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Assessment of monthly soil erosion rates in different land-uses of a Mediterranean agro-system at high spatial scale

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Distributed soil erosion models are potential tools for identifying sediment sources. However, the uncertainty of model predictions in different land-uses has yet to be resolved. In this work the erosion module of the SERT (Soil Erosion and Redistribution Tool) model is presented and used to estimate soil loss by sheet and rill erosion at monthly scale in a small endorheic sub-catchment in the Spanish Pre-Pyrenees (0.7 ha). The different land-uses of the study area are crops of winter cereal, pasture, Mediterranean and oak forest, and dense scrublands. The physical basis of the SERT model is the revised Morgan, Morgan and Finney (RMMF) model, though overland flow per raster cell and cumulative overland flow volume are calculated after assessing the volume of rainfall to ponding (López-Vicente and Navas, 2008 [Geophysical Research Abstracts 10: 03390]) and by using multiple and combined flow algorithms (López-Vicente and Navas, 2009 [Land Degradation and Development DOI: 10.1002/ldr.901]). The SERT model also deals with the effect of soil microtopography, roughness, infiltration properties, temporal changes of soil moisture and the number of monthly erosive events. The main target of this work is to compare the predicted soil erosion rates in different Mediterranean land uses with the SERT model as well as to discuss the effect of the temporal changes of climatic conditions and soil properties. A total of 266 soil samples were collected in order to obtain a detailed database of the different soil properties. All maps were derived with a GIS application and the model was run at a spatial resolution of 5 x 5 meters. Results underline the complexity of runoff connectivity in the study area due to the presence of sinkholes, stone bunds and terraces. The average annual erosion rate for the whole catchment is 17.5 Mg ha-1 yr-1, though the predicted rates of soil erosion vary at temporal and spatial scales. The highest values of cumulative overland flow, total soil detachment and soil erosion take place in September when rainfall intensity is the highest. Soil erosion in September and October represent 68.3 and 9.4 %, respectively, of the total annual amount of eroded soil. Moreover, from November to June same areas of the catchment do not become saturated and thus no soil erosion is expected. Crops had the highest erosion rates of the different land-uses with an annual average rate of 48.5 Mg ha-1 yr-1, whereas the lowest rates were obtained in pastures (1.5 Mg ha-1 yr-1) and in Mediterranean forest (0.03 Mg ha-1 yr-1). This work has proved the usefulness of the SERT model to improve the monthly assessment of overland flow volume at catchment scale and soil erosion rates for different land-uses. The SERT model is quite sensitive to the temporal changes of rainfall intensity, soil saturation and cumulative overland flow. This model allows identifying areas with no erosion as well as to consider the monthly and seasonal variations of the parameters of canopy cover and thus their influence on soil erosion rates for different land-uses. The information gained is of interest for better understanding the hydrological dynamics of runoff generation and the effect of different land-uses in controlling the processes of soil loss by sheet and rill erosion under Mediterranean climatic conditions.