Modelling the contribution of ephemeral gully erosion under different soil management in an olive orchard microcatchment using the AnnAGNPS model

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Abstract. In Spain, few studies have been carried out to explore the erosion caused by processes other than inter-rill and rill erosion, such as gully and ephemeral gully erosion, especially because most of the available studies have evaluated the erosion at the plot scale. A study was undertaken into the environmental and economic impact of different soil management strategies, spontaneous grass cover with and without gully control (SC/SCGC) or conventional tillage with and without gully control (T/TGC), based on the experimental results obtained in an 6.1 ha olive crop microcatchment.

Initially, two years of rainfall-runoff-sediment load data series, (34 events) recorded under the current management (SCGC), was used for the calibration of the AnnAGNPS model at event and monthly scales providing suitable adjustments of runoff, peak flow and sediment loads (E >70, r >0.85). Ephemeral gullies were also identified using aerial orthophotography and field work.

The module of the AnnAGNPS model for simulating ephemeral gully generation and the tillage operations based on a bibliographical review were used to compare different scenarios and to perform a 10 year-analysis. The results showed mean runoff coefficients of 10.0% for SC/SCGC and of 3.2% for T/TGC while the average sediment loads were 2.0 t.ha-1year-1 (SCGC), 3.5 t.ha-1year-1 (SC), 3.3 t.ha-1year-1 (TGC) and 4 t.ha-1year-1 (T). Significant differences in sediment sources (rill/inter-rill erosion and ephemeral gullies) were evaluated between SC (46% of gully contribution) and T (19% of gully contribution), in order to optimize the environmental and economic effort required in each case.

Finally, the annual costs associated with soil losses were estimated (< 1 €.ha-1year-1). SC was the most profitable alternative for soil management. Despite the additional reduction in soil losses of the SCGC approach, the higher cost of its implementation and the minor effect on yield losses in the medium term suggest that without additional support (such as subsidies for gully control measures), farmers would have not an obvious incentive to use it.