LiDAR on trial

An overview on the national LiDAR support for the archaeological research on Mediterranean unfavourable areas

Rosanna MONTANARO, Università del Salento, Italy

Keywords: LiDAR; multisensory prospection; farming fields; raster visualization; Mediterranean territory

Introduction

The LiDAR (Light Detection and Ranging) prospection is widespread in several European territories, especially in the northern part of the continent, where forests and high vegetation cover a large percentage of territory. The ability to penetrate the canopy and detect the micro-relief of topographical features in inaccessible areas by optical remote sensed tools has led the proliferation of this technology in such kind of area, but the investigation of its potentialities has reached other kind of territories, not covered by trees (Opitz and Cowley, 2013). As a matter of fact, one of the first ever employment of the LiDAR technologies did occur at Stonehenge, where important results have been achieved, despite the absence of canopies in the landscape. More often in the last decade, the application of LiDAR gradually has shifted southward, toward Mediterranean areas where several projects demonstrate fruitful results for the landscape archaeology.

Tested territories and research aims

During the last decade, the Italian territory has been detected through LiDAR on some spots with encouraging results, as García Sánchez (2018, pp. 1-2) explains. This experience has supported the application of LiDAR to other Italian areas to maximize the archaeological information provided by this remote sensed technology even in critical areas not completely responsive to this technology. The aim of this paper is to draw attention to the use of the ALS (provided by the Italian Ministry of Environment) in territories where aerial photography has already proven an extensive presence of archaeological features and to investigate the chances of usability of public Lidar in extensive research. The first examined area is the Tavoliere, Apulia, characterized by a quite intensive farming that is going to change its landscape; the other one is Ostia Antica, where unexcavated areas provide interesting sparks for a systematic application of ALS, but both urbanization and farming represent a threat to the archaeological record.

The Tavoliere plain

After the Second World War, the Tavoliere plain became a privileged field for the aerial photography analysis (Bradford 1957), revealing an impressive and unique amount of archaeological anomalies related to a complex palimpsest of settlements running from the Neolithic to the Medieval times. This abundance of archaeological presence has inspired the testing of ALS (Airborne Laser Scanning) technology and the maximum exploitation despite of it despite the high percentage of farming developed in the last forty years that could have damaged part of the archaeological record.

Ostia Antica

The Ostia Antica landscape has favoured several topographical and aerial prospections due to its archaeological importance and historical role. These researches have displayed a promising field for evidence aerial photos are able to detect (Martin et al., 2002, pp.259-274). Despite these examples, LiDAR prospection has not been planned yet in neither of the numerous projects involving Ostia Antica. The application of ALS on this kind of landscape has revealed several information on archaeological features, but numerous limits can be equally observed.

Methodology

Italian Ministry supplies LiDAR data (1x1 m of resolution) under various file extensions and, where available, the point cloud has been classified and processed. A particular attention is dressed to the raster elaboration

of the data (Kokalj and Hesse, 2017): it is a crucial point of the entire process of elaboration and resulting interpretation of the data. For this reason, it is interesting to discriminate the appropriate visualization for each case and speculate on the possible correlation between landscape features and the best raster view.

Moreover, ALS has been systematically compared with aerial photos, satellite images, cartography (both modern and historical) (Fig. 1) in order to validate the detected features. In particular, the stereoscopic analysis of stereo-pair aerial photos allows to better understand the micro-reliefs detected by LiDAR and to evaluate both the efficacy of the LiDAR data and to observe the changes occured in the landscape in the last decays. The last one is possible when the stereoscopic view is performed on historical aerial photos.

a *b* *c*

Fig. 1. Via del Sabazeo, Ostia Antica: a) historical aerial photo (SARA, 1930 c.); b) GeoEye01, July 6, 2015, RGB (© DigitalGlobe); c) Hillshade LiDAR A45-H10-Ve2.0.

Expected results

The selected areas present several critical issues for a successful application of LiDAR. Farming (i.e. Tavoliere plain) as well as urbanization (i.e. Ostia Antica) have probably invalidated the micro-relief of numerous evidence, but a moderate percentage of evidences has been detected (fig. 2). The analysis and comparison of these features with other sensors and sources has led to speculate on numerous matters, such as the archaeological record preservation, the specific characteristics of the archaeological features, the landscape management and so forth.

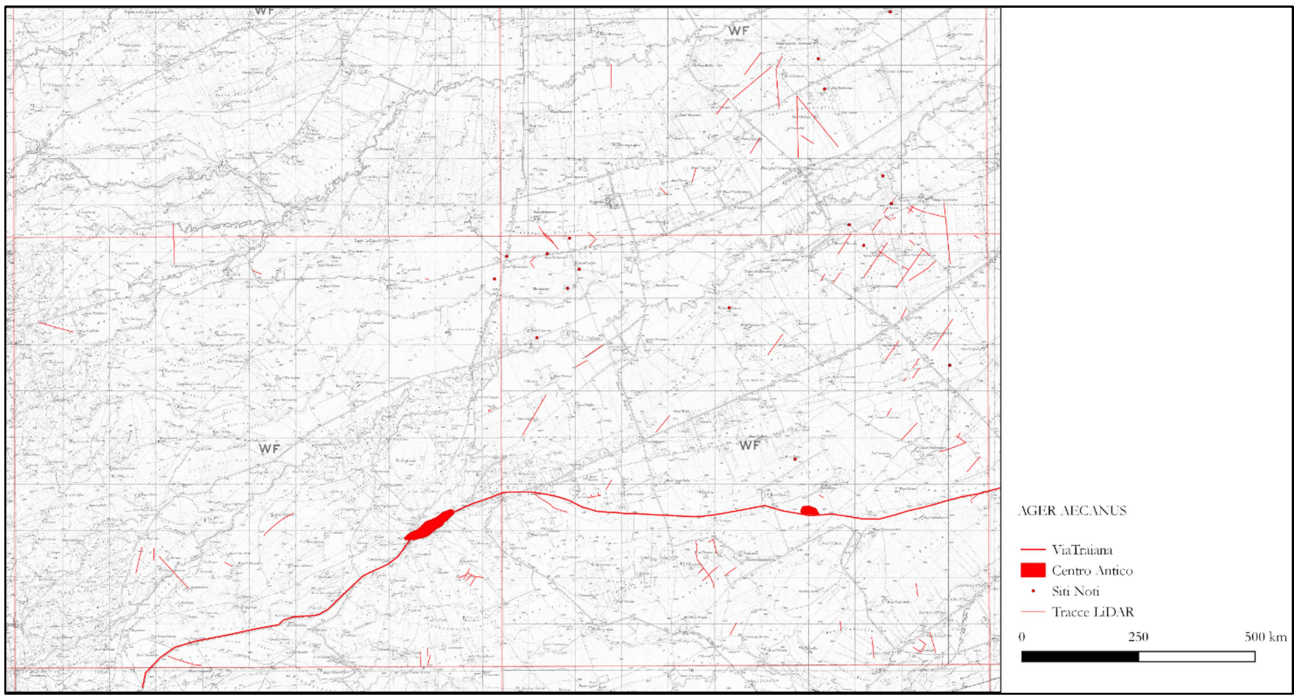

Fig. 2. Map of the LiDAR features detected on the Tavoliere Plain.

References

Opitz, R.S. and Cowley D.C. (eds.) (2013). *Interpreting Archaeological Topography. 3D data, visualisation and observation* (Occasional Publication of the Aerial Archaological Research Group, 5), Oxford: Oxbow books.

García Sánchez, J. (2018). 'Archaeological LiDAR in Italy: enhancing research with publicly accessible data', *Antiquity* 92 (364), pp. 1-10.

Bradford, J.S.P. (1957). *Ancient Landscapes. Studies in Field Archaeology*, Westport, Cunnecticut: G. Bell & Sons.

Martin A., Heinzelmann M., De Sena, E.C. and Granino Cecere, M.G. (2002). 'The urbanistic project on the previously unexcavated areas of Ostia', *Memoirs of the American Academy in Rome* 47 (2002), pp. 259-304.

Kokalj, Ž. and Hesse, R. (2017). *Airborne Laser Scanning raster data visualization. A guide to good practice*, Ljubljana: Založba ZRC.