Long term characterization of ephemeral gully erosion from orthophotographs

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For a knowledge of the importance and characteristics of ephemeral gully (EG) erosion to be adequate, continuous observations and measurements for long periods of time are required. Despite recent methodological advances, such as the availability of drones or photo-reconstruction, the data obtained from orthophotos taken on approximately the same dates for several years in the same places can supply information of great interest. This study aims to explore the applicability of orthophotos taken during 8 years to make a semi-detailed characterization of erosion due to ephemeral gullies over an extensive area.

Thus, a homogeneous area as regards soil type, use and management, of around 570 hectares, was selected in the municipality of Pitillas, Navarra, frequently affected by EGs to carry out a long-term monitoring of it. From 8 orthophotos ($\approx$1:5000) taken in 2003 (17 Apr-20 Sep), 2006 (28 May), 2008 (19 Jun), 2010 (5-21 Jun), 2011 (25 Sep), 2012 (23 Jun), 2013 (24 Jul) and 2014 (17 Aug), the position of small channels was digitized, identifying their ends downstream and upstream, georeferencing them, and determining their length. All the photos were taken in approximately the same season, usually in the summer. Since the area was cultivated with winter cereal or was lying fallow, its gullies have remained on the land since their formation, generally at the start of the winter, up to their elimination. This probably occurs due to tilling during the preparation tasks of the following sowing time, generally after the flight period. If we also consider that the EGs in the area remain almost unalterable after the winter, protected by the dense cereal vegetation, it can be affirmed that the flight dates supply adequate information on their final state. The authors' knowledge of the land simplified the identification of the gullies on the orthophotos.

In the study area, 58 small watersheds were identified as being affected by EG erosion at least once during the study period. It was observed that most of the gullies, specifically 41 of them, appeared only once in their respective microwatersheds during the whole of that time. Of the 14 remaining ones, one of them appeared in 7 out of the 8 years studied, another one in 6 of the years, 2 of them appeared 5 times, another 2 did so on 4 occasions, 6 on 3 occasions and 5 on 2 occasions. The factors explaining that repeatability, or its absence, are not clear, although the topographic indicators proposed by De Santisteban et al. (2005) might help to shed some light on them. The places where the channels were formed were not exactly the same in the case of the gullies, which appeared repeatedly. This could be due to interannual variations in the soil's properties or its roughness due to tilling; and also to the nature of the precipitations causing them. A very high correlation was found between the total rainfall of the agricultural year and the total length of ephemeral gullies in the study area (R2= 0.85) in a linear regression between both annual variables. The total lengths of EGs ranged between 250 and 800 m, and the precipitations between 300 and 800 mm.

References

L. M. De Santisteban, J. Casalí, J. J. López, J. V. Giráldez, J. Poesen and J. Nachtergaele, 2005. Exploring the role of topography in small channel erosion. Earth Surf. Process. Landforms 30, 591–599