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Use of stereoscopic satellite images for mapping and characterization of rill and gully erosion

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Water erosion is one of the major causes of soil loss, and consequently one of the most important causes of economic loss for a region. Water erosion includes sheet, rill, gully and channel erosion, and contributes significantly to sediment delivery to permanent drainage network. Soil erosion is due to detachment and transport of soil particles by the direct action of raindrops and runoff water. When runoff concentrates soil erosion may locally peak with the formation of rills and gully channels. Direct measurements of soil loss during episodes of ephemeral gully formation are rare. Generally, gully erosion is measured by an a posteriori field survey, through the assessment of the eroded volumes. Hence, spotting gullies and large rills is extremely important to evaluate erosion on a slope. Field survey tends to underestimate channel erosion. Several studies attempted to determine length and depth of rills and gullies using stereoscopic aerial photographs in small areas. Very High Resolution (VHR) satellite images can allow mapping these features over larger areas. This work exploits the use of VHR stereoscopic satellite images in the Collazzone study area (Central Italy): (i) to identify and map erosion forms, (ii) to extract the relative channel morphometric parameters (i.e. length, width and depth), and hence (iii) to evaluate the eroded volumes. We estimated the power law fitting parameters correlating length and channel volumes, and we compared them to those in the literature estimated from field survey data. Finally we analyzed the density distribution of gully and rill channel length. Results show that rill-gully segments (a segment being the part of channel between two successive tributaries) follow an exponential distribution. This result can be used to simulate eroding network formations and hence to estimate their impact on a slope. Such a characteristic distribution complements the existing set of relationships which includes relations: (i) between the angles among tributaries and main channel and the local slope gradients, (ii) between channel width, channel bed roughness and formative peak discharge, and (iii) topographical thresholds for rill and gully formation.