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GIS and prospection

Non-destructive survey of Iron Age cemeteries: testing the topographic support system

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KEY-WORDS: topography, Iron Age, QGIS, mobile GIS, geophysical prospection, aerial reconnaisance, burial sites

BACKGROUND AND PROBLEMS

Since the 1960s fieldwalking has been the primary field method employed in the incomplete Archaeological Topography of Hungary (MRT) project. This method of site identification was more suitable for identifying settlements rather than cemeteries as pottery sherds on the surface are indicative most often of formal settlements. The completed volumes of the MRT, covering only about 12% of the country (Wollák 2009), show that most of the burials were found by chance and mainly during development work. The major reasons for this are the differences in taphonomic processes between settlements and cemeteries and the fact that it is difficult to locate individual archeological features based on a scatter of surface finds. Although aerial photography and magnetometry are now frequently able to identify small archaeological features, the predominance of settlement survey sites is still more significant in international archaeological topography research. While many excavations have taken place after the discovery of cemeteries by aerial photography, reports of investigation of burial mounds (especially with geophysical methods) are seldom made available. In addition to the methodological issues, it can be said that cemeteries are not located and investigated certainly to some extent because the topographic data are missing for analysis, leaving largely unanswered questions concerning burial place selection in different periods. This issue is not only a scientific problem, but it also has great practical significance: cemeteries are the most preferred targets of illegal treasure hunters.

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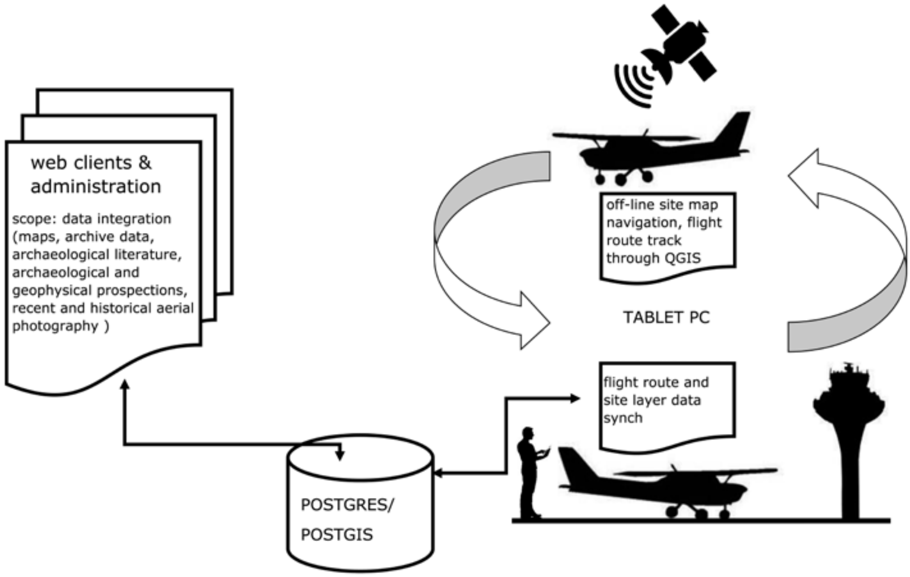

Fig. 1. Concept of the topographic support system (TSS)

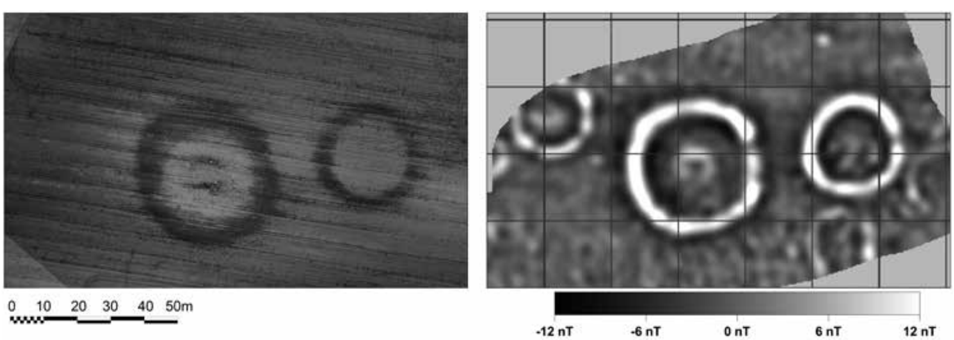

Fig. 2. Example of TSS data prepared for a fieldwork test: an Early Iron Age tumulus at Érd-Százhalombatta-Százhalom, Hungary. Burial mounds Nos 120 and 46 in aerial photograph (left: Z. Czajlik, 11 March 2014) and magnetic results (right; Sándor Puszta, Fractal technology, 2012). Survey carried out with a GSM-19FG GEM System Overhauser magnetometer (instrument resolution 0.01 nT, survey line spacing 0.50 m, standard recording time 0.5 sec, height of probe above ground surface approx. 0.30 m)

KEY QUESTIONS AND TECHNICAL BACKGROUND — TOPOGRAPHICAL SUPPORT SYSTEM

One of the technical objectives of the topographical support system (TSS) was to set up efficient topographical architecture for detecting and documenting archaeological sites. The system provides data on geographically located archaeological sites known from literature and explored, documented and verified sites. It is similar to the field survey solutions used by Eke and Kvassay (2011), but first of all it was adapted to aerial archaeological research.

Why was it necessary to set up a TSS? The use of mobile GIS equipment (Tripcevich 2004) or a GPS-connected PC for aerial archaeological research (Heller 2000; Campana and Sordini 2006) is hardly new technology. However, there was no adequate equipment to create a real-time archaeological database in flight, because common hardware was too large and the operation time and efficiency were unsuitable for long aerial reconnaissance flights. An adequate open source software solution was also not available. The great number of documented aerial archaeological sites and the demand for information on the sites during an aerial archaeological exploration flight led to the development of a device pack which, firstly, could be used during the flight; secondly, could present information about known archaeological sites, and thirdly, could record the accurate position of the airplane/photographer. Fourthly, it could operate for hours during the exploration stage, an aspect of the technology that has become available only recently.

The central information database of the TSS is based on a powerful server (with an open-source, but robust Postgres-PostGIS database system), which could be accessed by the operator's so-called thin client device from anywhere through an internet connection. The possibility for data upload directly from the field proved to be a great advantage. Before the flight, a small-sized tablet device with open source QGIS software, long-lasting batteries and a built-in GPS-module synchronizes the necessary data from the server through the internet connection, allowing the information to be used during the airborne survey. The built-in GPS shows real-time position of the airplane in a cartographic environment on a tablet, which also displays the previously synchronized layered spatial data of the known archaeological sites and the desired topographical (background) maps. Thus, the rediscovery of known sites can be avoided and consequently the efficiency of the time spent on the airplane improved.

Simultaneous site-monitoring is also possible with the assistance of this device as it can display previously documented conditions (with georeferenced, accurately transformed aerial photographs) of the respective archaeological sites.

TEST ON IRON AGE CEMETERIES

The chosen test period was the Iron Age, because all the morphologically identifiable burial categories (ditch enclosed, unenclosed inhumation and the least observable cremation graves) were present in this period. Simultaneously with the technical development, tests were carried out on some Iron Age cemeteries (Százhalombatta, Paks and Fadd), followed by a detailed aerial archaeological and field survey of four to five other cemeteries in Hungary and in Romania, chosen after consideration of different morphological, vegetation and geological attributes.

The great number of well-structured, representative data integrated in a GIS database will enable complex queries, while giving the tools to analyze them. The TSS system and the effectiveness of nondestructive methods in this case could be verified by the archaeological testing of burials of apparent Iron Age date, identified from aerial photographs. With the integration of settlement data in the TSS, one could also analyze the topographic relationship between cemeteries and settlements. This verification in the field with methods discussed above will be the last phase of the field part of the program.

EXPECTED RESULTS

Technological development in this case leads to the development of a scientific topographical database, which can serve other topographical research (requiring only limited modification to integrate the characteristics of other periods). The aerial photography module will improve the efficiency of aerial archaeological surveys and the field module will help object-level observation on archaeological sites. The usefulness of geophysical survey for burial research, not only settlement archaeology as has been to date, is thus confirmed and its efficiency will grow definitely as a result of system-level planning.

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