Interreg CENTRAL EUROPE
Centralparks
European Union
European Regional
Development Fund

D.T2.2.1
PILOT ACTION LIDAR

Testing LiDAR laser scan study on 2 habitat types (mountainous and river valley)

Final Version

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Content

Application of LiDAR and remote sensing data in nature conservation at the Duna Ipoly National Park Directorate (DINPD)

The DINPD ordered remote sensing data (LiDAR, orthophotography, and hyperspectral imagery) at the end of 2020.

Our strategic, long term goals were detailed in previous documents, but can be summarized as follows:

1, Abiotic patterns and processes

a, getting a detailed digital terrain model (DTM), searching for:

- special habitat types (rock towers)
- archaeological artefacts, e.g.: tells and bronze age fortifications, mining holes
- getting information about historical land use (timber transportation on water and tracks)
- getting information about the impacts of recent forestry infrastructure (most importantly: erosion, fragmentation caused by forestry activity

b, flood modeling on the Ipoly valley test site

2, Biological information gathering

a, signs of and information about historical disturbances from the distribution of eroded pit and mound complexes)

b, tree height map derived from the DTM (last returning signal) and the digital surface model (DSM – first returning signal)

c, vertical structure of stands

d, canopy closure, gap mapping

e, laying deadwood mapping

f, ecological analysis of biotic information (point data of animals and plants) and LiDAR data, try to build prediction models

g, trying to map patches with high structural diversity

h, try to map invasive species based on the hyperspectral imagery

3, Networking

a, sharing data and information with fellow research and managing organizations

It was clear from the beginning, that the information we purchased served strategical interest. Many components of this data hardly lost their information value (primarily: DTM), many components are changing on the midterm (5-10 years, e.g.: DSM, orthographic imagery), and there are components which are changing quickly (hyperspectral imagery – the invasive species spread rapidly). Many of the goals we want to achieve go beyond the strict time limitations of the Centralparks Interreg, and we have to involve specialists.

As of the end of September 2021, we (partly) achieved the goals set in italics. In the following, we are detailing these with illustration

Abiotic patterns and processes

Special habitat types (e.g.: rock towers)

Rock towers and sudden fractures in the terrain create special habitats for mosses, ferns, and provide nesting and hiding places for birds (ravens, peregrine falcon) and mammals (lynx, wildcat). Therefore, the detailed knowledge of this habitat type can promote the effective protection of these taxa. We show a map example of the higher Börzsöny, where this is a characteristic type.

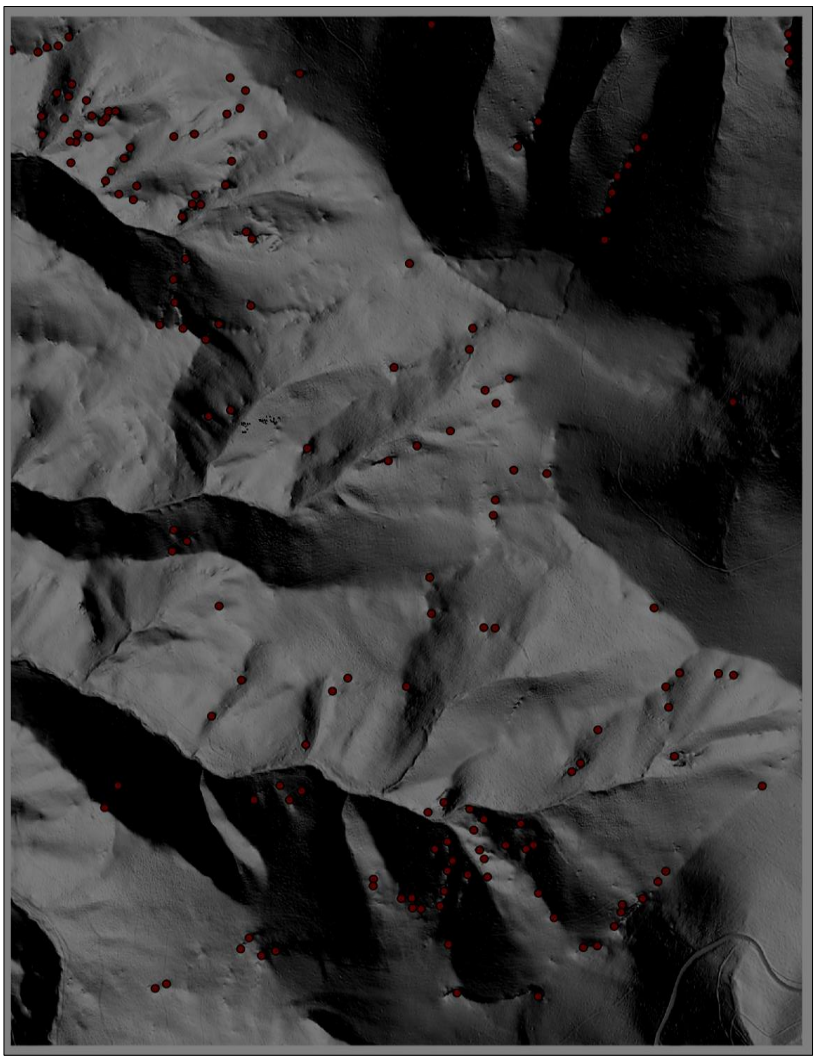


Figure 1.: rock towers in the High Börzsöny

Status:	completed
Further activities:	nest mapping, evaluating the mapped towers

Archaeological artefacts, e.g.: tells and bronze age fortifications, mining holes

Elements of cultural heritage found in the countryside are protected value in Hungary, therefore the national park directorates are responsible for their intact state (along with the National Museum, and local museums). Mapping and understanding these are important tasks, and the DTM provided by the LiDAR survey provides an excellent base for that. (Fig. 2).

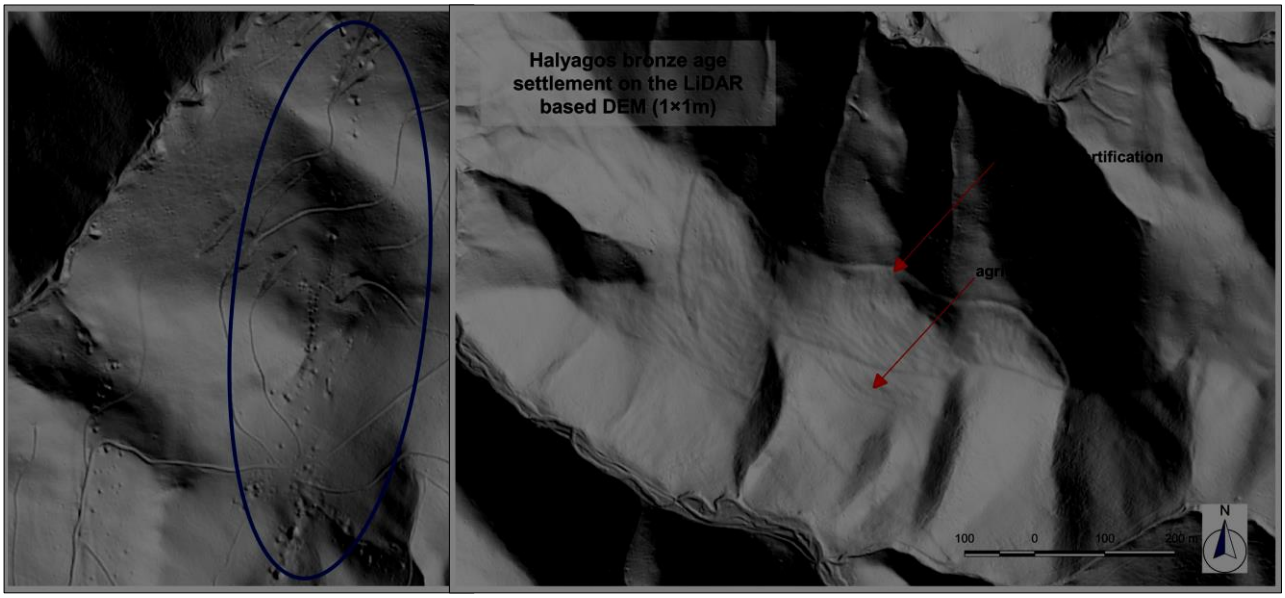


Figure 2.: R: ancient mining holes in the Nagybörzsöny area. L: bronze age settlement and fortification of Halyagos.

Status:	ongoing, the current maps of fortifications made by our ranger service are corrected in many sites.
Further activities:	networking with museums and research centers, we already got a few inquiries.

Getting information about historical land use (timber transportation on water and tracks)

In Europe, the history of land use usually dates back to the Neolithic. The most significant changes are made however in the last few centuries when forest and timber used for producing wood ash (for glass making), charcoal, fuelwood, and later industrial timber, and large areas were clear cut. The skinning of the wood and the products were conducted

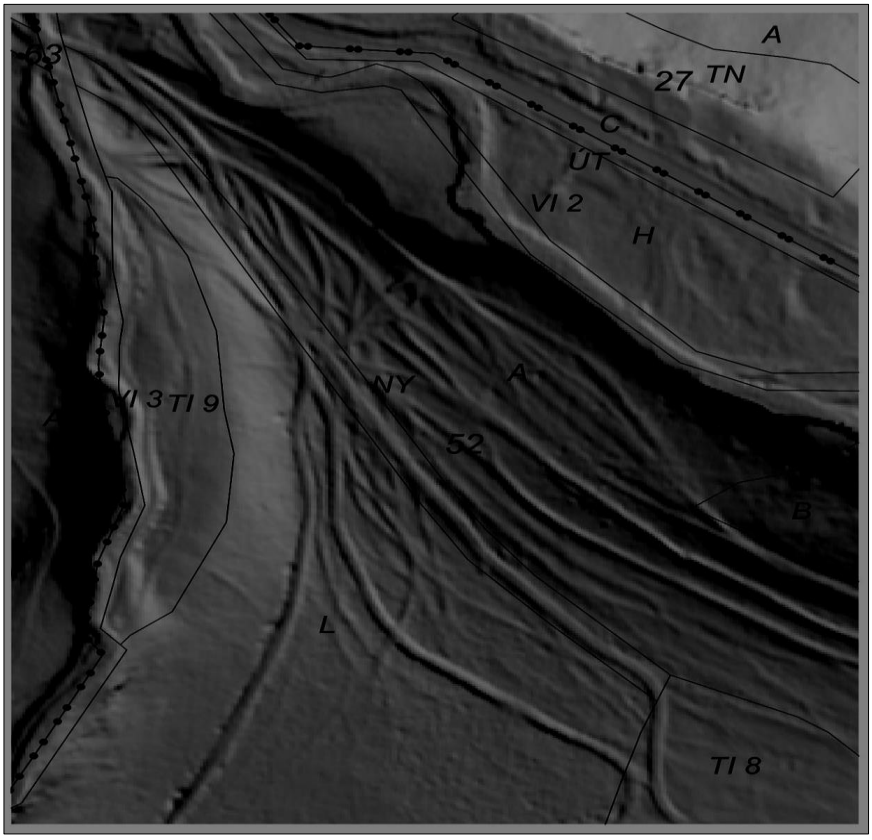
earlier on chariots, later on, railways. We have historical maps of railway systems from the XIX. century and the LiDAR data can help to specify the traces.

Usually, the substructure can be found, but many times it is reused as forest roads, therefore it is covered, and more detailed DTMs are required, which can be done from the LiDAR point clouds.

Status:	starting
Further activities:	more detailed DTM is required, and the base maps should be georeferenced

Getting information about the impacts of recent forestry infrastructure (most importantly: erosion, fragmentation caused by forestry activity

Erosion and fragmentation are the two most detectable signs of forestry activities on LiDAR-based DTM-s. The forestry road network in the Börzsöny Mountains is relatively sparse, although there are some cases, where further actions have to be carried out. The erosion caused by the skidding locally can be very brutal. The evidence provided by the DTM is crucial to estimate the extent of this damage. The only problem is to isolate the fresh and decades-old signs of the erosion marks, this can be evaluated on-site.



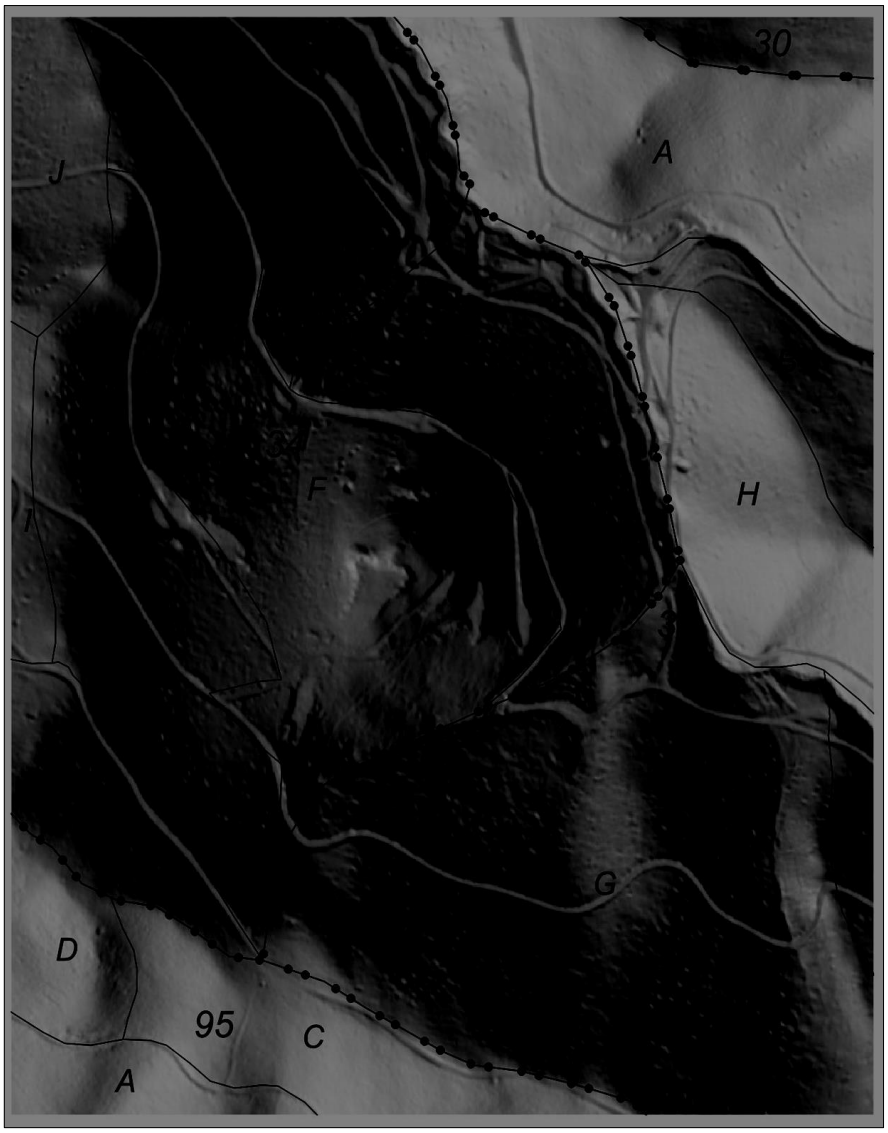


Figure 3.: R: erosion caused by skidding in the Királyháza area. L: fragmentation caused by intensive forest road system in the Kuruc-creek valley

Status:	ongoing
Further activities:	continuous mapping and evaluation, comparison of the DTM and the field experiences

Flood modeling on the Ipoly valley test site

Large areas of the Ipoly valley are in the management of the DINPD. The valley is unique in Hungary since the Ipoly is a medium-small river, surrounded by hills, and mountains, it is mostly narrow, but on a few areas it widens, and floodplains are created. These carry a large variety of wetland flora and fauna. The key factor to protect this system is flooding. The river regulations carried out in the past centuries cut out most of the wetlands, and the revitalization (planned flooding through canals) needs careful planning. Flood modeling requires fine detailed DTM data.

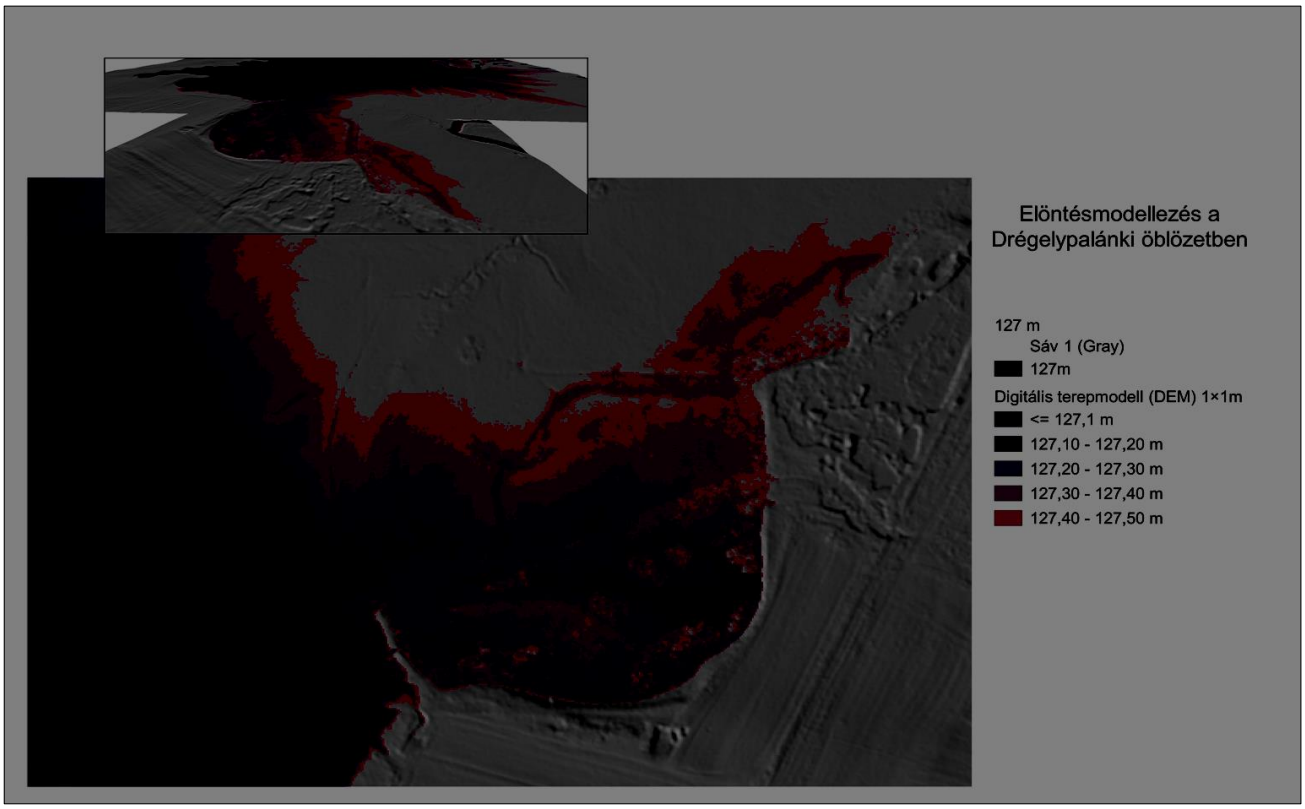


Figure 4: Flood modeling on a small „side-basin". The vertical resolution is 10cm. The deeper and higher ground can be easily identified, therefore the ideal direction of the flooding is readable

Status:	ongoing, tests were carried out
Further activities:	networking with the state water agency, further lowland areas will be mapped with LiDAR

Biological information gathering

Signs of and information about historical disturbances from the distribution of eroded pit and mound complexes)

The Börzsöny Mountains were struck in the last 30 years by large-scale abiotic disturbances (1996, 1999, 2001, 2014), and it is a recurring question that it has any historical antecedents? The fine resolution DTM can be used to map historical pit and mound complexes. This micro topography, caused by uprooting can be found even after 100 years.

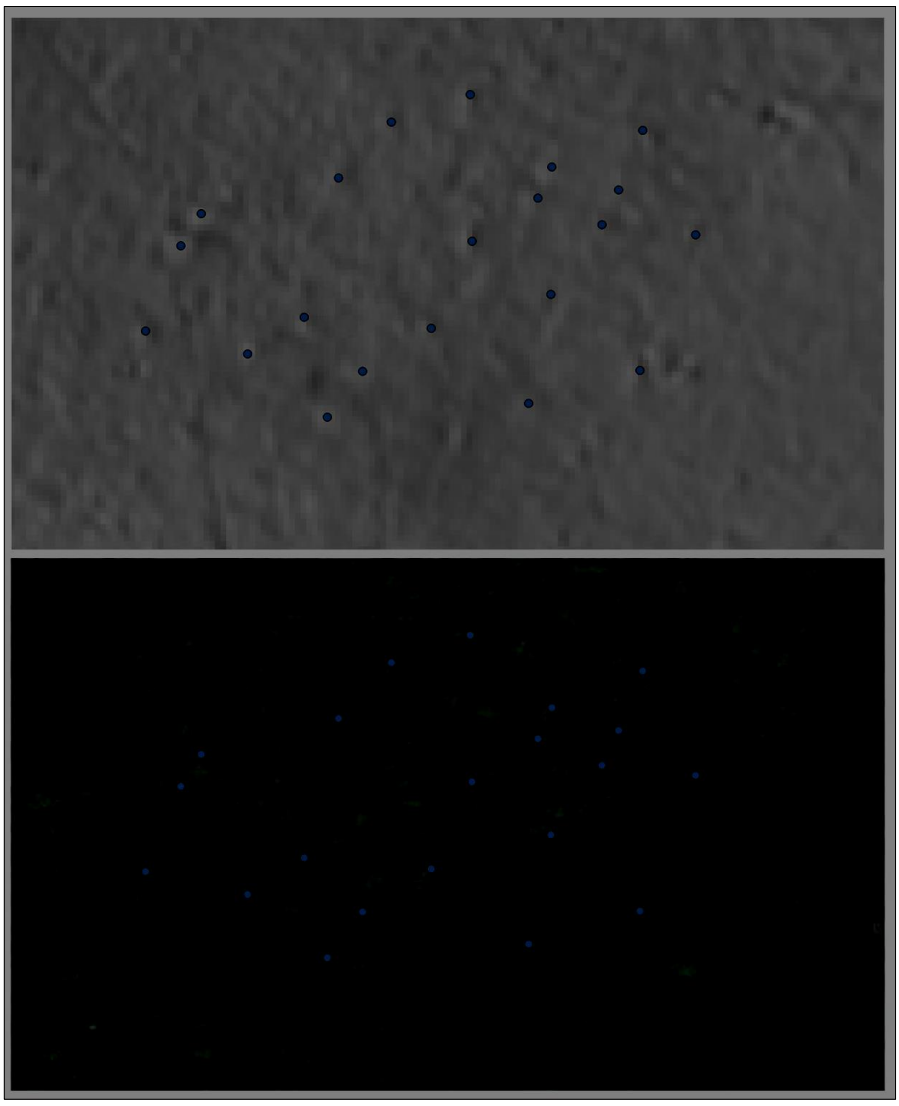


Figure 5: pit and mound complexes identified on the DTM, on a known historical disturbance site

Status:	ongoing, starting
Further activities:	finer resolution DTMs have to be built, to reliably identify the eroded pit and mound complexes.

Tree height map derived from the DTM (last returning signal) and the digital surface model (DSM – first returning signal)

Tree height gives primary information about the quality of the stand. E.g.: lower-height oak stands, with deteriorating health, are very important for many protected Buprestidae species. The height (evaluated together with the stand age) carries information about the timber value, and we can point out areas more unsuitable for forestry activities.

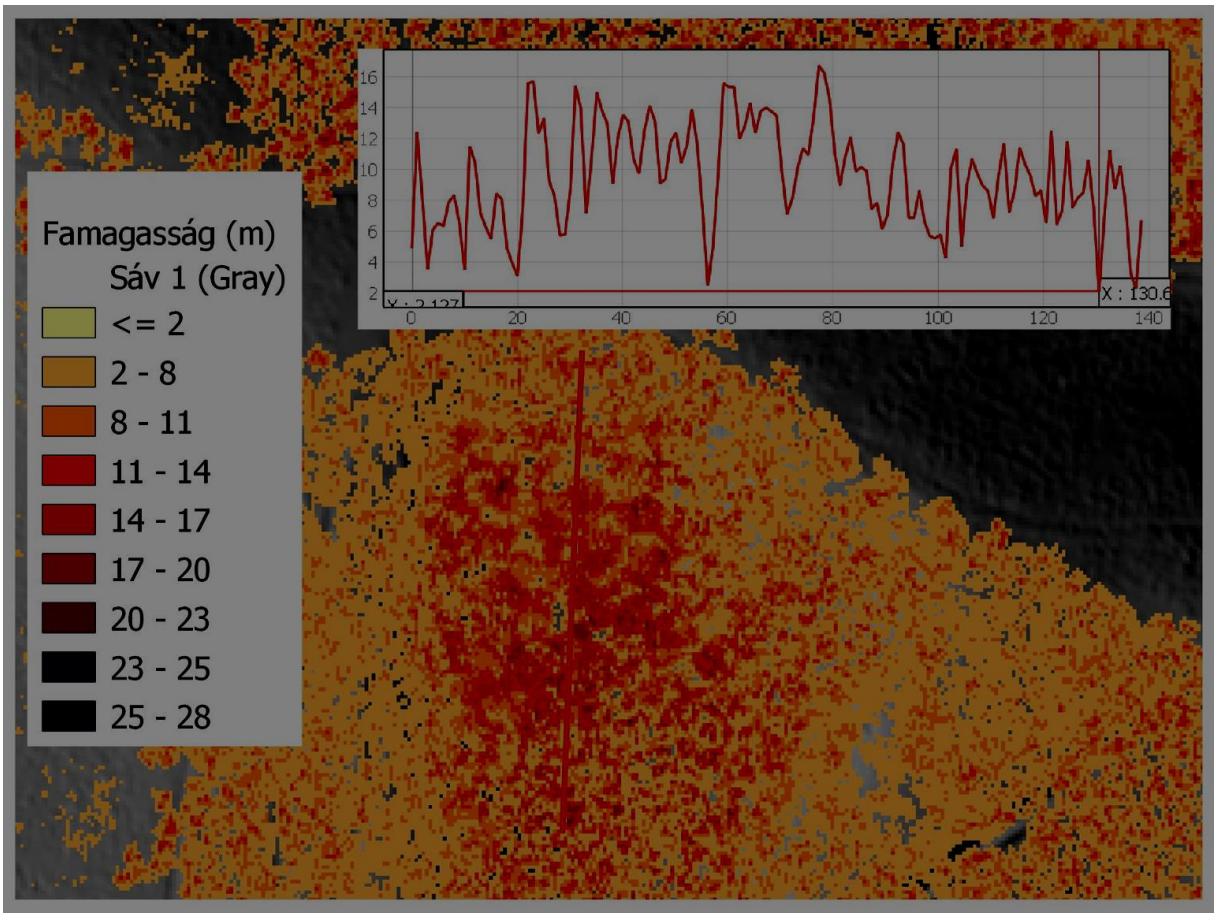


Figure 6: tree height model and profile on a southern slope

Status:	ongoing, starting. We currently use this data on forest planning negotiations.

Further activities: building models to automate the mapping

Vertical structure of stands

Current LiDAR data can be used to evaluate the in-stand structural richness, based on the number of the in-stand reflections. However, it is a very current, upcoming topic with many difficult questions to answer. We get a reflection-density (numbers of reflections between the first and the last reflection) map, but the resolution is too fine to evaluate stand-scale patterns.

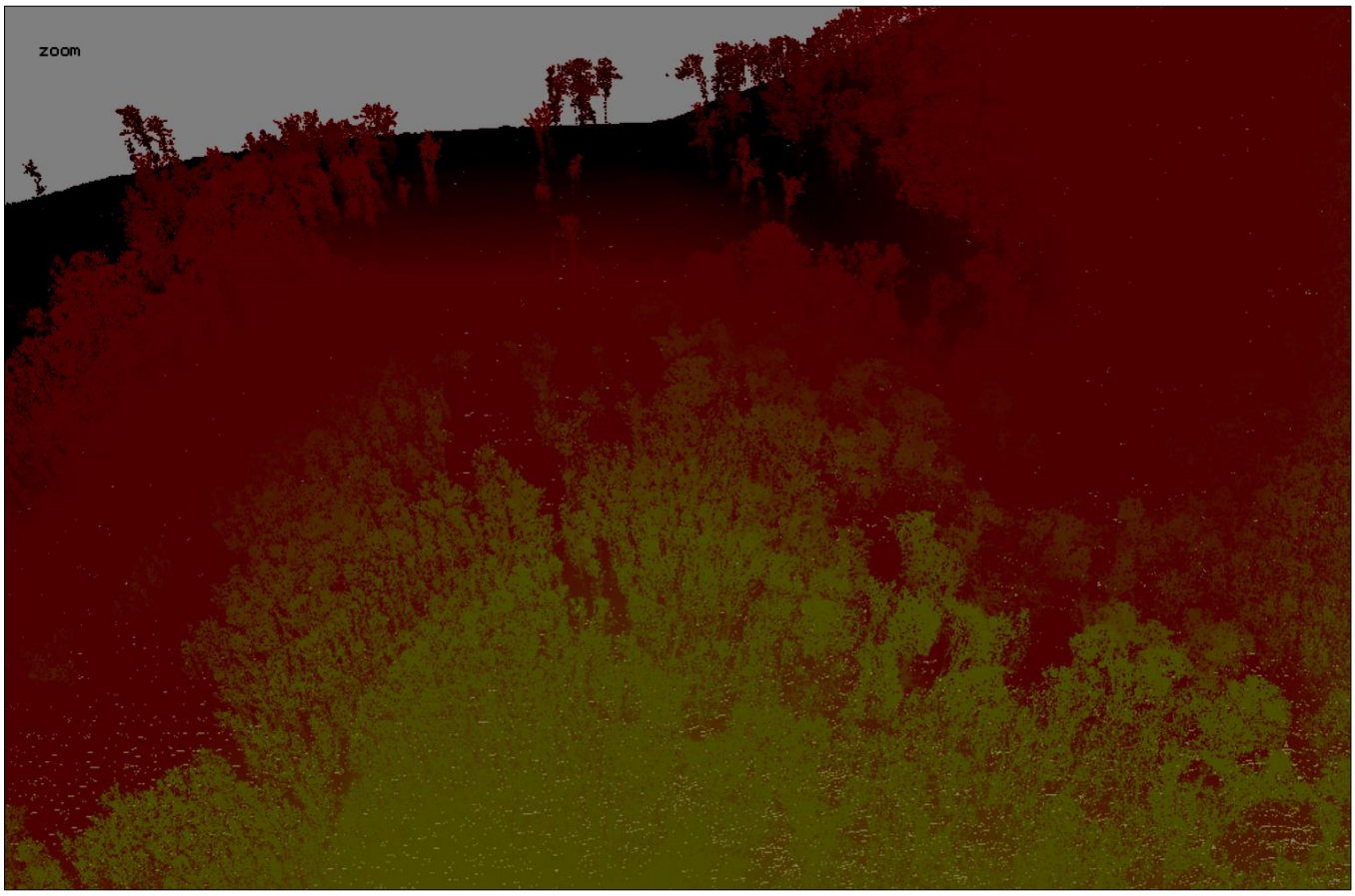


Figure 7: LiDAR point cloud

Status: starting, experiments were carried out

Further activities: many questions have to be answered, through strong networking with experts.

Canopy closure, gap mapping

Canopy closure can be easily estimated to certain areas from LiDAR data. We need to select a minimal height, and the remaining reflection cloud gives the canopy cover percentage.

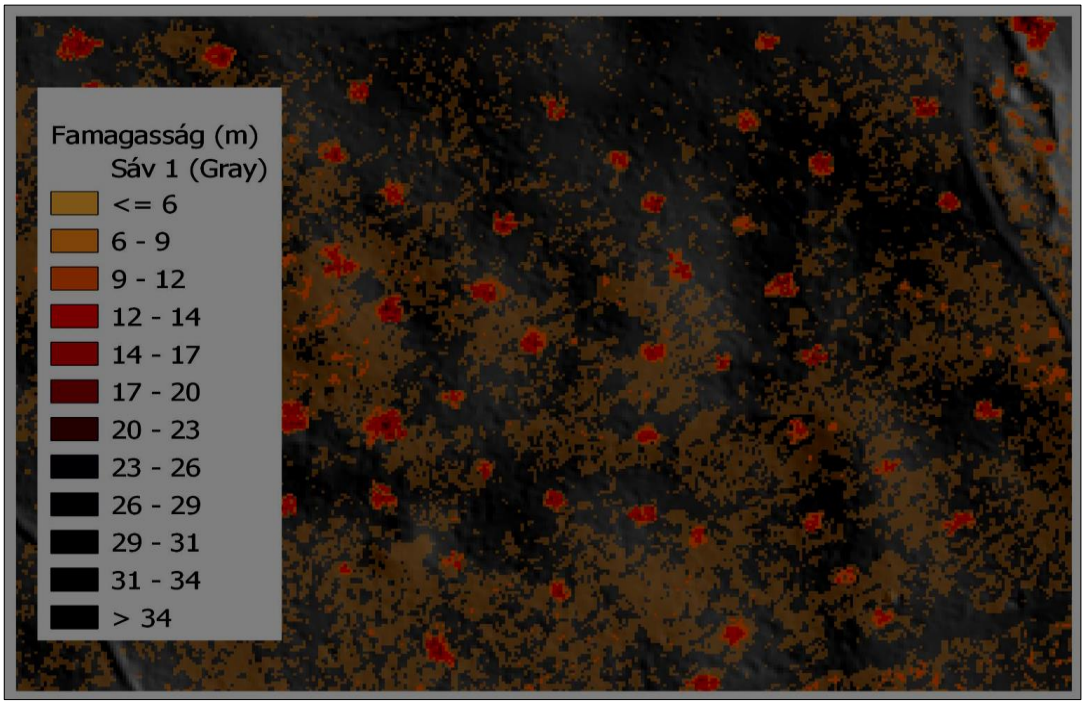


Figure 8: tree height and canopy closure on a clear cut area, with the remaining trees

Status:	ongoing
Further activities	the method is finished, certain areas of interest have to be selected if this question comes up

Networking

LiDAR data covering large areas is not unique, but neither widespread in Hungary, but the basic understanding and use it is spreading. In such cases, if someone is in possession of good quality LiDAR data covering relatively large areas, the interests of professionals from attached areas are growing. We are already connected with museums, the archaeological research group of the Pécsi University of Sciences and the forest ecological group of the Eötvös Loránd University.

This data sharing and joint research can be very useful and productive.

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