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Using airborne LiDAR in geoarchaeological contexts: Assessment of an automatic tool for the detection and the morphometric analysis of grazing archaeological structures (French Massif Central).

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Airborne laser scanning (ALS) of archaeological regions of interest is nowadays a widely used and established method for accurate topographic and microtopographic survey. The penetration of the vegetation cover by the laser beam allows the reconstruction of reliable digital terrain models (DTM) of forested areas where traditional prospection methods are inefficient, time-consuming and non-exhaustive. The ALS technology provides the opportunity to discover new archaeological features hidden by vegetation and provides a comprehensive survey of cultural heritage sites within their environmental context. However, the post-processing of LiDAR points clouds produces a huge quantity of data in which relevant archaeological features are not easily detectable with common visualizing and analysing tools. Undoubtedly, there is an urgent need for automation of structures detection and morphometric extraction techniques, especially for the "archaeological desert" in densely forested areas.

This presentation deals with the development of automatic detection procedures applied to archaeological structures located in the French Massif Central, in the western forested part of the Puy-de-Dôme volcano between 950 and 1100 m a.s.l.. These unknown archaeological sites were discovered by the March 2011 ALS mission and display a high density of subcircular depressions with a corridor access. The spatial organization of these depressions vary from isolated to aggregated or aligned features. Functionally, they appear to be former grazing constructions built from the medieval to the modern period. Similar grazing structures are known in other locations of the French Massif Central (Sancy, Artense, Cézallier) where the ground is vegetation-free.

In order to develop a reliable process of automatic detection and mapping of these archaeological structures, a learning zone has been delineated within the ALS surveyed area. The grazing features were mapped and typical morphometric attributes were calculated based on 2 methods: (i) The mapping of the archaeological structures by a human operator using common visualisation tools (DTM, multi-direction hillshading & local relief models) within a GIS environment; (ii) The automatic detection and mapping performed by a recognition algorithm based on a user defined geometric pattern of the grazing structures.
The efficiency of the automatic tool has been assessed by comparing the number of structures detected and the morphometric attributes calculated by the two methods.

Our results indicate that the algorithm is efficient for the detection and the location of grazing structures. Concerning the morphometric results, there is still a discrepancy between automatic and expert calculations, due to both the expert mapping choices and the algorithm calibration.