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Exploring free LiDAR derivatives. A user's perspective on the potential of readily available resources in Poland

Piotr Wroniecki[a], Marcin Jaworski[a] and Mikołaj Kostyrko[b]

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INTRODUCTION

Airborne laser scanning (ALS), that is, the use of laser scanning devices from airborne platforms to record surface topography, is a technique used for archaeological prospection that has evolved from being a new technology to common practice in the course of the past decade (Holden *et al.* 2002). Data recorded through the employment of remote-sensing techniques find numerous applications for public use. Among them are government spatial databases created and developed to foresee, monitor and prevent potential environmental and natural disasters in high-risk areas (e.g., flood plains). Such were the intentions of the ISOK (IT System of the Country's Protection against Extreme Hazards) programme, which included initially, among others, ALS and the creation of DTM and DSM models of river sub-basin areas for more than 204,000 km^2 of the territory of Poland (over 65% of the total area of the country). This processed and visualised data is available free to the public as a WMTS layer in Poland's national geoportal (Geoportal.gov.pl) administered by the Head Office of Geodesy and Cartography (GUGiK). Data for particular areas, provided in .LAS and its derivatives, i.e., ASCII formats, can be purchased for further enhancement.

The potential for prospection of landscapes, including remote and forested areas, is inestimable. The area covered by ALS contains numerous islands, mountain ranges, bogs and forests. The lattermost are of utmost importance where ALS data is concerned, because about a third of the territory of Poland is densely forested (Zajączkowski *et al*. 2014), making regular fieldwalking (the fundamental prospection technique applied in Poland) in search of known and new archaeological resources a challenge over large parts of the country. The possibility of exploring these areas provides a new dimension for national heritage management in Poland as far as earthworks are concerned (Kiarszys and Szalast 2014; Banaszek 2014).

CURRENT TRENDS

In recent years, the emphasis on making use of ISOK data has been placed mainly on case studies of particular areas, geographical units, mostly forested (example in Banaszek 2014), or detection of specific types of archaeological features within a cultural landscape (see Przybył 2014). The use of ALS data has become relatively common in site or landscape field projects

[a] Independent researcher, Warsaw, Poland
[b] Institute of Prehistory, Adam Mickiewicz University, Poznań, Poland

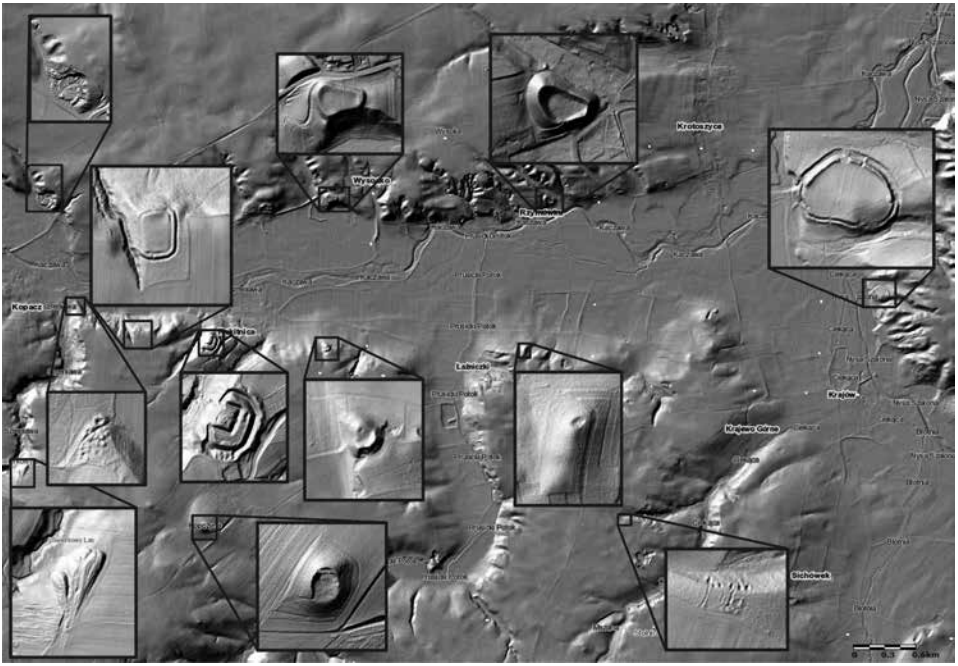

Fig. 1. Example of an abundance of archaeological resources in the cultural landscape of the Kaczawa river valley (North at top)

and this rising trend has been reflected at archaeological conferences in Poland (e.g., *Computer Applications in Archaeology*, Poland, 12–13 June 2014) and in the development of scientific projects aimed at exploring the skill of local communities for recognising historic monuments in LiDAR visualisations (Laser Discoverers project, Sztampke 2014).

The potential of this data in Polish archaeology has yet to be recognized. Past landscapes can now be perceived as a continuum rather than as separate 'islands'. Through the perspective of LiDAR-derivatives, evidence of past human activities can be seen almost everywhere, creating meshworks and connecting individual places into broader landscapes (Mlekuž 2012). Research should be focused on this issue, as the ALS data clearly show how much there is still to be learned.

The number of users other than archaeologists browsing through the free data is also growing, as is the general interest in this kind of geographical visualisation. This is revealed by visit statistics of thematic articles on various Internet sites (e.g., archeolog.pl). Browsing through free ALS resources complies with the needs and social aspects of "armchair archaeology". It has also become unwittingly a resource beyond archaeological control, activating spreading social interest in archaeology (the processes of discovery and viewing) and the ALS technique itself. Exploring readily available data leads thus not only to recognition of various archaeological and historical earthwork features in rural or secluded environments (Fig. 1), but also to enhancing landscape perception of already studied and documented sites in a broader spatial context (Fig. 2).

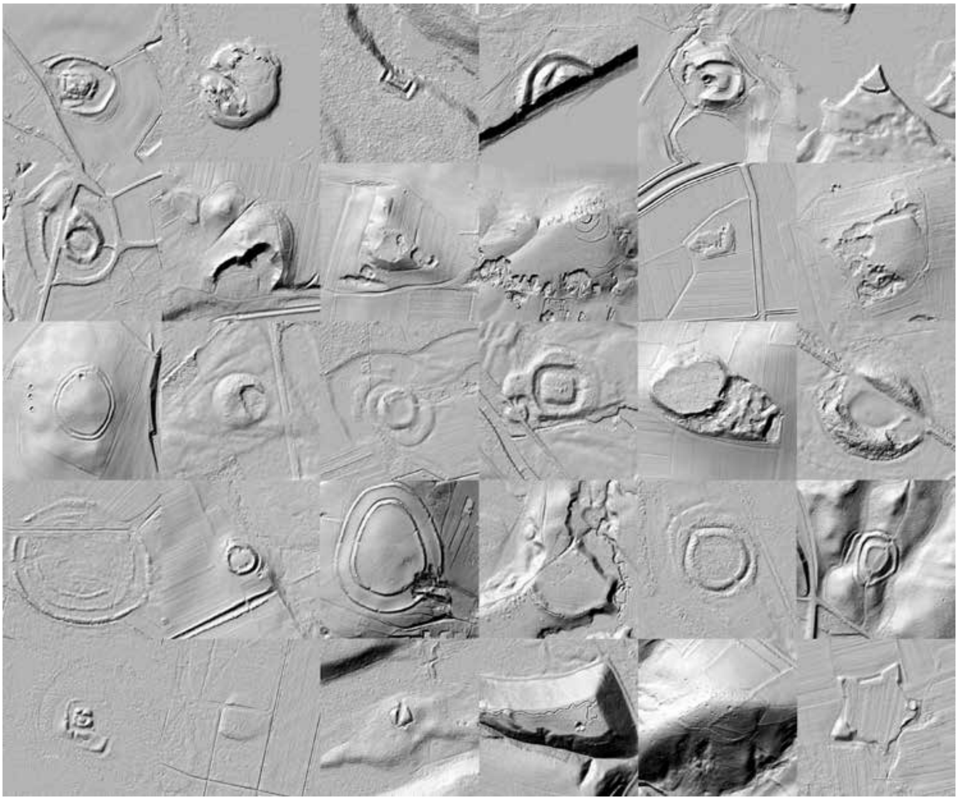

Fig. 2. Various types of archaeological earthwork monuments throughout Poland in different phases of destruction (North at top, scales differ)

The authors of this presentation have been browsing through the ALS visualisations available on Poland's national geoportal, systematically cataloguing various types of manmade ground features that include already known archaeological resources, as well as potentially new archaeological sites. Initially a strictly hobbyist initiative, it has expanded into a regular collection of over 1500 places of interest, including extensive prehistoric fortified settlements, gords or burgwalls, single barrows and barrow complexes, fortification systems, castles, mottes and baileys, abandoned granges, villages, homesteads and farms, mines and mine dumps, charcoal piles, enclosures, communication tracts, ditches and other earthworks connected with past human activities, not to mention innumerous scars on the landscape left by military battles and other army activities of the past 500 years in Poland. All these features are pinpointed in a simple GIS database, developed with open-source software. Every observed ground feature is located within existing administrative regions, classified and supplied with additional information (local name, historic meaning). The database enables a broad landscape perspective for examination of topographical features and factors, relations between close and distant sites and potential

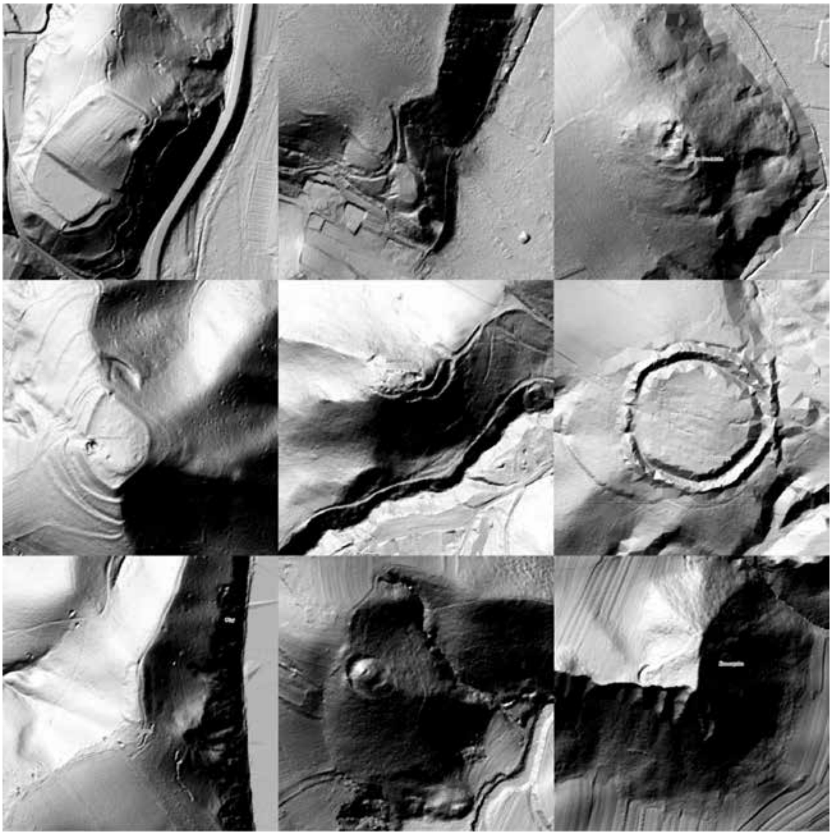

Fig. 3. Examples of reliefs with prominent hillshade visualisation covering archaeological features (North at top, scales differ)

management of archaeological resources. Integration with the national register of heritage sites and monuments and the (still undigitized) AZP database (Archeologiczne Zdjęcie Polski, that is, Polish Archaeological Record, a nationwide fieldwalking survey project conducted since the late 1970s) (Konopka 1981) is the next natural step in enhancing the potential of the developed database. It offers the possibility to cross-reference with other data.

CONCLUSIONS

At a basic level, detection and registration of ground features bearing potential for archaeological research requires nothing but a keen eye and awareness of possible feature types. Basic processing of detected features is possible in any available GIS software or even the national geoportal browser-based viewer. Readily available visualisations are quite suited for this task. In the long run, however, they would benefit from further processing that would allow enhanced feature analysis, simply because extraction of their full potential requires more advanced analysis (Zakšek *et al.* 2011; Kokalj *et. al.* 2013) than simple *hillshaded* reliefs (Fig. 3). The potential of this new dimension of information is enormous, yet due to the fragmentation of initiatives aimed at its systematic exploration and the absence of any central hub for sharing, cataloguing, describing and verification, ALS data are still an untapped resource. Surely untapped for research projects, but foremost for heritage offices, which could stand to benefit from the application of "armchair" approaches, especially taking into account their severe underfunding.

From a social perspective this situation has many implications in view of the fact that in Poland information regarding archaeological sites is not in the public domain. As the ISOK DTMs reveal archaeologically sensitive information, but are officially for the purposes of hydrology or forestry, they have become a rather interesting way of circumventing restrictions on archaeological data and are being used intensively by hobbyists and professional exploration groups. The irony of this situation is that archaeologists continue to rely heavily on outdated fieldwalking documentation that serves as the basis for research projects and heritage management, while unofficial groups have long-ago embraced high-quality ALS approaches, allowing them to streamline their legal and (more often than not) illegal activities.

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