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Routing soil particles in a distributed model with GIS in Mediterranean agricultural landscapes and implications for wetland conservation

M. López-Vicente, A. Navas

Department of Soil and Water, Estación Experimental de Aula Dei, Apartado 202, 50080 – Zaragoza, Spain. Corresponding author E-mail: mvicente@eead.csic.es

Intense human action on the landscapes and limiting climate conditions are main threats to preserve Mediterranean wetlands. Distributed modelling of runoff pathways with GIS lead to accurate estimations of soil erosion and deposition rates at catchment scale. The semi physically-based revised Morgan, Morgan and Finney (RMMF) model calculates the detachment of soil particles by splash and runoff and compares these rates with the transport capacity of runoff to predict annual rates of soil erosion. In this work the RMMF model was modified with a simple flow, a multiple flow and a combined flow algorithm with two threshold values to calculate the distributed volume of the effective runoff. After field observations one threshold value of the combined flow algorithm was associated with the beginning of the gullies. The modified RMMF model was applied in the endorheic "Laguna Grande de Estaña" catchment (120 ha) that holds a protected wetland area (Central Spanish Pre-Pyrenees). Distributed maps of initial and cumulative runoff and soil loss were calculated and rates were obtained for different land uses and geomorphological units. The highest rates of erosion ($>$ 30 Mg ha^{-1} yr^{-1}) were associated to areas of bare soil, paths, open Mediterranean forest and barley fields located on slopes, whereas the lowest rates ($<$ 1.0 Mg ha^{-1} yr^{-1}) were found in dense scrubland, oak forest, pasture and poplar. The main stream of the catchment, steepest areas, alluvial deposits, areas of massive gypsum and gullies had high soil losses ($>$ 30 Mg ha^{-1} yr^{-1}), whereas divides and colluvial deposits had the lowest rates ($<$ 5.0 Mg ha^{-1} yr^{-1}). The combined flow algorithm adapted to the gullies best represents the existing runoff flow-path. The estimation of deposition rates

in the areas surrounding the lake are of 2.2 mm yr^{-1} and agree with existing records of siltation rates in sediment lake cores. These results suggest that the modification performed with GIS included in this work allowed the sound assessment of the actual processes of soil loss and runoff redistribution in the study area. The information generated with the modified model could be used to implement soil and water conservation practices for the preservation of wetlands in Mediterranean environments.