Geophysical Research Abstracts
Vol. 18, EGU2016-15091, 2016
EGU General Assembly 2016

A critical discussion on the applicability of Compound Topographic Index (CTI) for predicting ephemeral gully erosion

Javier Casalí, Youssef Chahor, Rafael Giménez, and Miguel Campo-Bescós
Public University of Navarre, Projects and Rural Engineering, Pamplona, Spain (chahor.youssef@unavarra.es)

The so-called Compound Topographic Index (CTI) can be calculated for each grid cell in a DEM and be used to identify potential locations for ephemeral gullies (e. g.) based on land topography (CTI = A.S.PLANC, where A is upstream drainage area, S is local slope and PLANC is planform curvature, a measure of the landscape convergence) (Parker et al., 2007). It can be shown that CTI represents stream power per unit bed area and it considers the major parameters controlling the pattern and intensity of concentrated surface runoff in the field (Parker et al., 2007). However, other key variables controlling e.g. erosion (e. g. e.) such as soil characteristics, land-use and management, are not had into consideration. The critical CTI value (CTIc) "represents the intensity of concentrated overland flow necessary to initiate erosion and channelised flow under a given set of circumstances" (Parker et al., 2007). AnnAGNPS (Annualized Agriculture Non-Point Source) pollution model is an important management tool developed by (USDA) and uses CTI to locate potential ephemeral gullies. Then, and depending on rainfall characteristics of the period simulated by AnnAGNPS, potential e. g. can become "actual", and be simulated by the model accordingly. This paper presents preliminary results and a number of considerations after evaluating the CTI tool in Navarre.

CTIc values found are similar to those cited by other authors, and the e. g. networks that on average occur in the area have been located reasonably well. After our experience we believe that it is necessary to distinguish between the CTIc corresponding to the location of headcuts whose migrations originate the e. g. (CTIc1); and the CTIc necessary to represent the location of the gully networks in the watershed (CTIc2), where gully headcuts are located in the upstream end of the gullies. Most scientists only consider one CTIc value, although, from our point of view, the two situations are different. CTIc1 would represent the minimum intensity of concentrated overland flow necessary to create a migrating gully headcut. Whereas CTIc2 would represent the minimum intensity of concentrated overland flow necessary for a headcud to migrate, once the headcut is created. CTIc1 would be linked to the primary downstream headcut. Whereas CTIc2 would be linked to the final (actual) position of the migrating headcut. This scheme involves accepting that create the incision head and enlarge the gully mouth requires more overland flow intensity than headcut migration itself. Despite several authors use CTIc to characterize the gully network caused by isolated rainfall events, in our opinion this methodology take on its full meaning when it is used to characterize mean trends of e. g. e. in homogeneous areas (in terms of climate, soil class and soil use and management). In addition, this global approach corresponds to the spirit and concept of AnnAGNPS and other management tools, which mainly explore the medium-long term effect of land use and management changes. On the other hand, this global approach minimizes the main limitation of CTI (according to which only topography is considered as controlling factor). However, this shall not preclude the incorporation of other factors (such as soil properties) in a future modified CTI. Another limitation that has been evidenced in our work is that CTI is only useful for the so-called "classical e. g.", which "are considered the prototype ephemeral gully, formed by concentrated runoff flows within the same field where runoff started" (Casalí et al., 1999). This is of interest because in the study area in Navarre, other classes of e. g. such as drainage e. g., which "are created by concentrated flows draining areas upstream from the field" (Casalí et al., 1999), are also very important. Anyway, and despite its limitations, CTI is probably the most widely used approach for predicting e.g. location.

REFERENCES

Casalí, J., J. J. López, J. V. Giráldez, 1999. Ephemeral gully erosion in southern Navarra (Spain). Catena 36, (1-2): 65-84.

Parker, C., C. Thorne, R. Bingner, R. Wells, D. Wilcox. 2007. Automated Mapping of Potential for Ephemeral Gully Formation in Agricultural Watersheds. NSL Tech. Research
Report No. 56. Oxford, Miss.: Watershed Physical Processes Research Unit, National Sedimentation Laboratory.