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Modelling the effects of land abandonment on runoff and erosion at catchment scale

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Land abandonment is nowadays widely spread in Mediterranean countries and is expected to increase, due to changing EU policies, urbanisation and climate change. Several studies showed that land degradation will increase after abandonment, especially under semi-arid conditions. The main cause of increased erosion is the absence of ploughing and a slow vegetation recovery, which results in the formation of soil crusts, lower infiltration rates, and increased runoff and erosion. Especially gully erosion through agricultural terrace walls is a major source of sediment from abandoned fields.

The objective of our study was to assess the effects of land abandonment on runoff and erosion for a semi-arid catchment using a multi-scale approach based on hydrological connectivity. The study area was the semi-arid Carcavo catchment in Southeast Spain, where large parts of agricultural land have been abandoned. We simulated runoff and sediment dynamics at the catchment scale with the LAPSUS model. From a large rainfall simulation database we derived the main parameters for infiltration and runoff for the different combinations of land use and substrate.

The analysis of the rainfall simulation showed that the runoff threshold for abandoned land was much lower than for shrubland and agricultural land, while the runoff coefficient was higher for abandoned land compared to shrubland. We simulated runoff and erosion for different scenarios of land use and maintenance of agricultural terraces. Runoff and sediment yield for the scenario without agricultural terraces were, respectively, a factor four and nine higher compared to the current situation, while runoff and erosion rates where about 20% lower for the scenario of conservation of all agricultural terraces. Distributed erosion modelling enables the identification of erosion hotspots, which makes the mitigation of soil erosion more effective.