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Assessing soil losses in mountain agricultural fields by applying the RUSLE and the MMF models

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Two soil erosion maps calculated with the RUSLE and the MMF models are compared in a set of rainfed crops of winter barley. The selected fields for this study are located in the Spanish pre-Pyrenees, covering a total extension of 48.5 ha. The study area has a temperate climate with a mean annual precipitation of 631 mm and a mean value of temperature of 12.8°C. The soils are developed on two different types of lithologies, which are clay with gypsum and limestones. The two selected models predict an average annual value of soil loss at long-term. The empirical RUSLE model calculates the soil loss as a function of the rainfall and runoff erosivity and the soil erodibility. Then, this value is modified with the factors of topography, cover management and the support practices. The MMF approach is a semiphysically-based model which compares the predictions of soil detachment by rain-splash and the transport capacity of the runoff, selecting the smallest value of the two predicted maps as the soil loss rate. In order to calculate the input values a field survey was carried out, collecting a total of 77 soil samples. The soil properties analysed were soil moisture content at field capacity, bulk density, organic matter content, percentage of coarse fragments and grain size and the textural classes and the soil detachability index were established. Moreover, the saturated hydraulic conductivity and the effective hydrological depth were measured for each soil type, as well as changes in soil moisture. Finally, the ratio between the actual and potential evapotranspiration, the rainfall interception, the surface roughness, the canopy cover and the plant height were calculated for the winter barley crop. This database was linked in a GIS application as well as the digital elevation model.

The mean soil loss calculated with the RUSLE model was 0.09 kg $m^{-2}yr^{-1}$ with a maximum value of 5.11 kg $m^{-2}yr^{-1}$, whereas the mean and maximum values pre-

dicted with the MMF model were 0.47 and 6 kg m^{-2} yr^{-1}, respectively. The map of soil losses calculated with the RUSLE model has a homogeneous distribution over all these fields and a general low rate of erosion, however there is an abrupt change from the fields with low rates to that with the highest values. The map of soil losses produced with the MMF model is characterized by a gradual distribution of the soil loss rates. Despite of the differences in the mean soil losses estimated with the models, the highest rates of predicted soil erosion are quite similar and they occur in the same areas, which correspond to the steepest fields. Hence, with both models it is possible to identify the areas with the highest erosion risk in order to design effective protection management practices to minimize the lost of fertile soil.