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What can glacial cirque morphometry tell us about palaeoclimate in the Northern Iberian Peninsula?

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Glacial cirque landforms are the result of glacier erosion on mountain ridges and they are repeatedly activated on every glaciation. Cirque distribution is largely determined by climatic patterns during periods of glacier initiation, whilst their dimensions are largely determined by glacial erosion over tens of thousands of years (continued in successive glacial cycles), which is likely maximised during the onset and termination of periods of glaciation (Barr and Spagnolo 2015). Glacial cirque morphometry has been widely used in revealing glaciation climatic patterns (Barr et al. 2017).

In this contribution, the ACME GIS toolbox for ArcGIS (Spagnolo et al. 2017) was used to calculate glacial cirque morphometry in manually mapped glacial cirques N and NW of the Iberian Peninsula. Given that several mountain areas in N and NW of Iberian Peninsula are below the regional Late Quaternary ELA, only areas were Quaternary glaciation has been identified and described were used. A total of 445 cirques were mapped. A 5 m. pixelsize national DEM provided the surface data. The amount of cirque population makes us confident enough to dismiss the influence of topography, lithology or geological structure on the statistically relevant results.

Results show an unsurprising NW-SE cirque floor altitude increase pattern, which is concomitant to Quaternary ELA distribution. Cirque orientation shows a N-NE preference, which we interpret as temperature-driven, confirming that glaciation was marginal during a long period of the Quaternary. Cirque depth and shape shows larger, deeper and rounder cirques located in mountain ranges well above the ELA, where cirques have been active for longer.

Glacial cirque morphometry has proved to be valuable as palaeoenvironmental tool only if a large population of cirques is considered. The study area for this contribution -the entire Cantabrian Range- and the amount of cirques mapped, can be seen as a minimum thresholds for achieving reliable conclusions. Therefore, only through the use of automatic calculation methods, these studies can be performed in a cost-effective way.

I would like to stress the possibilities that ACME has for morphometric analysis on glacial and non-glacial landforms, such as cirques, drumlin, esker, landslides or meanders. Also, I would like to point to automatic or semi-automatic mapping tools as the way forward in the geomorphological mapping research field.