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A case history of using high-resolution LiDAR data to support archaeological prediction models in a low-relief area

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Hungary is situated in the crossroad of several large-scale infrastructural pathways like transnational pipelines and transcontinental motorways. At the same time the country is rich in known and potential archaeological sites. Archaeological prediction techniques aided by remote sensing are intended to help increase preparedness for archaeological surveying and rescue activities in response to planned new infrastructural developments (e.g., a new pipeline), as they try to estimate the number of potential archaeological sites, area to be surveyed, potential cost and time needed for these activities. In very low-relief areas microtopographic forms may indicate sites, high-resolution LiDAR DTMs are suitable for their detection.

Main sources of archaeological prediction models are known archaeological sites, where optimal environmental conditions of settling down existed at historic ages. Hydrological characteristics, relief, geology, vegetation cover and soil are considered to be as most important natural factors. Sorting of the factors and accuracy of the sampling differentiate our models. Resolution of an inductive model depends on the spatial properties of the integrated data: a raster data set can be generated that contains probability values and the reliability of the estimation.

The information content of the predictive model is highly influenced by the resolution of the used digital terrain model (DTM): its derivatives (slope, aspect, topographic features) are important inputs of the modelling. The quality of the DTM is even more important in low-relief areas as microtopographic features may indicate archaeological sites. The conventional digital elevation models (SRTM, ASTER GDEM) provide unsatisfying resolution (both in horizontal and vertical senses) as they are rather digital surface models containing the vegetation and the built-up structures. Processed multiecho LiDAR data can be used instead.

Our study area is situated in the foothills of the Transdanubian Range characterized by NNW-SSE directed valleys. One of the largest valleys is a conspicuously straight valley section of the River Sárvíz between Székesfehérvár and Szekszárd. Archaeological surveys revealed various settlement remains since the Neolithic. LiDAR data acquisition has been carried out in the framework of an EUFAR project supported by the European Union. Although the weather conditions were not optimal during the flight, sophisticated processing (carried out with of OPALS software) removed most of the artifacts. The resulting 1 m resolution digital terrain model (DTM) has been used to out.

This DTM and the known archaeological site locations were integrated in a GIS system for qualitative and quantitative analysis. The processing aimed at analyzing elevation patterns of archaeological sites: local microtopographic features have been outlined and local low-relief elevation data have been extracted and analysed along the Sárvíz valley. Sites have been grouped according to the age of the artifacts identified by the quick-look archaeological walkthrough surveys. The topographic context of these elevation patterns were compared to the relative relief positions of the sites.

Some ages groups have confined elevation ranges that may indicate hydrological/climate dependency of the settlement site selection, whereas some long-lived sites can also be identified, typically further away from the local erosional base. Extremely low-relief areas are supposed to have had swampy or partly inundated environmental conditions in ancient times; these areas were unsuitable for human settlement for long time periods. Such areas can be typically attributed by low predictive probabilities, whereas small mounds, patches of topographic unevenness would get higher model probabilities. The final the models can be used for focused field surveys that can improve our archaeological knowledge of the area.

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