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## Evaluation of the Compound Topographic Index (CTI) for the location of gullies in cultivated areas of Córdoba (Spain)

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The identification of areas susceptible to gully formation is an objective that has important consequences for erosion control. It allows for the optimization of resources by focusing on prevention and control efforts on the most susceptible areas, avoiding the frequent evolution of ephemeral to permanent gullies. The issue is of great interest in Spanish olive groves, many of which are affected by serious problems of gully erosion.

Gullies are formed in the swales, which allows the use of topography-based tools to predict their location.

The Compound Topographic Index (CTI) proposed by Thorne et al. (1986) is calculated for each pixel as an estimate of the flow capacity to cause erosion, as it includes the product of the pixel draining area and its slope. Its application requires the identification of a critical value of the CTI (CTI<sub>c</sub>), above which the potential areas of gully occurrence will be located. Using historical orthophotos, the gullies observed were digitized for 2011 in the experimental areas called Morente (11 km<sup>2</sup> of traditional olive groves on degraded and poor vertisols) and Matasanos (6 km<sup>2</sup> of intensive olive groves also on vertisols) and nearby area, with cereal crops.

The objectives of this work are: to identify CTI<sub>c</sub> values corresponding to cultivated areas in Cordoba, mainly olive groves; to develop and evaluate an application that allows a user without great technical skills to obtain the CTI; to evaluate the capacity of this CTI<sub>c</sub> to reproduce gullies observed in nearby areas or in different time periods (2005) to establish cause-effect relationships between changes in landuse in this type of phenomenon, using the aforementioned tool.

Part of the digitized gullies, representative of olive grove areas, were used to obtain the CTI<sub>c</sub> of each gully, by modifying it until the best reproduction of the gullies observed was achieved, then their average value was taken as CTI<sub>c</sub>. To calculate the CTI, a 5m resolution DEM was used, obtained from LiDAR PNOA 2014.

In the framework of the Innolivar project, a desktop GIS application has been developed in a free software environment such as QGIS, which allows the calculation of the CTI. The APET tool (AGNPS Potential Ephemeral Gully Evaluation Tool) recently implemented has helped in the development of this application.

The CTI calculation by the application, after the determination of the CTI<sub>c</sub> threshold, serves to identify critical areas from a DEM, which is free and available in many countries. A first qualitative evaluation by visual verification indicates a very good characterization of the gullies. Subsequently, the goodness of fit of the gully position between the digitized gullies and the app-calculated gullies according to the CTI<sub>c</sub> is evaluated quantitatively by obtaining a binary confusion matrix by lengths. In the Morente area, an error of omission of 29% and of commission of 16% was obtained.

It can be concluded that the application generated that allows the application of the CTI methodology makes identification of areas susceptible to gully formation possible in an efficient and relatively simple manner, helping to achieve a more sustainable agriculture.