Detecting major environmental parameters influencing the gully erosion occurrence in Mediterranean karst landscapes of Lebanon using remote sensing and GIS statistical correlations

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Soil erosion by water is one of the major causes of land degradation in Mediterranean karst environments, including Lebanon, which represents a good case study. This research deals with how to use Geographic Information Systems (GIS) for establishing the relationships between gully erosion occurrence and different environmental parameters over a representative region of Lebanon. Factors influencing the gully erosion process can be represented by different parameters, and each can be extracted from remote sensing, digital elevation models DEMs, ancillary maps or field observations. These parameters can be endogenous/quasi-static, i.e. soil type, organic matter content, soil depth, lithology, proximity to fault zone, karstification, distance to drainage line, slope gradient, slope aspect, slope curvature, or exogenous/dynamic triggering the erosion process, i.e. land cover/use, proximity to sources and rainfall erosivity. All these parameters have been analyzed and correlated with existing gullies under a GIS environment. The gullies were first detected through visual interpretation of two stereo-pairs of SPOT 4 images (anaglyph) at 10 m resolution. This study indicates, depending on bivariate remote sensing and GIS statistical correlations (Kendall Tau-b correlation), that the soil type is the most influencing factor on gully erosion occurrence. It also shows that statistical correlations to gullies exist best between the extracted parameters at the following decreasing order of importance: soil type–lithology, soil–land cover/use, soil–slope gradient, lithology–distance to drainage line, and soil type-karstification at 1% level of significance, and lithology–proximity to fault line, slope aspect-land cover/use, and soil type-slope curvature at 5% level of significance. These correlations were verified and checked through field observations and explained using univariate statistical correlations. Therefore, they could be extrapolated to other Mediterranean karst countries having similar geo-environmental conditions.