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A probabilistic water erosion model for Mediterranean olive orchards with changing cover factor

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A simple probabilistic framework is presented to describe soil and water loss in olive orchards in Mediterranean environments. The model is based on the exploration of field observations, obtained during three hydrological years (2003-2007) from a network of 1m2 microplots located in olive orchards throughout southern Spain. The objective of this experiment was to compare soil erosion under conventional tillage (CT) and a cover crop system (CC).

The basis of the model is a linear relationship between soil and water loss (output) and key variables (input). The exploration of field observations suggested that the key variables were i) rainfall, which was easily described by a gamma probability density function (pdf), ii) slope, for which we adopted a uniform pdf, with values ranging from 4 to24%; and iii) cover factor. This factor could be well described using a truncated beta pdf, but due to the growing trend in the data we proposed an expression similar to a sigmoid curve. Runoff and sediment yield in both soil managements were best represented by exponential pdfs.

To generalize the model we combined it with a Monte Carlo scheme to generate the inputs randomly. The model was run using the simulated input data and the relative frequencies of simulated output data were compared with the proposed pdfs for the observed data.

The results showed the ability of the model to provide a probabilistic description of soil erosion. Observed and simulated data indicated that the probability to obtain higher soil losses was larger in CT as compared to CC. Therefore, conservationist soil management is essential for maintaining the productivity of olive orchards in this area.

Keywords: soil management, erosion processes in olive orchard, probability density function, Monte Carlo scheme.