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Geomorphological analysis of Castro de Laboreiro area (PNPG) with LiDAR data

Análise geomorfológica da área de Castro de Laboreiro (PNPG) com dados LiDAR

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Resumo: *Este trabalho apresenta os resultados da análise geomorfológica do relevo de Castro de Laboreiro (Parque Nacional da Peneda-Gerês). A interpretação realizou-se com recurso a dados topográficos de grande precisão vertical e horizontal (dados* LiDAR*) e fotografia aérea de elevada resolução. Assim, foi possível identificar e diferenciar formas de relevo características da área, tais como: relevos residuais, vales de fratura/falha, cones de dejeção/leques aluviais. Paralelamente, identificaram-se possíveis capturas fluviais com os respetivos cotovelos de captura e vales secos, assim como, a definição de pequenas paleobacias endorreicas. Os dados morfológicos acentuam a influência da fracturação/litologia nas formas de relevo desta área. Adicionalmente, demonstram a importância destes dados para o avanço no conhecimento geomorfológico do PNPG.*

Palavras-chave: *Análise Geomorfológica, Morfologia Granítica, Paisagens Relíquia, Dados LiDAR*

Key words: Geomorphologic Analysis, Granitic Landforms, Relict Landscapes, LiDAR data

Introduction

Geomorphological analysis of the landscape is essential to understand the processes that shape the Earth surface. The results can be applied in various fields, e.g., the management of natural resources or in the study of relief evolution.

To perform geomorphological analysis, it is important to have access to detailed topographic data. With the development of LiDAR (Light Detection and Ranging), and the increasing amount of data being gathered, researchers gained access to high-resolution topographic data. Additionally, LiDAR allows to filter vegetation returns and process a bare-ground digital elevation model (DEM). These models expose terrain features that couldn't be seen in traditional elevation models, aerial photography or during field work (Hudak et al., 2009; Glennie et al., 2013).

In this study, we explore the use of DEMs derived from LiDAR, to identify geomorphological features in Castro de Laboreiro, in Peneda-Gerês National Park (PNPG). Our main objectives comprise the analysis of the drainage network arrangement, relict landscapes and lithologic differences, the identification of geomorphological features (e.g., slope deposits, alluvial fans), and assess the influence of structure (tectonics and lithology) on the area landforms.

Methodology

To generate the DEM of the study area, we verified the provided LiDAR data classification (CIM Alto Minho) and corrected specific locations where the data was wrongly classified. In the case of the Castro de Laboreiro dataset, four small granitic mountain tops were wrongly classified as buildings or vegetation. The dataset errors were manually corrected with GIS software.

Following the data validation, the non-ground returns were removed, and a 50 cm resolution DEM was processed with the bare-ground returns. The model served as a base for terrain analysis with the extraction of geomorphic parameters (slope, drainage network, hillshade and contours). The resulting terrain data and high-resolution aerial photographs were used to analyse and identify the Castro de Laboreiro relief and geomorphological features. The results of the analysis were validated with field observations of key locations in the study area.

Results and discussion

From the analysis taken, it was possible to identify interesting features in the Castro de Laboreiro landscape (Fig. 1). Concerning the drainage network, several potential river captures were identified. One

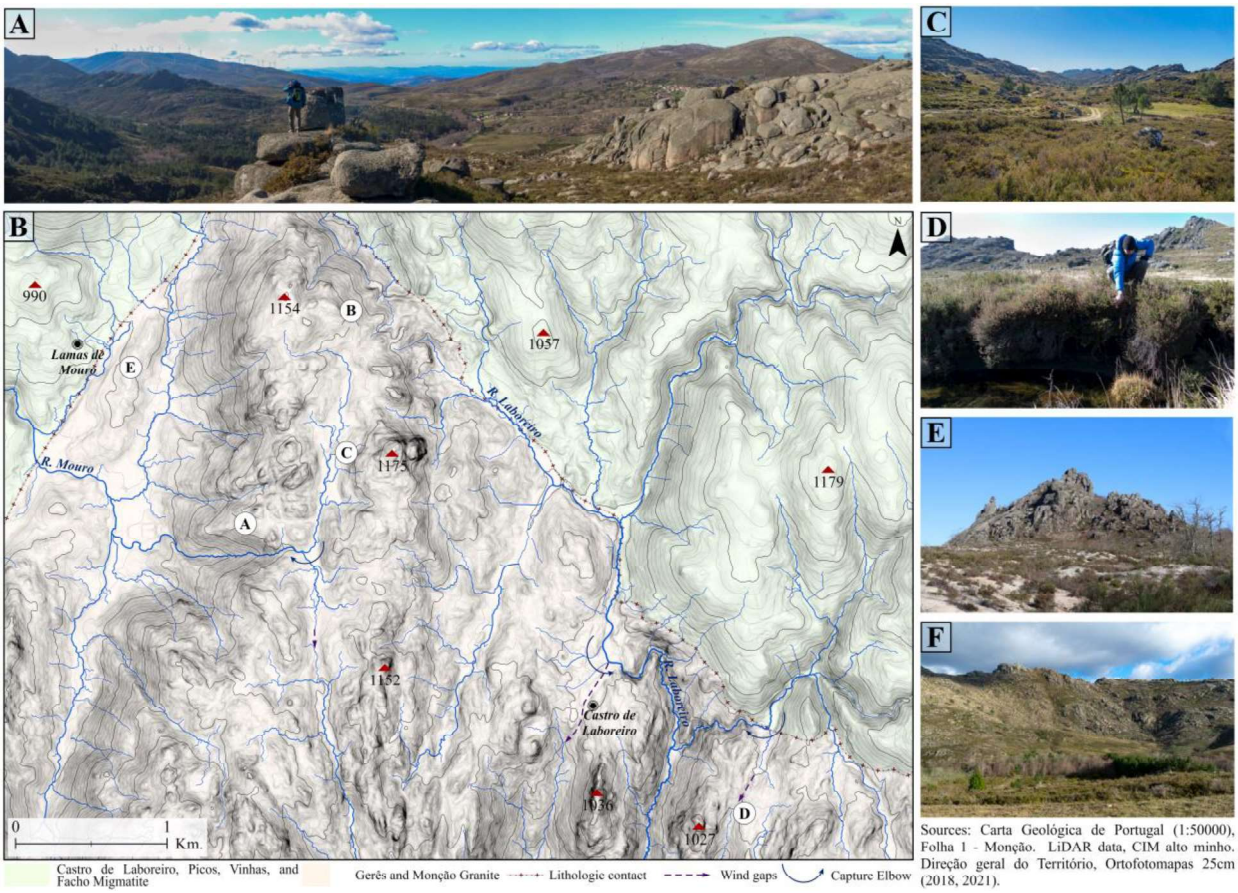

Fig. 1. The relief of Castro de Laboreiro area: A) Panoramic view over Lamas de Mouro depression, highlighting the contrast between the relief on granitic and metamorphic basement; B) Hillshade, Lithology and main hydrographic network map; C) Panoramic view of the potential perched endoreic basin; D) Peat and sand deposits filling the bottom of the potential endoreic basin; E) Granitic residual relief; F) Slope deposit.

in the Franqueira mountain top (Fig. 1B), between Lamas de Mouro and Castro de Laboreiro, where the river flows on a top flat surface, and then falls into the Mouro River watershed. The conditions on the top and the lowered divide indicate that the river previously flowed into the Laboreiro river.

In the same area, the presence of peat and sandy sediments filling the bottom of a probable perched watershed, suggest that the Franqueira mountain top might be an old endorheic basin. Additionally, two possible river captures in the Laboreiro river were identified, near Castro de Laboreiro. In this case, due to the presence of wind gaps and elbows of capture.

A high contrast between landforms and relief characteristics was identified between granitic and metamorphic basement, highlighting the relict landscapes of granitic residual landforms (Fig. 1D). Finally, we identified several slope deposits and small alluvial fans, in Lamas de Mouro depression (Fig. 1E). All these depositional landforms are in the west side of the Franqueira Mountain.

Conclusion

Overall, with this study we could confirm the usefulness of detailed earth surface models for geomorphologic analysis. Additionally, interesting geomorphic features were observed in the landscape of the PNPG, such as river captures and alluvial fans, indicating that this area has an important geomorphologic history to unveil.

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