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Impacts of climate change on erosion in humid and dry Mediterranean regions of Portugal

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Soils in the Mediterranean regions of Europe are often vulnerable to soil erosion, due to a combination of annual plant cover cycles, centuries of human use, the concentration of rainstorms in a short period of the year, and other factors. Climate change could bring about a warmer and drier climate, limiting vegetation growth while bringing heavier storms during winter. This could eventually lead to higher risks of soil losses and the consequential problems of land degradation and desertification.
Project ERLAND, which began in 2009, is assessing these risks for two Mediterranean research catchments in Portugal, with four main goals: (i) collect data to understand hydrological and erosion processes in representative catchments; (ii) use this data to parameterize the SWAT eco-hydrological and erosion model as accurately as possible; (iii) use future socio-economic scenarios to estimate both impacts on climate change and on future land-use practices; and (iv) apply the SWAT model for these scenarios and estimate the consequences for soil erosion rates.
The Macieira catchment is in a wet Mediterranean climate region, with high rainfall (c. 1300 mm.y-1) but a distinct summer dry season; erosion processes are associated with periods of sparse cover in autumn in fields with a pasture-corn rotation, but also with forest plantations after clear-cutting and especially after forest fires. The occurrence of a forest fire inside the catchment in 2011 allowed an analysis of the role played by this kind of disturbances on soil erosion. Climate change could bring less erosive rainfall events, but an increase in fire frequency, and therefore a potential shift of erosion from agriculture to forest land-uses.
The Guadalupe catchment has a dry Mediterranean climate (rainfall of c. 550 mm.y-1); erosion processes occur mostly in permanent crops (olive trees) and winter cereal fields. Climate change could bring a concentration of rainfall in winter, as well as an increase in the area with permanent crops, bringing additional exposure to erosion.
This communication presents the overall concept and work performed in project ERLAND, including an assessment of the large impact of the fire in the wet catchment (Macieira) on soil erosion rates, where results indicate that soil losses after soil preparation for forest replanting might be equivalent, in long-term, to soil losses in agricultural fields. It also provides preliminary results for the impacts of climate change on soil erosion in the dry catchment (Guadalupe), which indicate a potential increase of soil loss rates by 2100 in the most vulnerable areas (winter cereal fields and olive groves) due to a higher concentration of rainfall in winter. The foreseen replacement of some winter cereals and pastures by sunflower cultivation for biofuel production could also lead to important changes in erosion rates.