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Archaeohydrological studies in the Sárvíz valley (Hungary) using high-resolution LiDAR data

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The central area of the Pannonian basin encompasses mostly low-relief areas. Its south-western part, the southern Transdanubian hilly areas have characteristic NNW-SSE directional pattern. One of the largest valleys is a conspicuously straight valley section of the River Sárvíz between Székesfehérvár and Szekszárd. The river collects the waters of eastern Bakony Mountains takes its rise in Sárrét, in its natural condition originally a marshland, and flows into the river Sió towards the River Danube. The studied valley section is characterised by low relief, in the west it is bordered by a scarp with incised tributaries whereas the eastern side is less sharp. Its hydrological characteristics was artificially changed to due to river regulation in the 19th century in order to change the swampy character of the valley that was previously typical earlier (Sárvíz means muddy water).

The area shows various settlement remains since the Neolithic, and characteristic spatial patterns have been found in ages of archaeological features and settlement sites, we assumed that the settlement pattern might have been influenced by the various water levels. To prove the changes in hydrological setting we can also use medieval written sources which makes us able to identify some of the former lakes and watercourse segments of the river at a surprising detail. Consequently, this research is aimed to detect the original features and the paleohydrological changes by collecting data on archaeological site locations and compare them to the fine elevation pattern of the sites.

In order to derive the elevations of the identified sites LiDAR data acquisition has been carried out in the framework of the EUFAR project supported by the European Union. The weather conditions were not optimal for the measurements, so we paid special attention to the processing of the resulting point cloud to create a high-resolution, high-accuracy digital terrain model (DTM). The data have been processed with of OPALS software. We integrated the DTM and the known archaeological site locations in GIS system for qualitative and quantitative analysis. The processing aimed at discovering small-scale surface changes (at 5-10 cm scale) and its possible causes.

The vertical clustering of the elevations of the sites above sea level show interesting patterns. The peaks of elevation histograms changes back and forth to lower and higher areas which shows that the settlement pattern has a history in elevations. Our interpretation is that this is due to the changes of the water levels in this low-relief areas. The water level changes may be due to several factors: (1) there may be long-term climatic changes influencing runoff and discharge; (2) the area is known to show geodynamic activity: there are at least two seismologically active zones (Berhida area and the Kapos line) that may cause tilting, slight tectonic uplift and/or subsidence so that the relief of the valley could have changed even at a historical timescale; (3) anthropogenic influence may also happened. There is a further possibility that a part of the observed variation in the elevation histograms is an artefact as not all the archaeological sites of a certain age have been found yet, so the histograms may also change later.

Our current conclusion is that the elevation pattern change is largely real, it is related to hydrological changes, however, the cause of these hydrological cannot be separated yet. Our goal is to achieve an environmental historical reconstruction of the Valley of Sárvíz, and consequently to make methodological analysis with the LiDAR-based DTM to make predictions concerning the archaeological heritage. Owing to this interdisciplinary approach these data processing methods may contribute to reveal further archaeological sites.

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