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Finding strategies to reduce soil erosion using modelling tools: a case study in olive orchards of Cordoba (Spain) including sheet and rill erosion, ephemeral and permanent gullies

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Agricultural activity can have a significant effect on the environment. Often, the lack of experimental data leaves simulation models as the only alternative for understanding and assessing such effects and they can be useful for exploring the response of agricultural systems to different scenarios, in order, for example, to minimize soil erosion or the pollution of watercourses by agrochemicals.

In this work we present a simulation exercise of the runoff and erosion in two typical olive groves of the Cordoba countryside with contrasting characteristics during the 2009-19 period. The model used is AnnAGNPS, widely tested and very well suited for use in agricultural environments. The specific objectives are: to analyze the applicability of the model confronting its results with data from other nearby areas; to determine the controlling factors of runoff and erosion, such as seasonality; to quantify the importance of the main types of erosion; to explore the response to two different management scenarios.

The study areas were two, Matasanos (189.4 ha of intensive olive groves on vertisols) and Morente (4.2 ha of traditional olive groves on degraded and poor vertisols). The first scenario (TC) consists of maintaining the soil bare by means of continuous conventional tillage. The second (CC) considers a temporary vegetation cover (around 70 %) on the lanes. All the possible types of erosion in those areas are considered: sheet and rill, ephemeral gullies (EG) and permanent gullies (PG). For the purposes of the simulations, the EGs are tilled while the PGs are not. The latter show more constant characteristics over time (although they also evolve), and are larger in size (i.e., they were assigned a greater depth).

The results show a significant decrease in average annual runoff in CC with respect to TC (38% in Matasanos and 55% in Morente), which is concentrated in the late autumn and winter months. Thus, according to our simulations, still preliminary, the implementation of covers would have

achieved one of its objectives, which is to reduce the runoff generated in the watersheds.

The sediment yields in both watershed outlets also suffered a significant decrease in CC with respect to TC, going from 4.75 to 1.66 Mg/ha/year and from 16.2 to 6.9 Mg/ha/year in Matasanos and Morente respectively. The simulated erosion rates are consistent with observations made in the area and with other previous simulation exercises. Both sediment export and runoff show a marked seasonality, although erosion occurs somewhat more distributed throughout the year. The different types of erosion take on different importance in each watershed. For example, permanent gullies play a very important role in Morente (46% in TC and 44% in CC), despite they are active at very specific times, probably with extreme events, which is reasonable according to the observations made in the area. The results show that the model is apparently useful with respect to the proposed objectives, allowing the effect of different uses and management on the environment to be contrasted in the medium and long term.