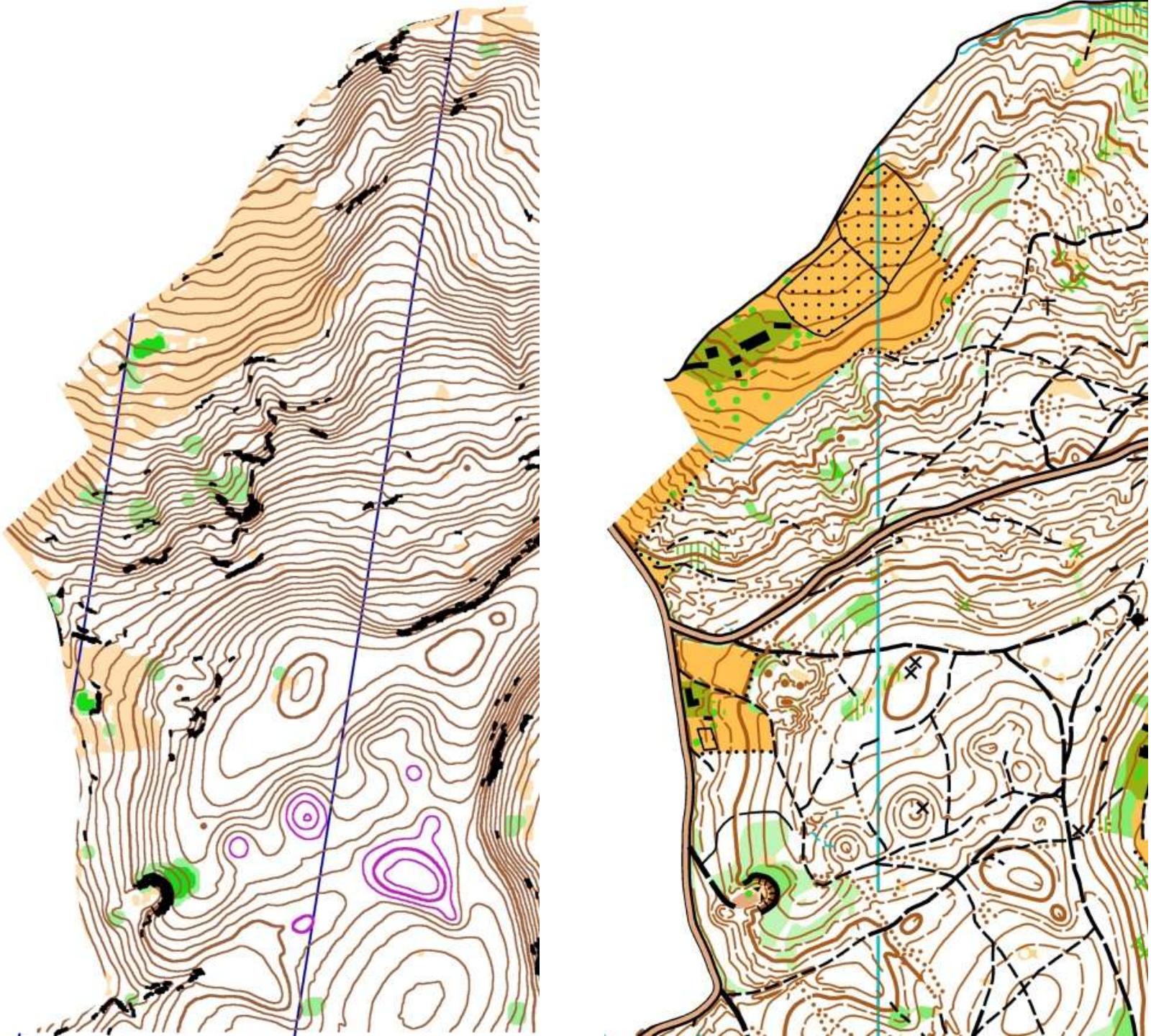


MTBO map
DEM 0.5
OP 0.1 m
(april)
2 hours
(tracks)

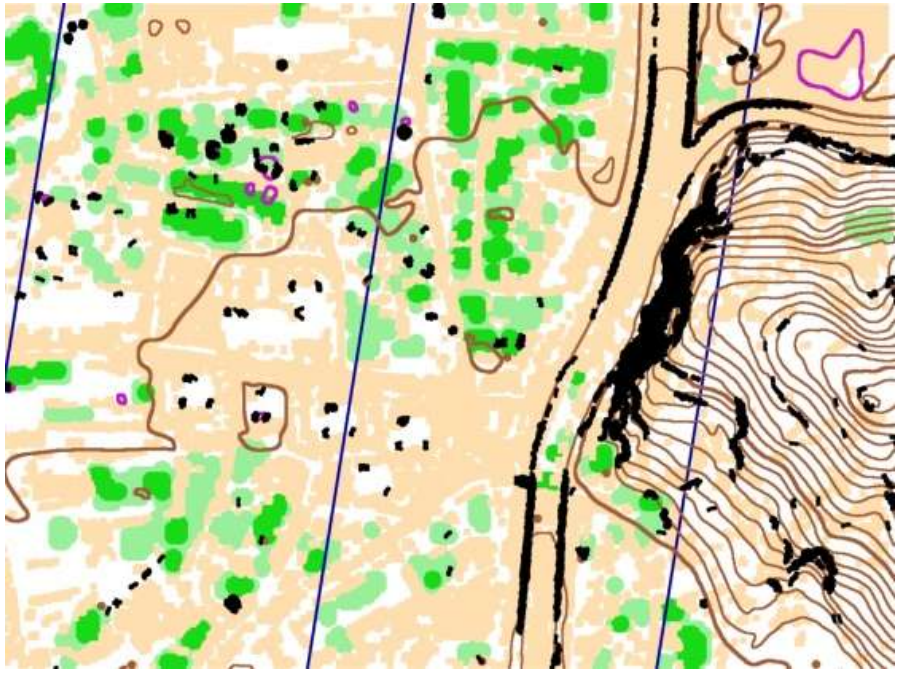
Automation in LiDAR data extraction:

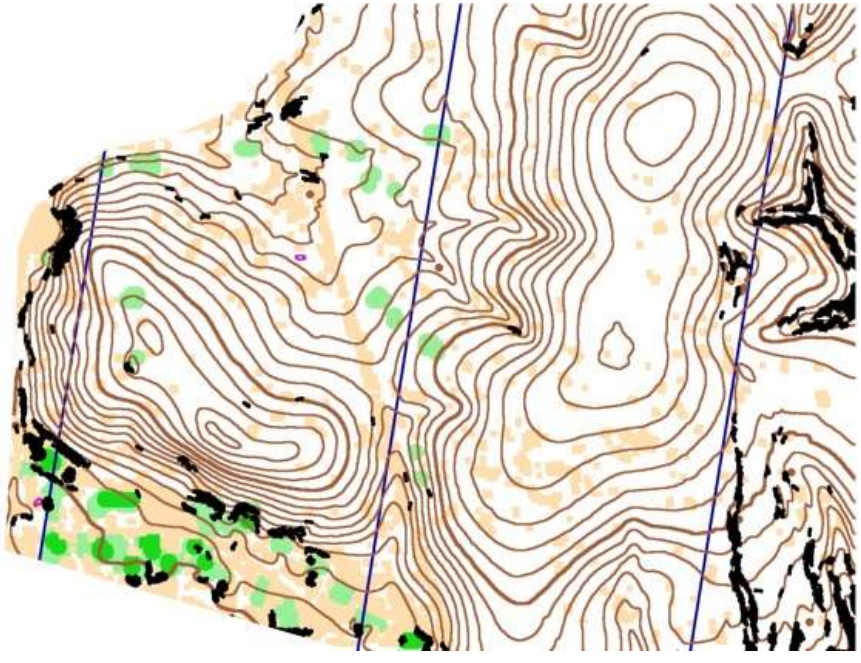
- contour lines,
- step areas (cliffs),
- vegetation height,
- relief objects (pits, knolls).

O-Laser ©, by Swedish Jarker Borman
Karttapullautin ©, by Finish Jarkko Ryyppo

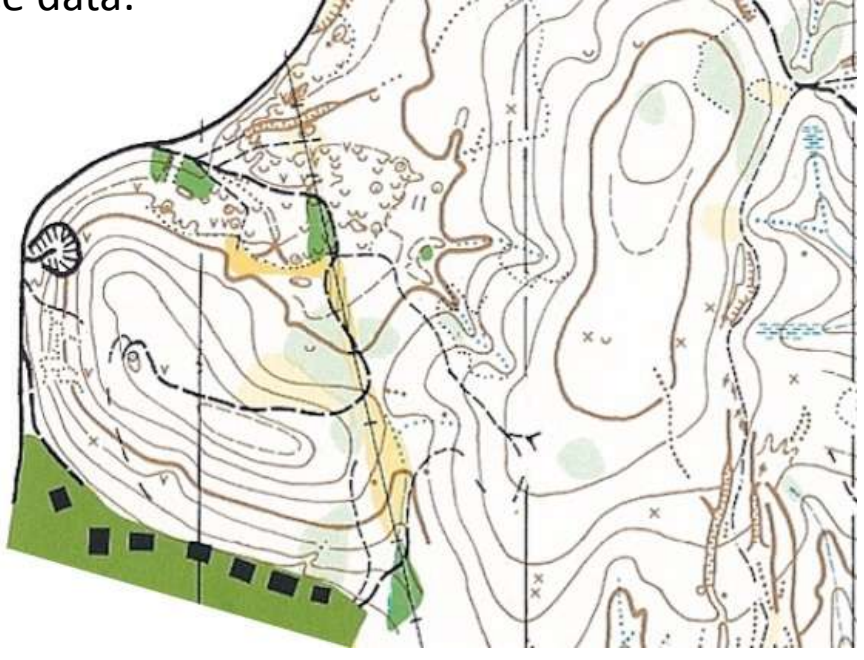


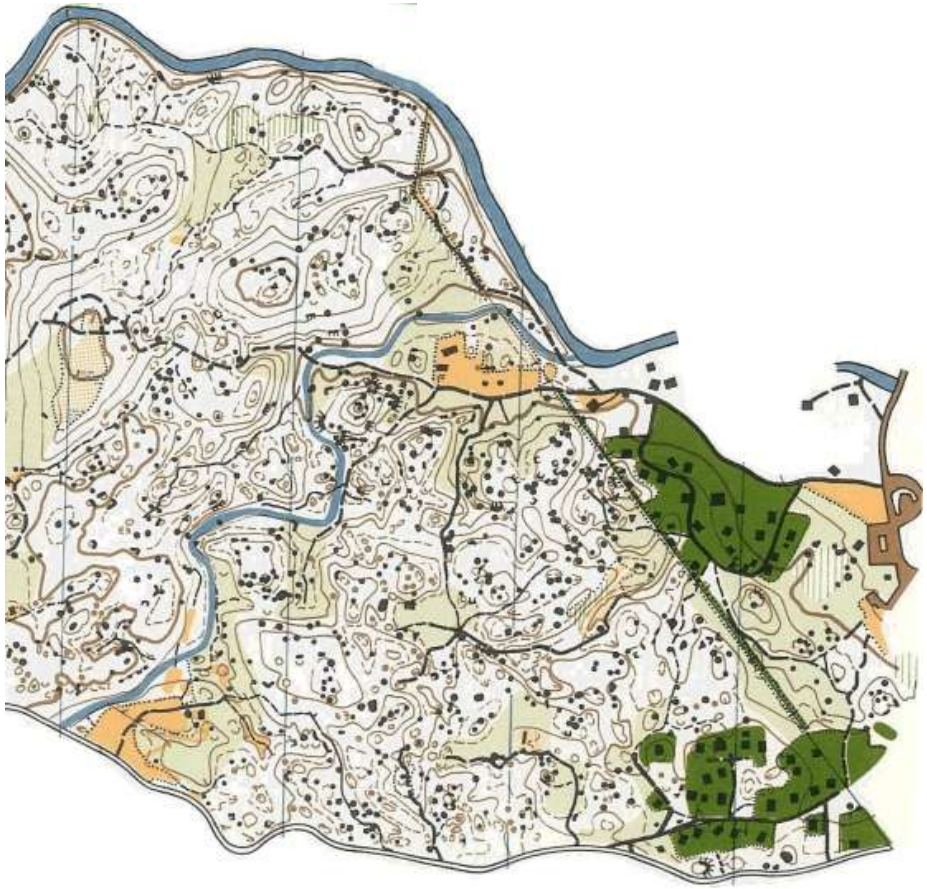
Source data:
LiDAR





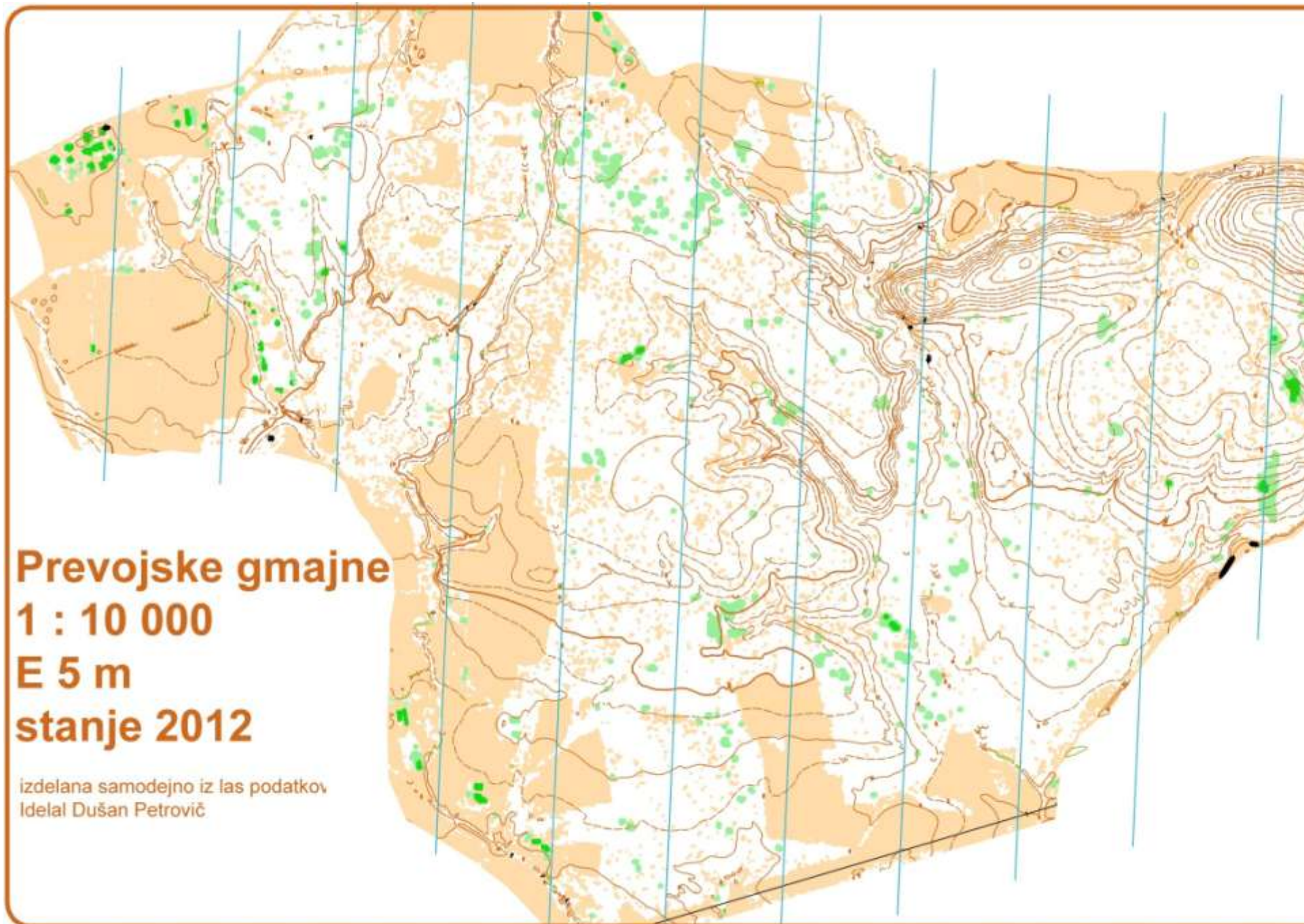
Source data:
TDB,
aerial



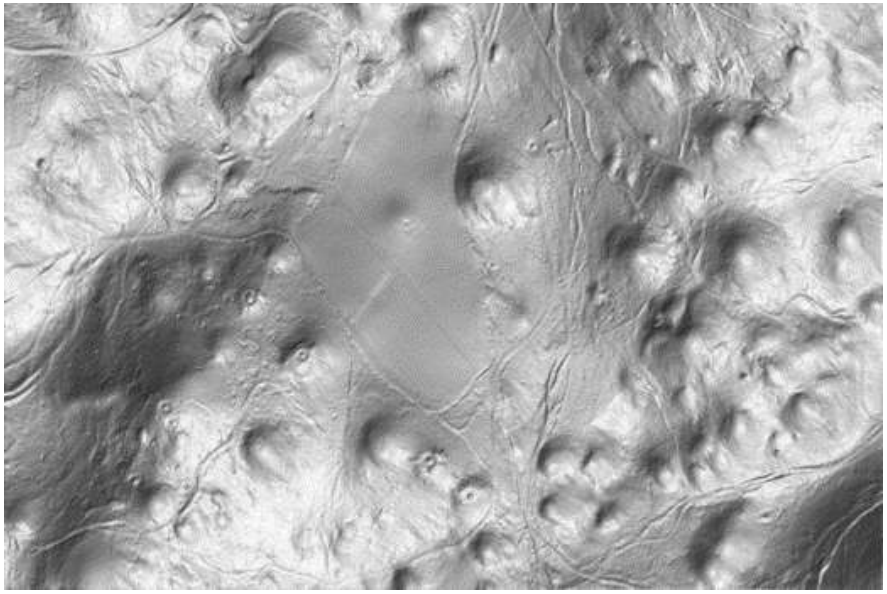


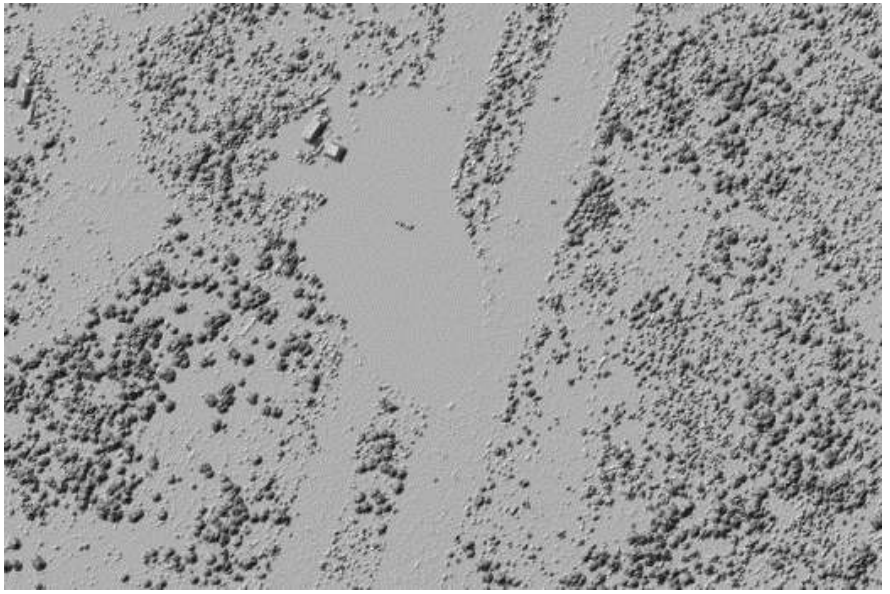
Source data: none, only field work

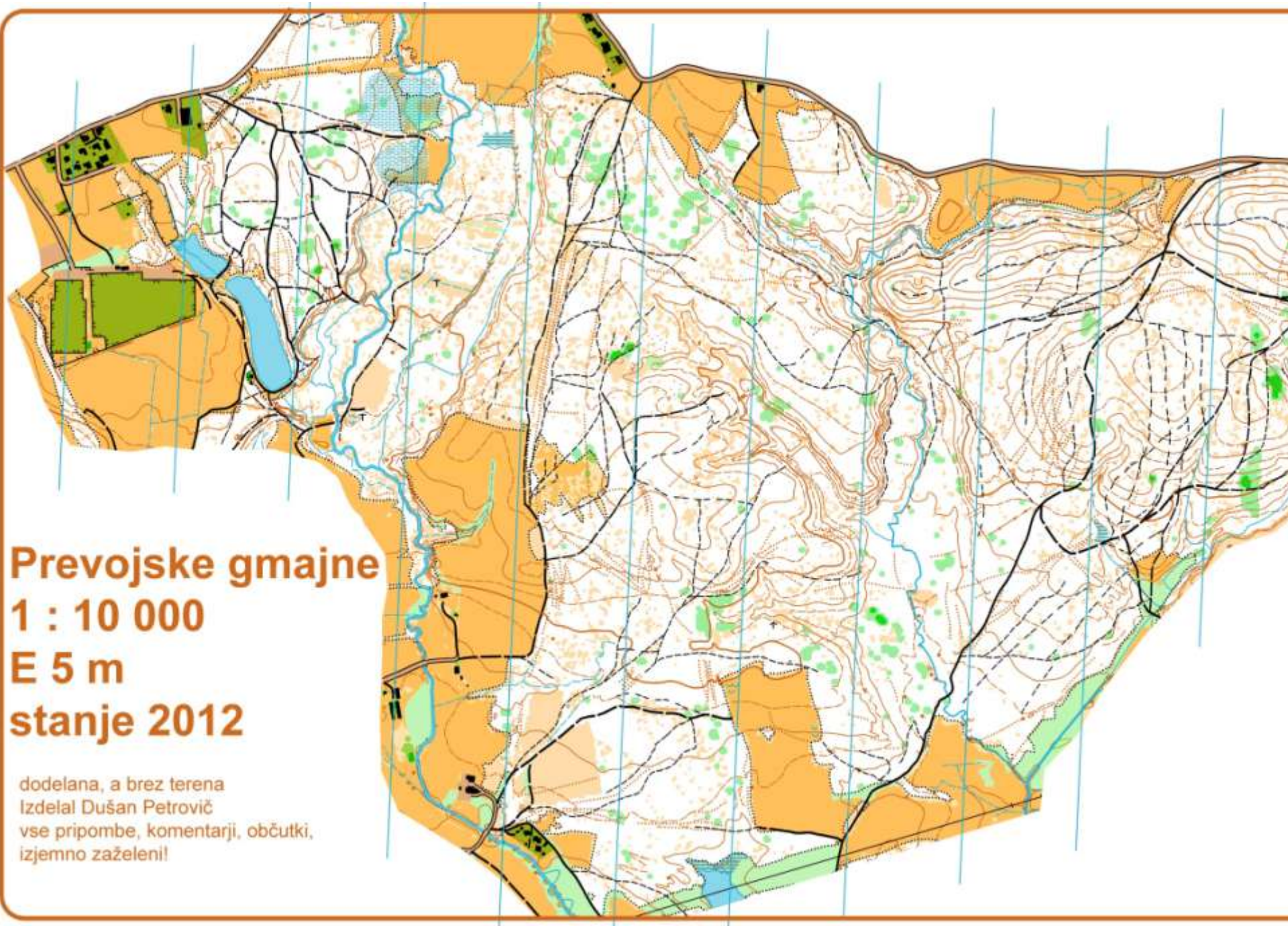
automatically created from LiDAR



Images for visual interpretation: ground relief shading, trees canopies, vegetation height and intensity (with OCAD11™)

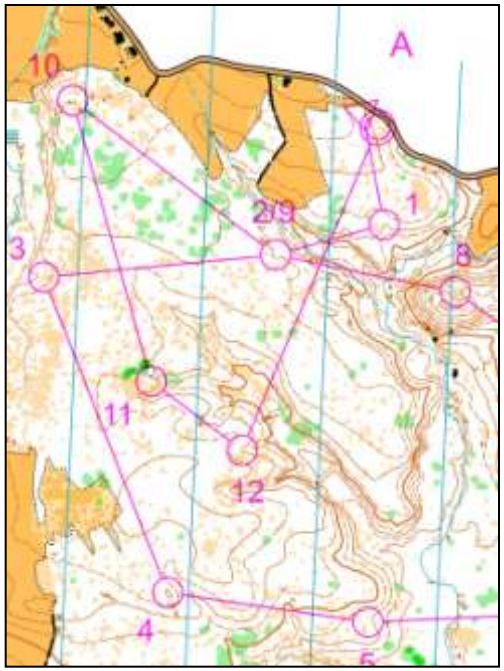


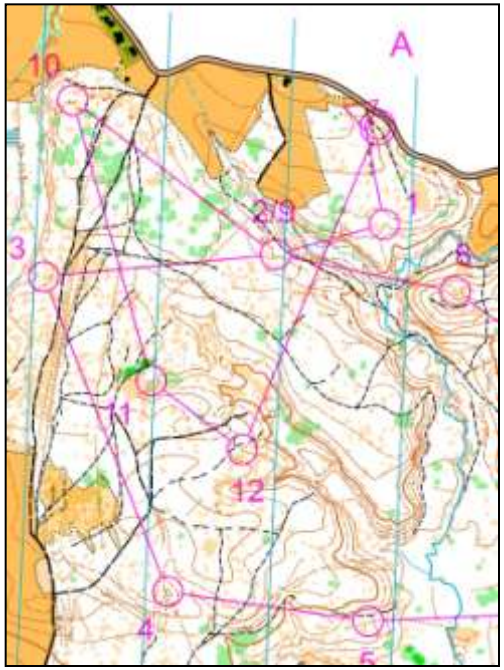


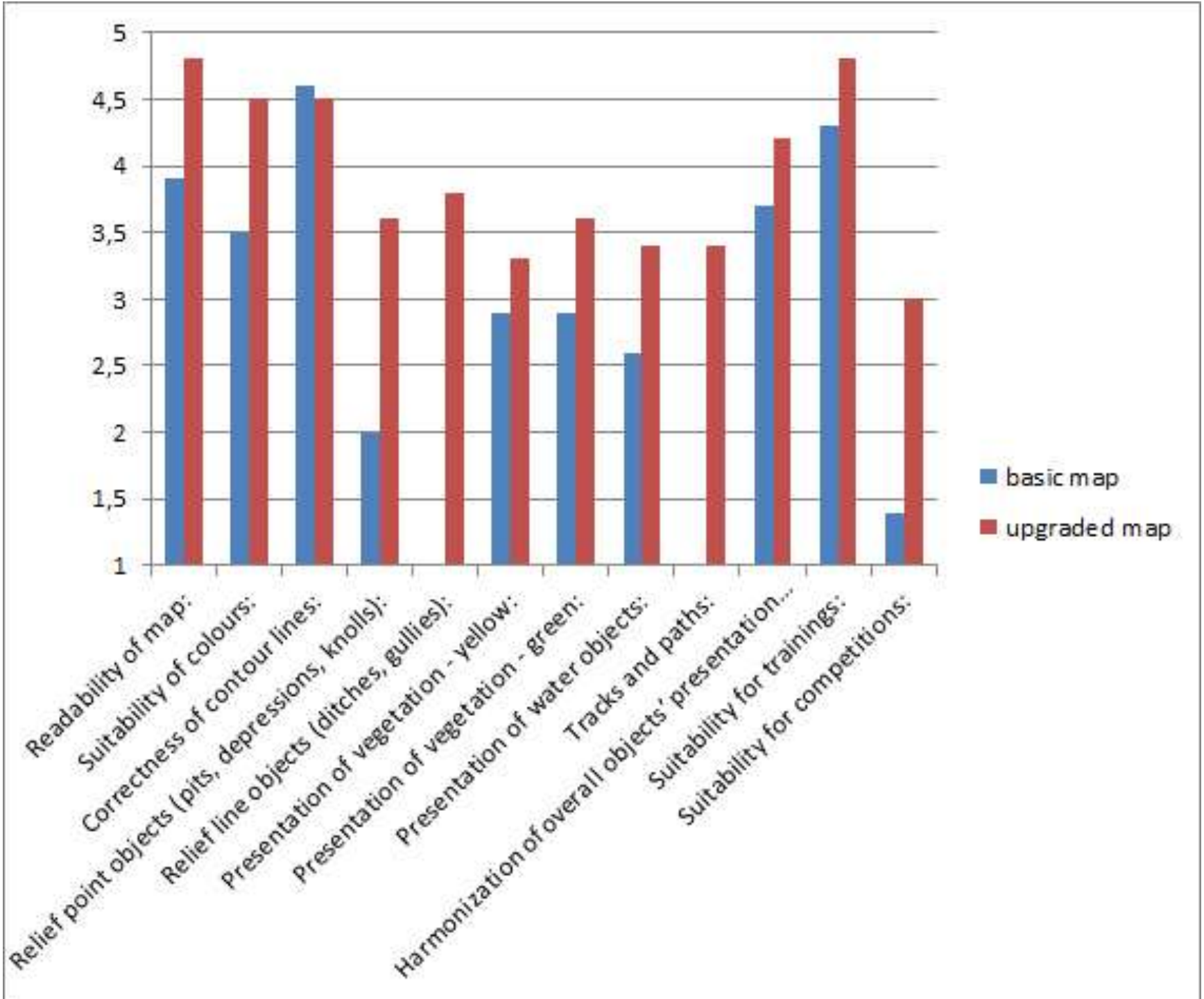

Prevojske gmajne
1 : 10 000
E 5 m
stanje 2012
dodelana, a brez terena
Izdelal Dušan Petrovič
vse pripombe, komentarji, občutki,
izjemno zaželeni!

Criteria	automated produced map		manually upgraded map	
	mean	stdev	mean	stdev
Readability of map	**3,9**	0,8	**4,8**	0,4
Suitability of colours	**3,5**	1	**4,5**	0,6
Correctness of contour lines	**4,6**	0,5	**4,5**	0,6
Relief point objects (pits, depressions, knolls)	**2**	0,8	**3,6**	1,4
Relief line objects (ditches, gullies)			**3,8**	1
Presentation of vegetation - yellow	**2,9**	0,6	**3,3**	1,1
Presentation of vegetation - green	**2,9**	0,8	**3,6**	0,8
Presentation of water objects	**2,6**	0,8	**3,4**	1,3
Tracks and paths			**3,4**	0,7
Harmonization of overall objects' presentation (generalization, mapping criteria)	**3,7**	0,6	**4,2**	0,8
Suitability for trainings	**4,3**	1	**4,8**	0,6
Suitability for competitions	**1,4**	0,7	**3**	1,3

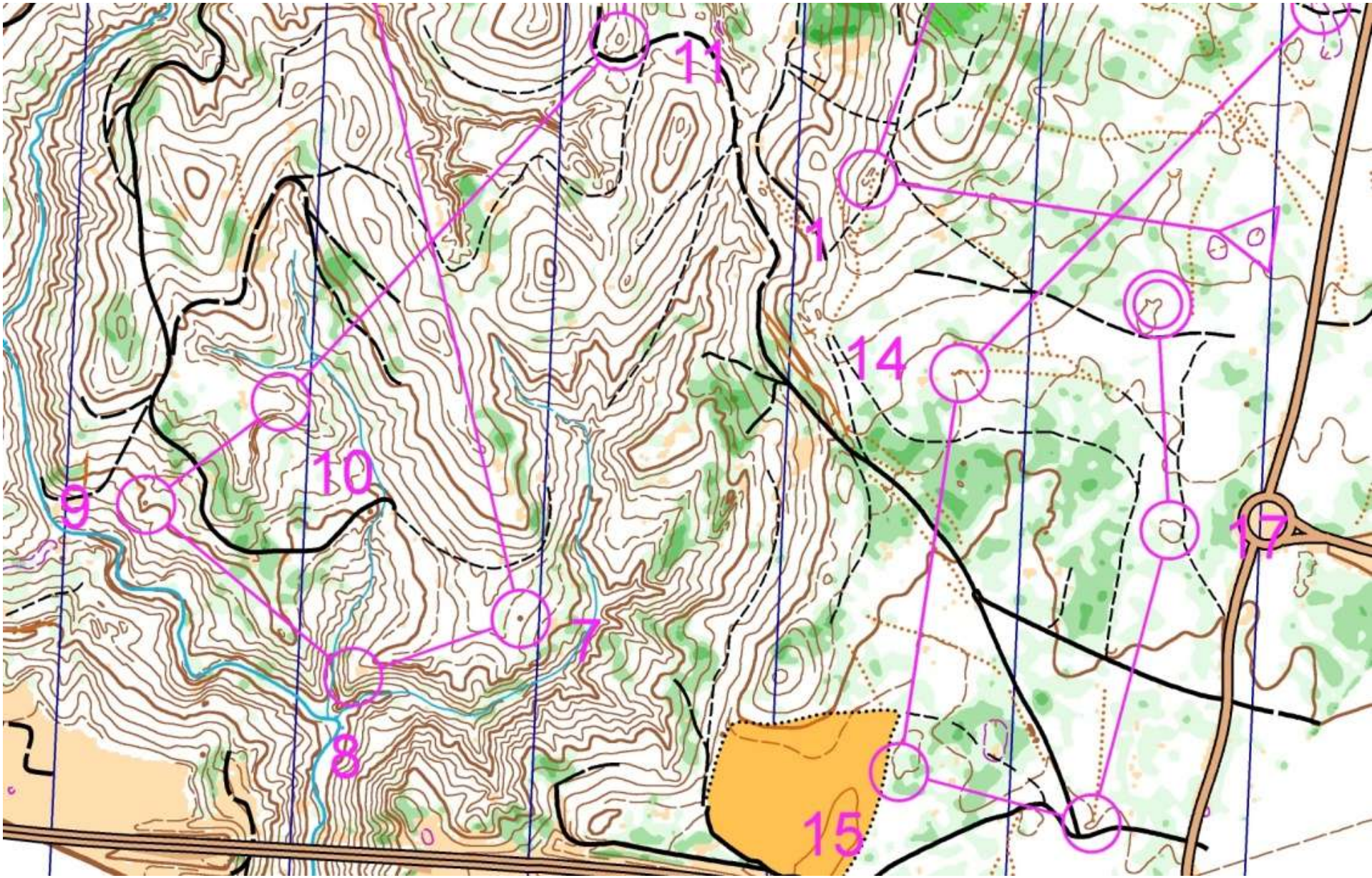
20 participants 8 answers 14 answers

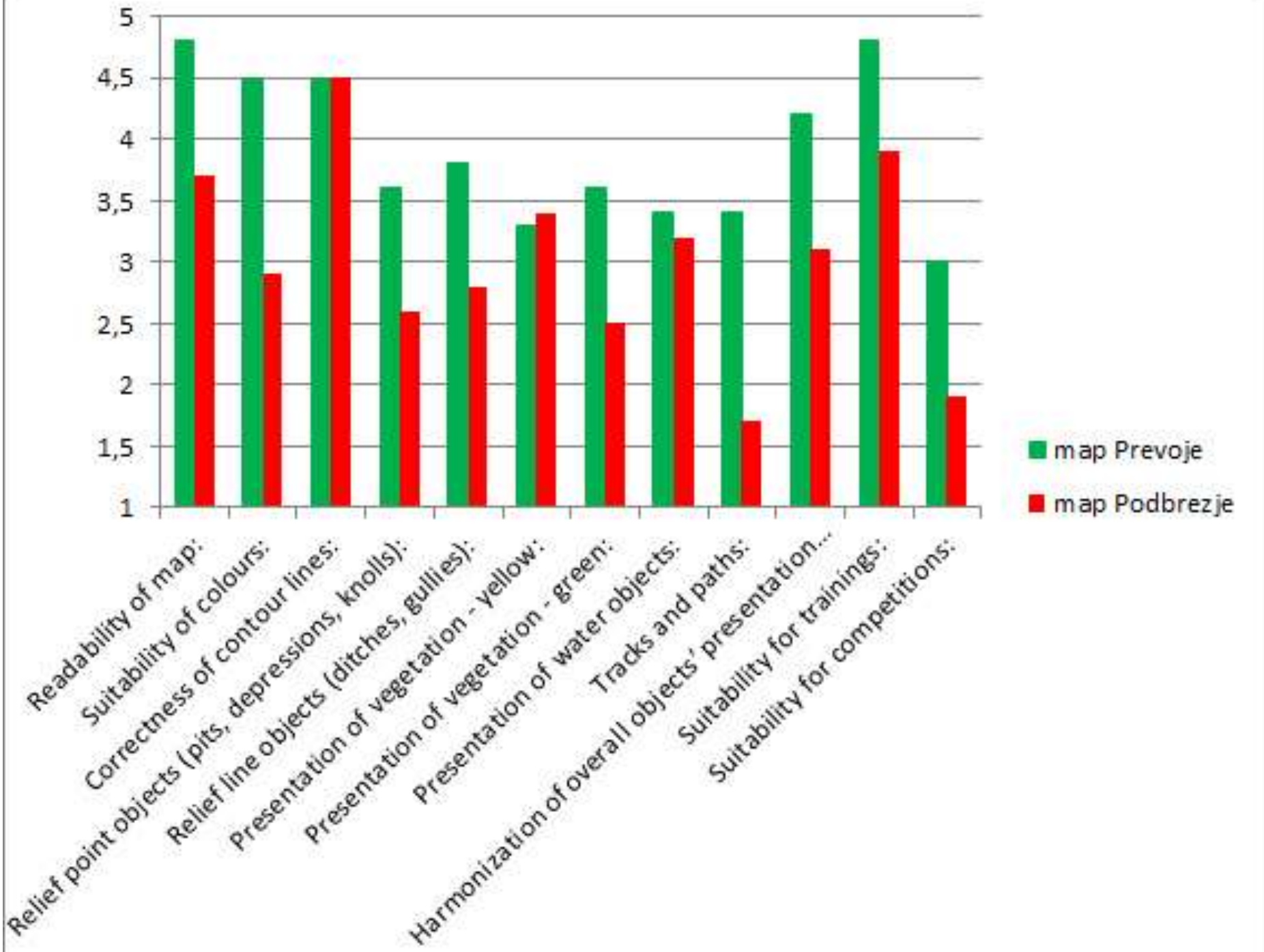




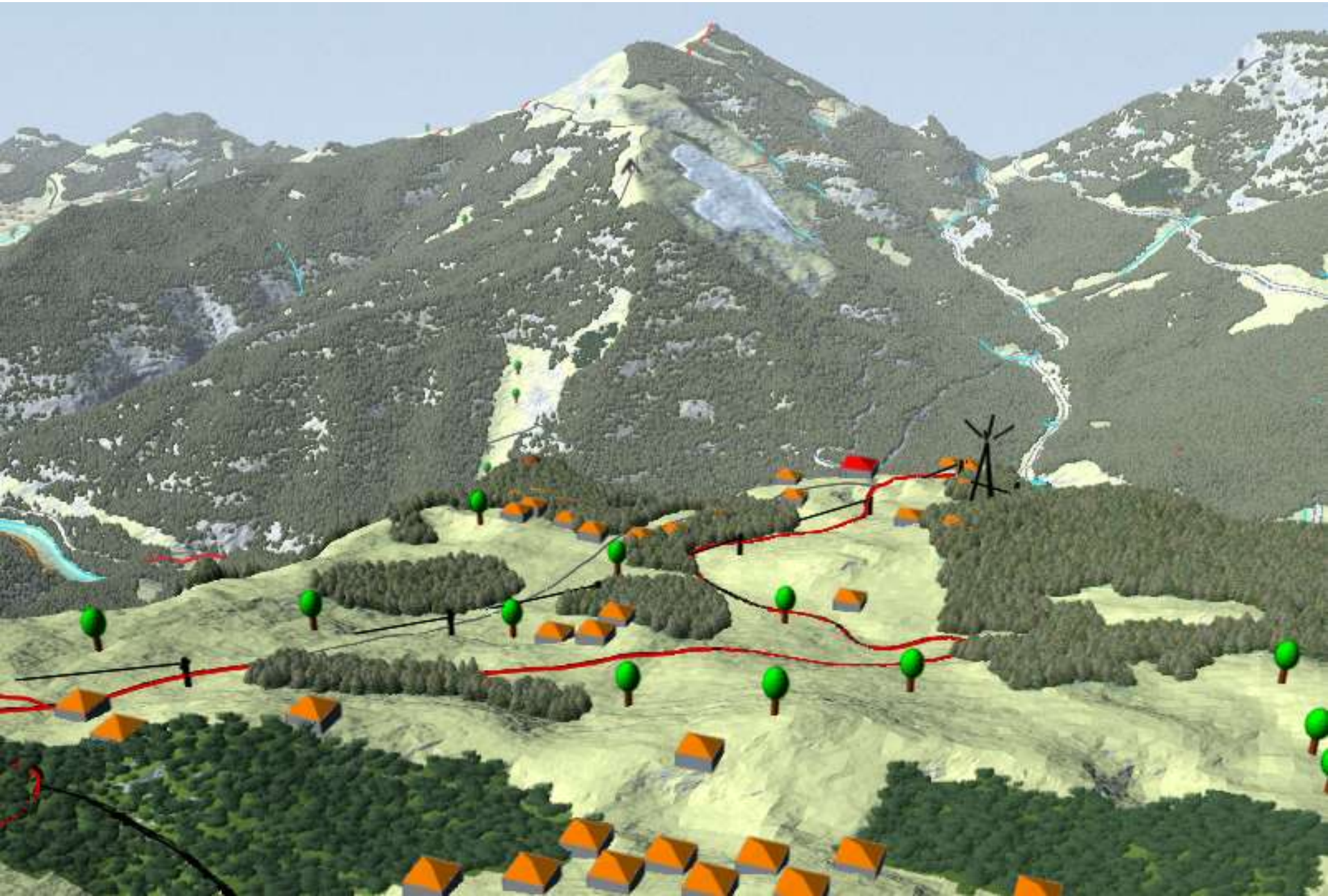

5
4,5
4
3,5
3
2,5
2
1,5
1
basic map
upgraded map
Readability of map:
Suitability of colours:
Correctness of contour lines:
Relief point objects (pits, depressions, knolls):
Relief line objects (ditches, gullies):
Presentation of vegetation - yellow:
Presentation of vegetation - green:
Presentation of water objects:
Tracks and paths:
Harmonization of overall objects' presentation...
Suitability for trainings:
Suitability for competitions:

Map “Podbrezje”, semi-automatically created from LiDAR and national topographic database with additional minimal manual visual interpretation and capturing




5
4,5
4
3,5
3
2,5
2
1,5
1
Readability of map:
Suitability of colours:
Correctness of contour lines:
Relief point objects (pits, depressions, knolls):
Relief line objects (ditches, gullies):
Presentation of vegetation - yellow:
Presentation of vegetation - green:
Presentation of water objects:
Tracks and paths:
Presentation of overall objects' presentation...
Harmonization of overall objects:
Suitability for trainings:
Suitability for competitions:
map Prevoje
map Podbrezje

3D maps



Abstract – cartographically oriented 3D map

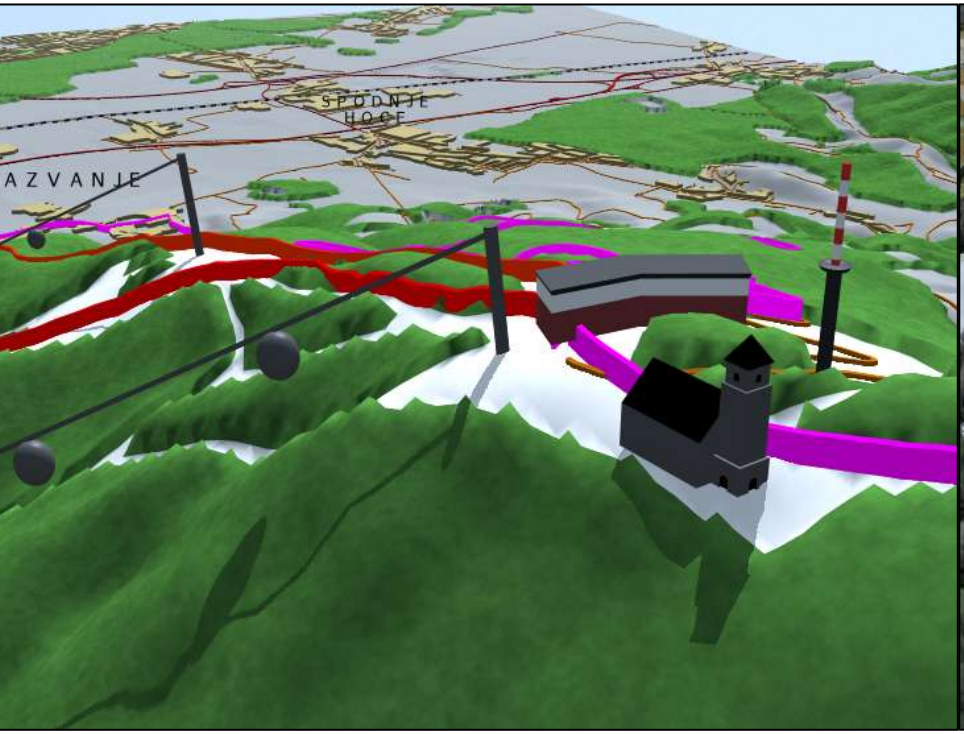
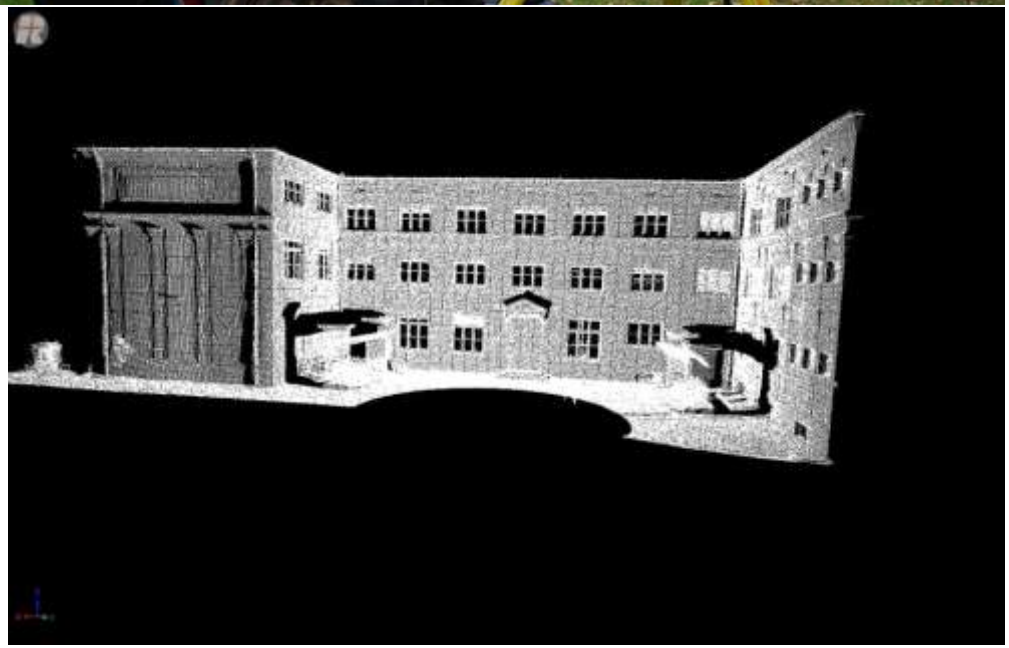
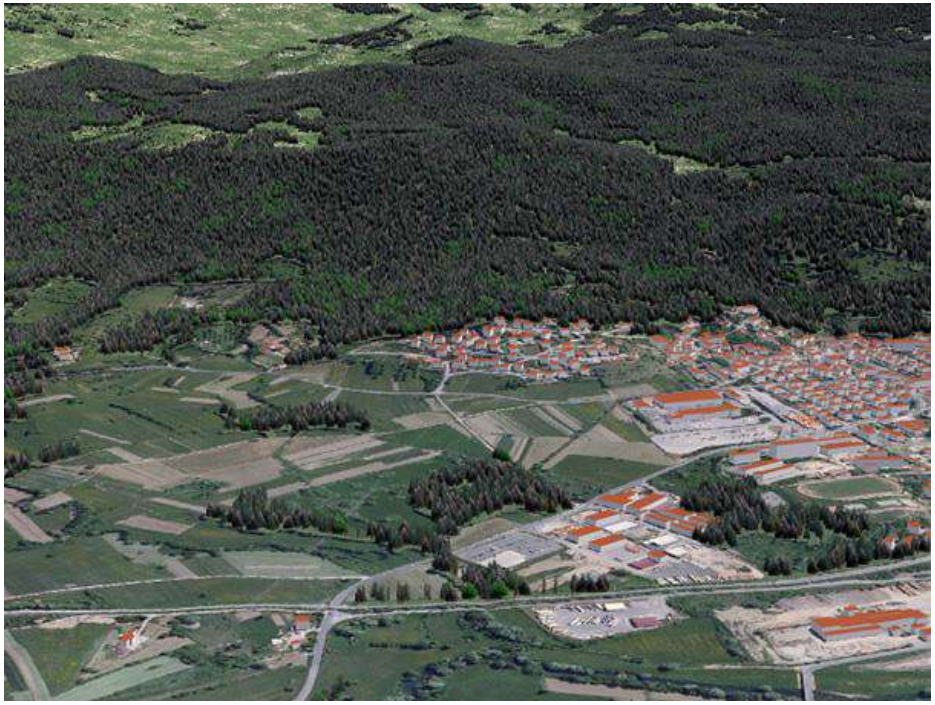


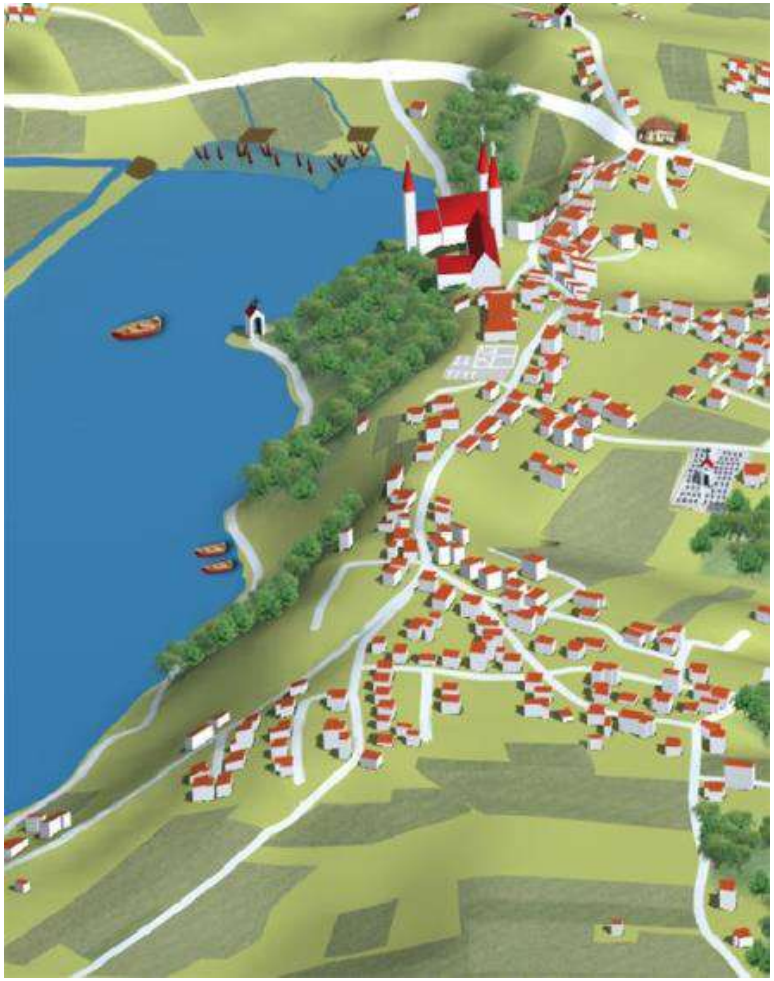
Photo-realistic 3D map

Use of terrestrial laser scanning



Use of terrestrial laser scanning





Mapping „hidden“ areas

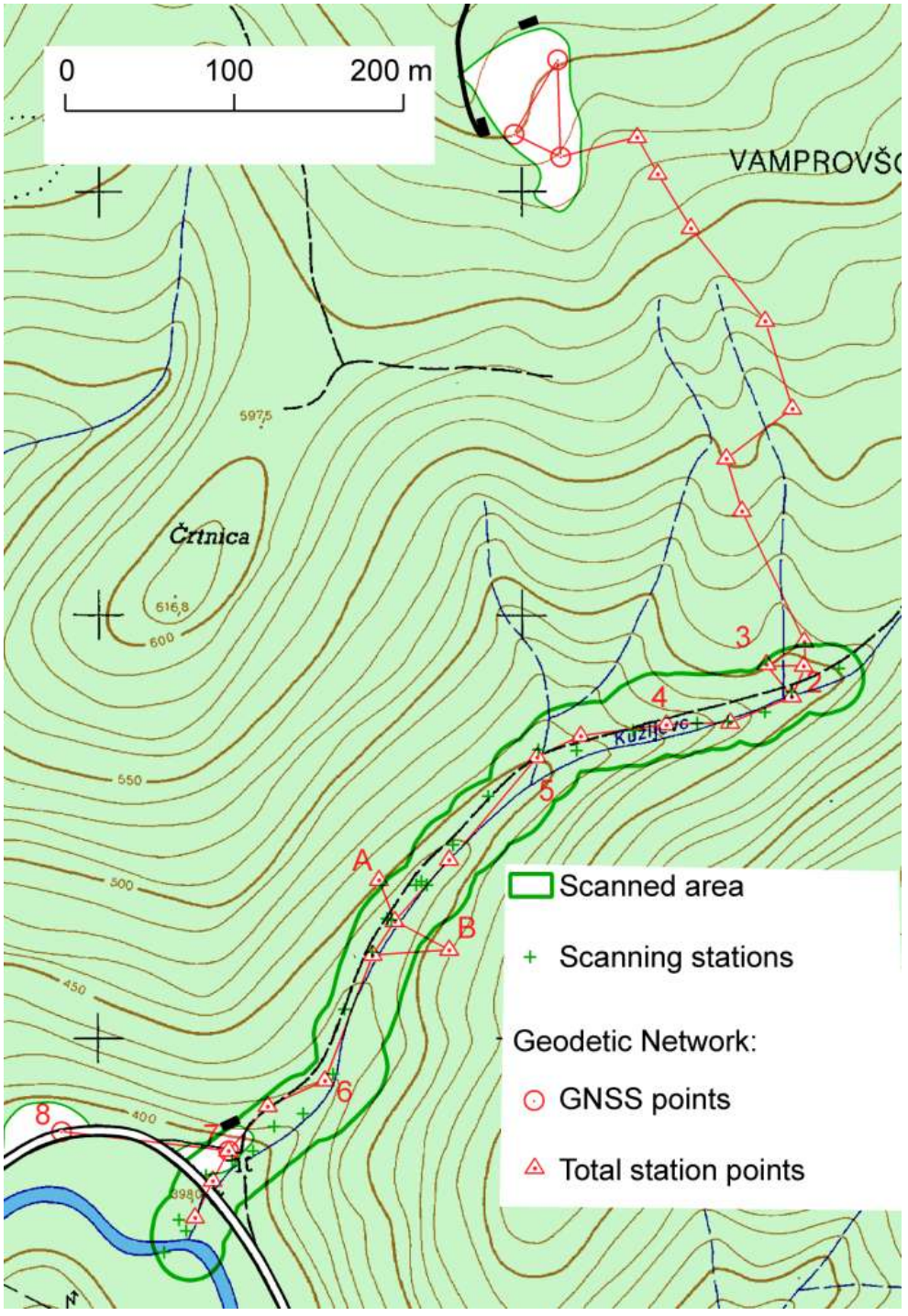
European Alpine Space project SedAlp "Sediment management in Alpine basins: integrating sediment continuum, risk mitigation and hydropower" (2012-2015)

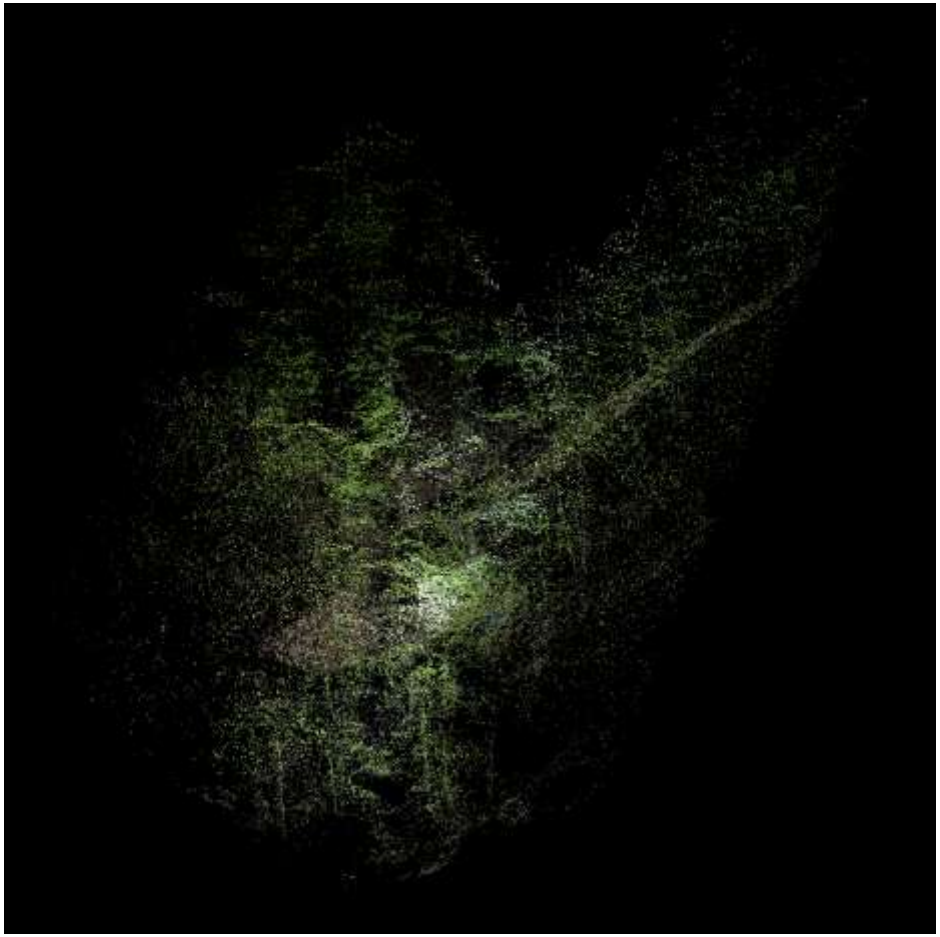
- estimate large wood (LW) recruitment potential in torrential watersheds,
- describe the interactions of wood and torrential sediments in a cascading forested torrential channel

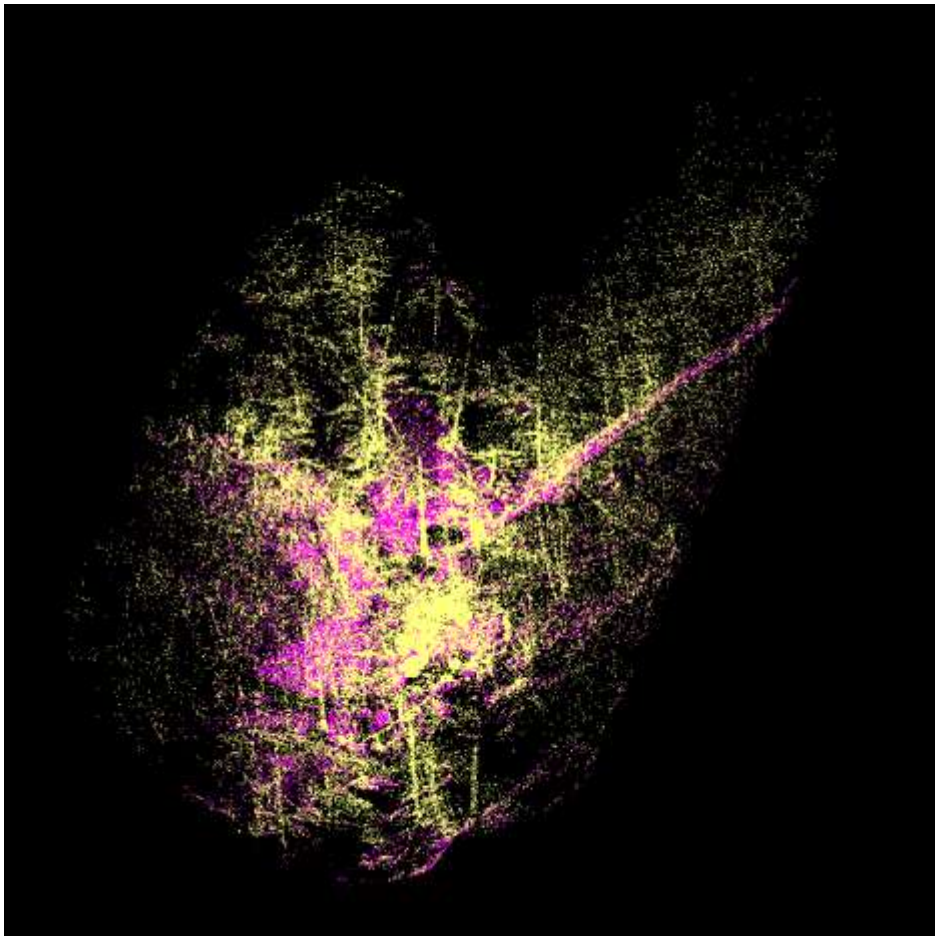
- the Kuzlovec Torrent in the Gradaščica watershed in central Slovenia
- TLS measurements covered the lower reach of the torrent with the longitudinal slope of the torrential channel of ~18% and with hillslopes of ~30°

- demanding field conditions in the torrent: steep slopes, occluded sights, varying temperature, step-pool sequences, rocks and boulders, large wood etc.

- TLS at 29 scan stations distributed along the torrent
- Resolution of scanning 4 – 8 cm on 50 m distance
- relative accuracy σ = 1.5 cm
- Georeferencing in the national coordinate system:
  - tie points were included in a polygon measured with total station
  - the coordinates of endpoints of the polygon were measured with GNSS
  - The absolute accuracy of the point cloud: σ = 3.5 cm





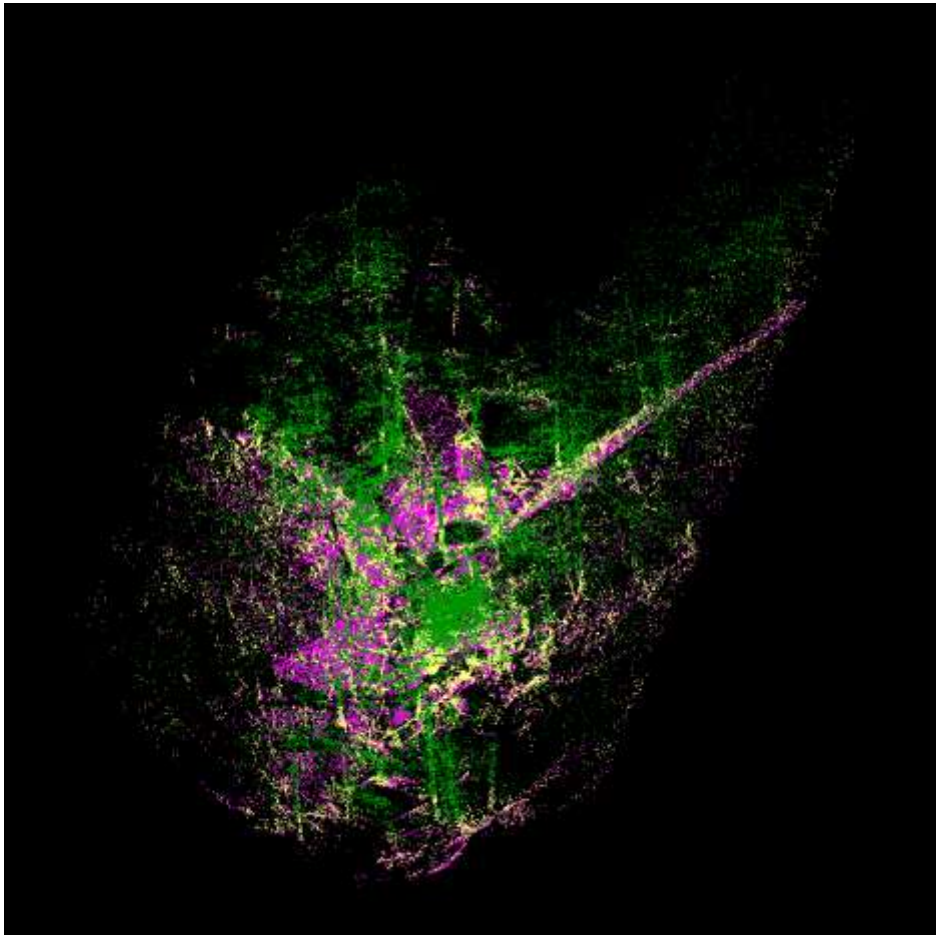


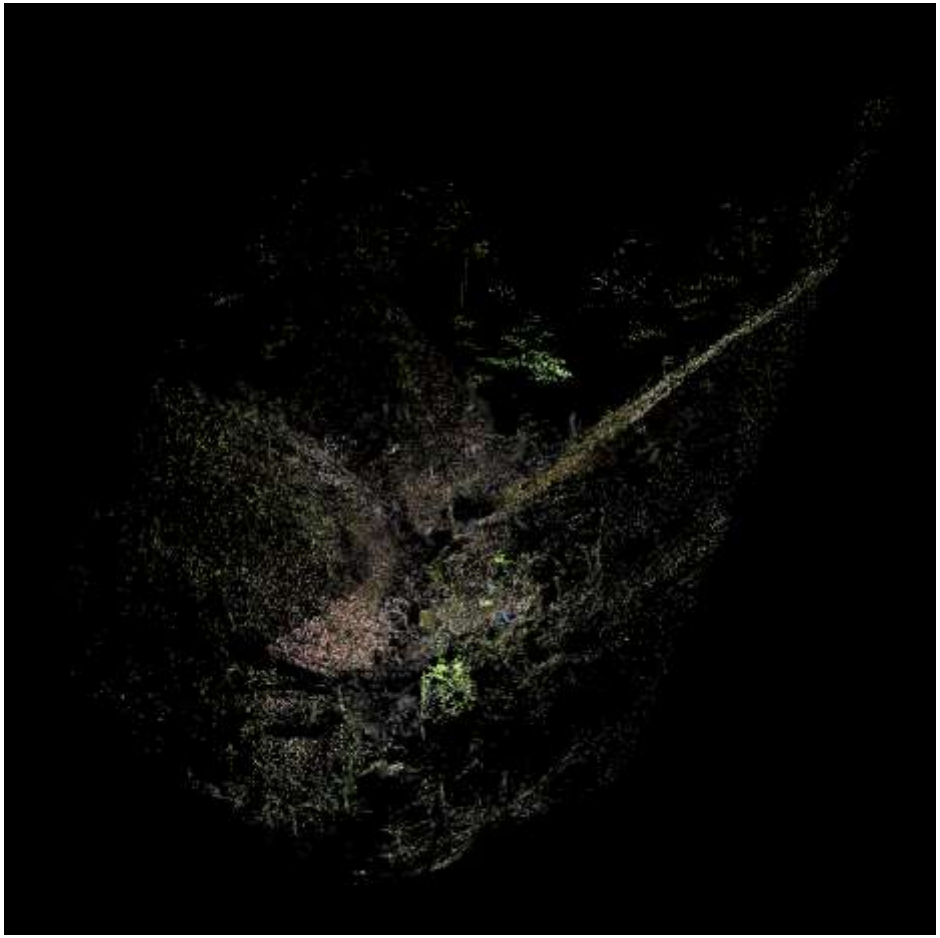
- RISCAN PRO: filtering the point cloud
- LAStools: classification to the ground and non-ground points

DEM creation

RISCAN PRO: merging sectors;

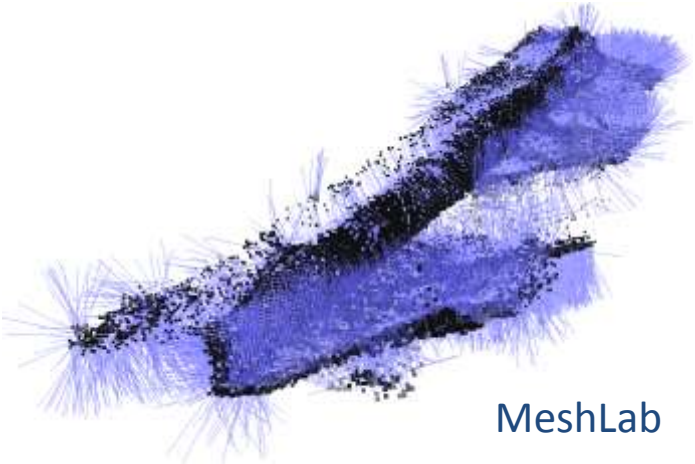
las2dem: interpolation DEM 0.05 m



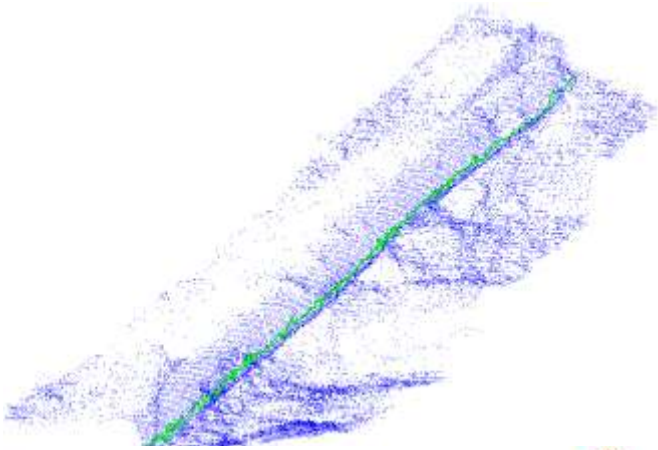


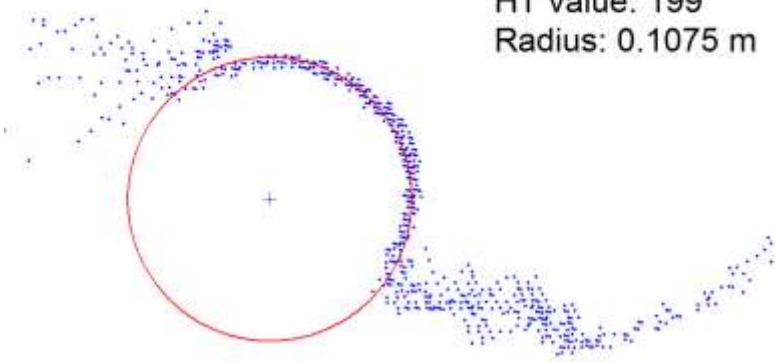
- lacclassify: classification of the point cloud
- RISCAN PRO: large wood identification

Modelling large wood



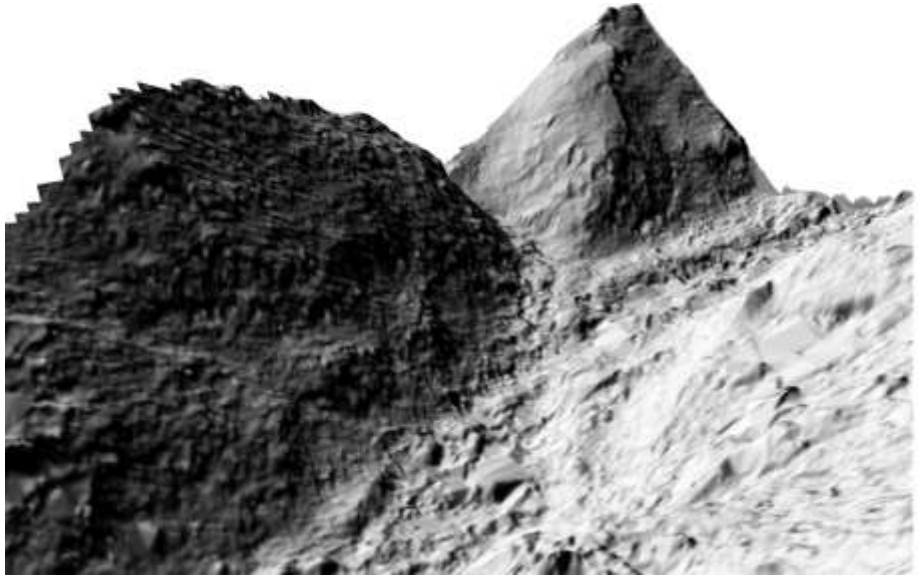
MeshLab

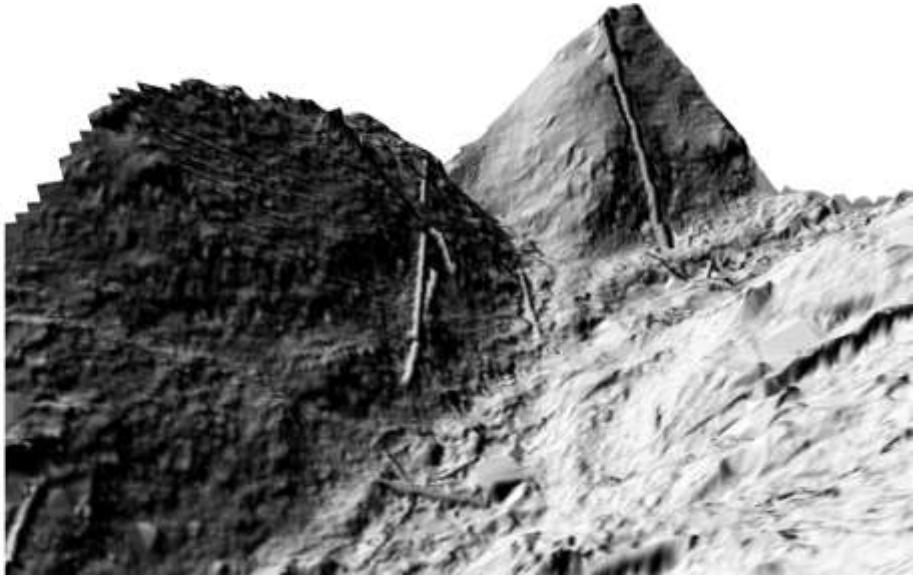


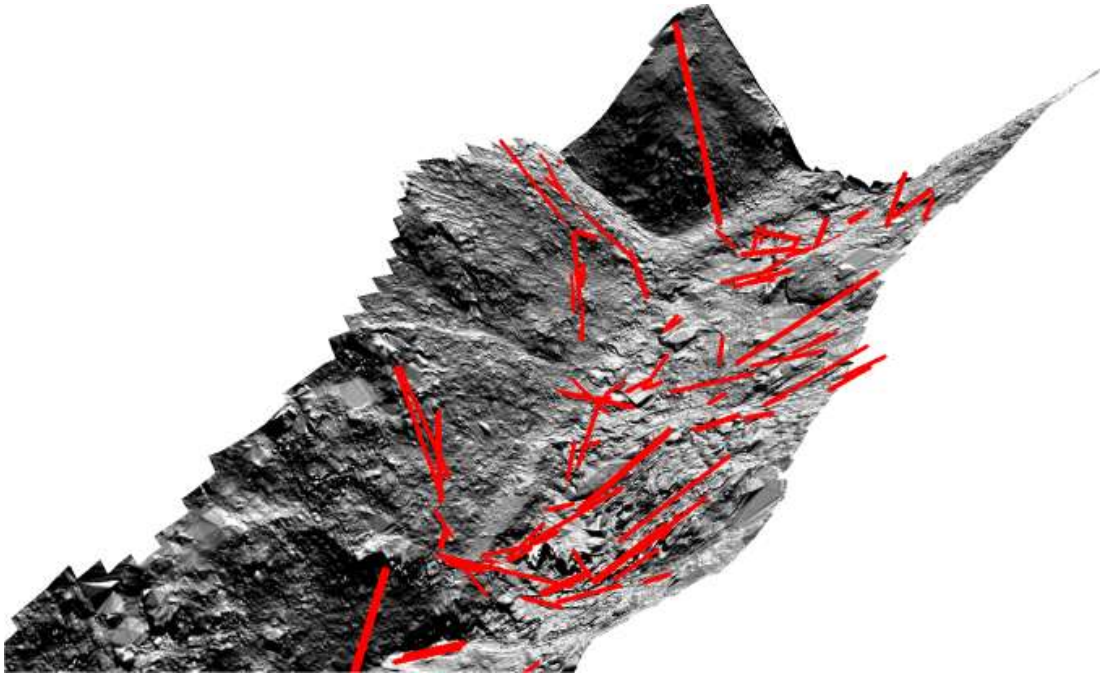


Matlab

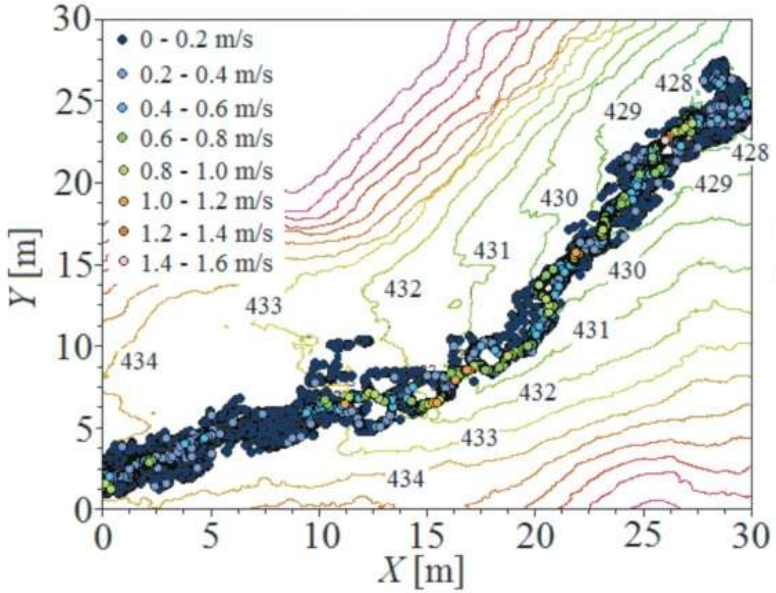
DEM / DEM with large wood

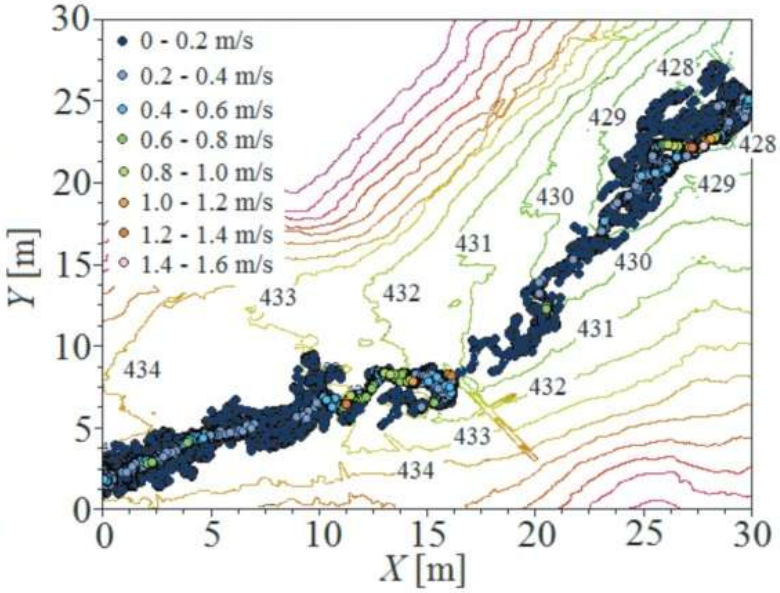


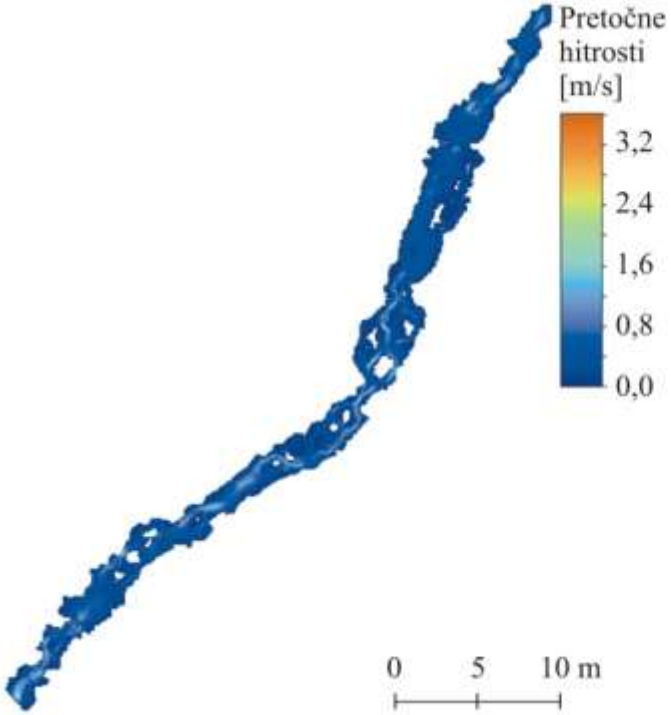


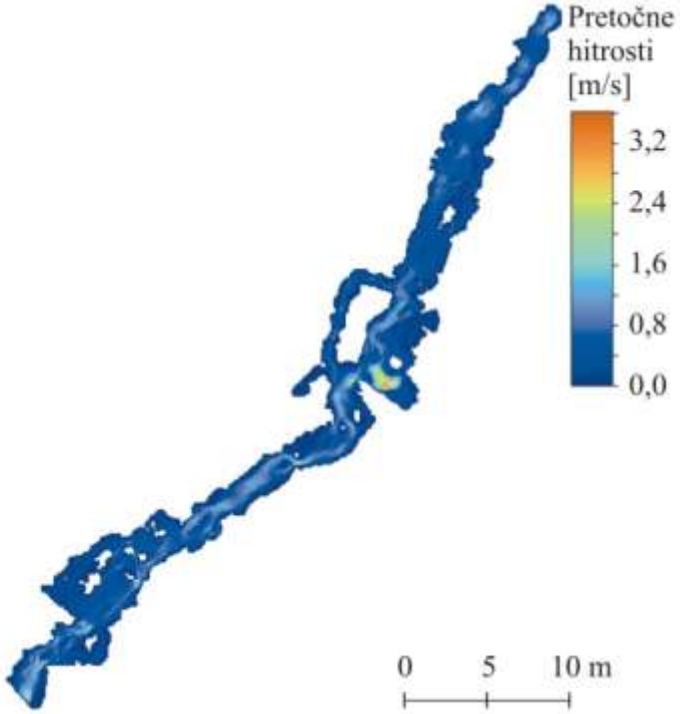


Hydraulic analyses



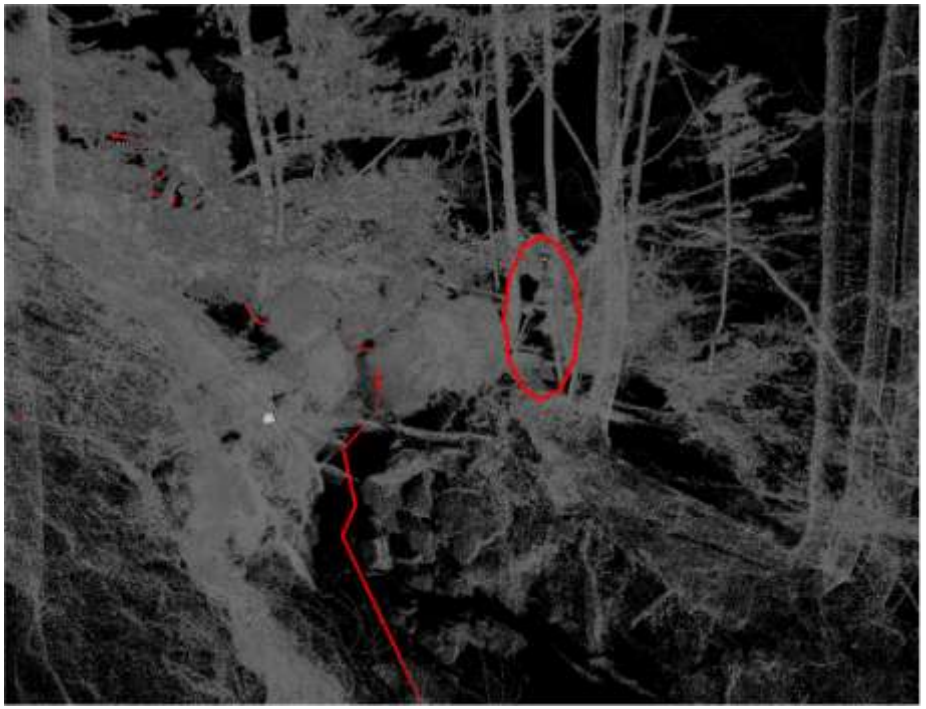




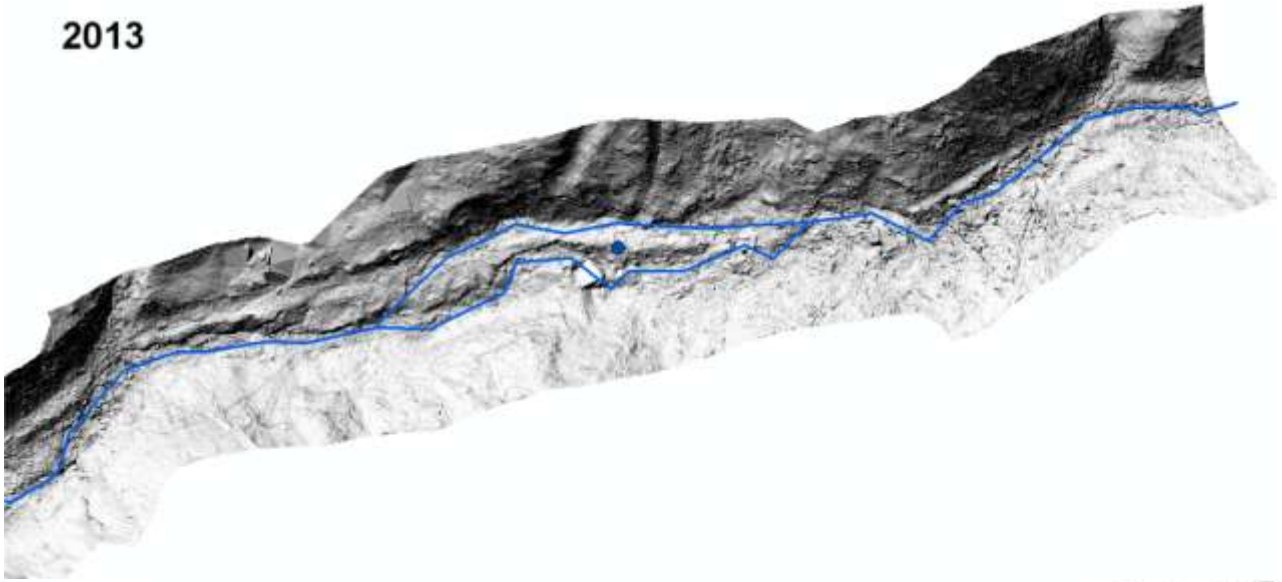


Ice storm in February 2014

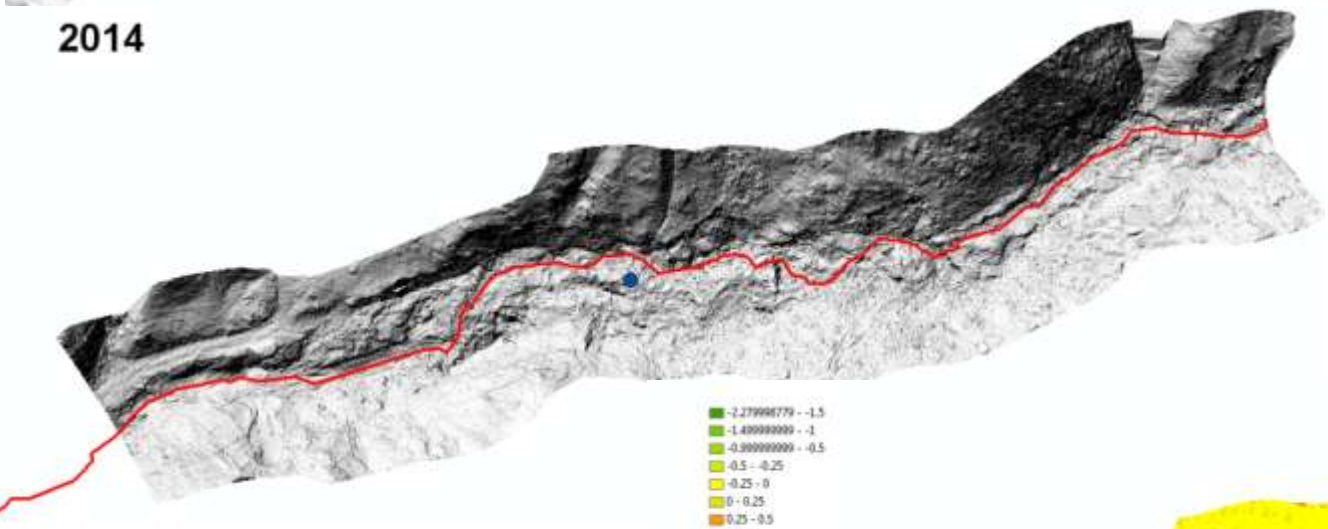
High water / floods in August 2014



2013



2014



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-0.25 - 0
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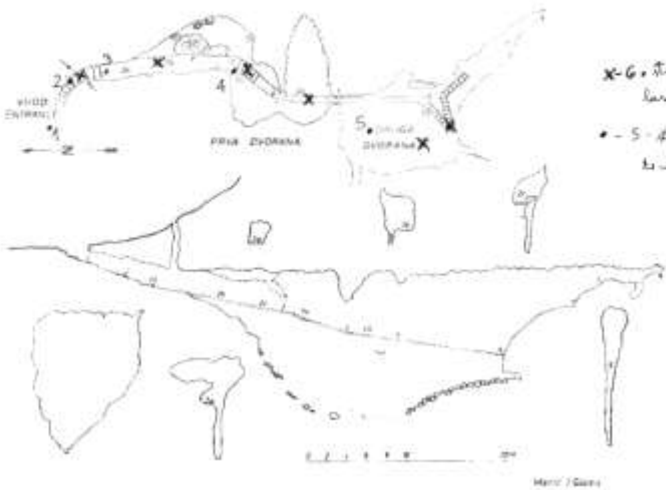
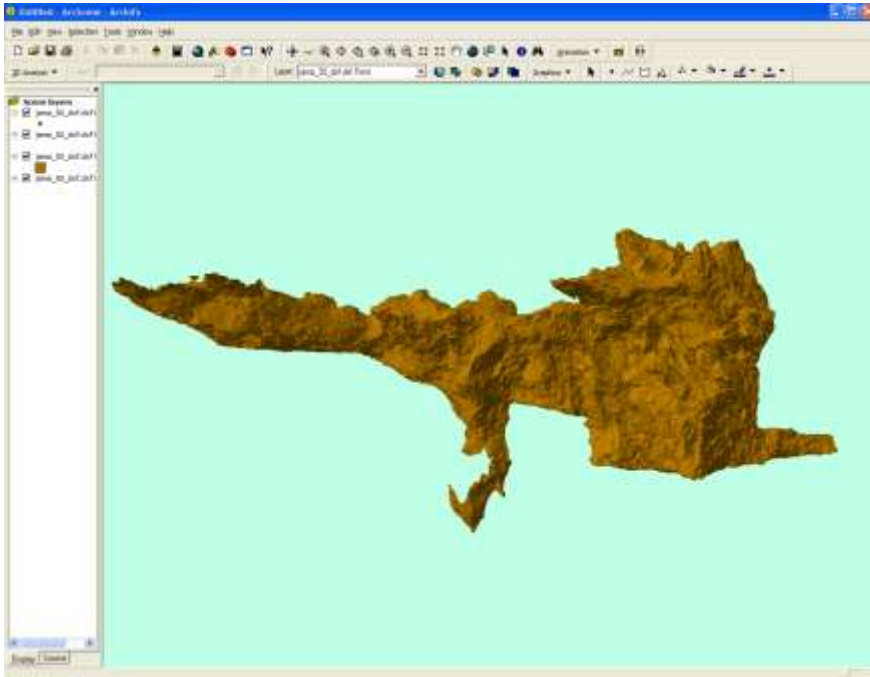
1.500000001 - 2

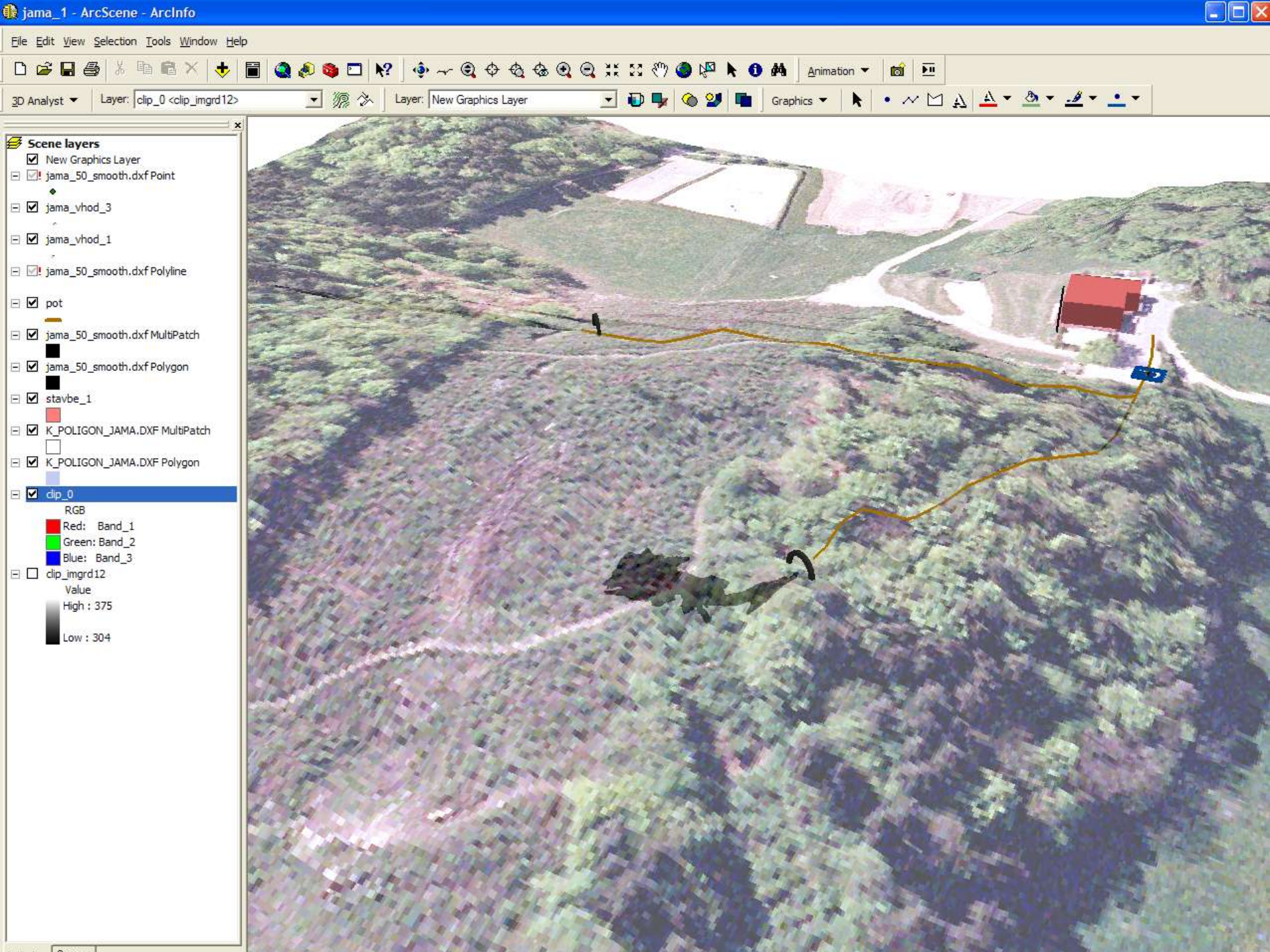
LASERSKO SKENIRANJE – stojišča

ŽELEZNA JAMA Kat št. 2678



2678	ŽELEZNA JAMA		
Ivan Gams			
Ivan Gams			1970
DZRJ SIMON ROBIČ DOMŽALE			

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3D Analyst
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Graphics
Scene layers
New Graphics Layer
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Green: Band_2
Blue: Band_3
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Low : 304

Conclusions

Airborne laser scanning data:
- Updating topographic databases and maps
- (Semi)automated map creation
- DEM updating and creation for panoramic and other cartographically oriented 3D maps

Terrestial laser scanning data:
- Photorealistic (3D) maps
- Large scale maps and visualizations
- „hidden“ areas, indoor, caves

ALS and TLS combination
UAV captured, Lidar or photogrammetricaly created point cloud

Dinamical 3D maps