



Historical soil erosion rates in rangelands of SW Spain determined using botanical evidences and high resolution 3D data

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The estimation of medium-term sheet erosion rates represents still a challenge in areas with long land use history. In the present paper, a new methodology for estimating medium-term sheet erosion rates is presented and applied in a wooded rangeland (dehesa). This human-induced semi-natural ecosystem is widespread in SW Iberian Peninsula and is characterized by centuries of agrosilvopastoral land use, being livestock breeding the most important economic activity at present. Vast areas are covered by shallow and poor soils, pointing to a long history of soil erosion. Research carried out in a representative area with open plots revealed low soil loss rates and degradation studies showed high spatial variation related with land use intensity. Knowledge on past soil erosion rates and its relation with land use is necessary in order to understand present soil properties and also for giving adequate advice on land management.

The present paper presents results of a pilot study on historical soil erosion in Mediterranean wooded rangelands. The methodology is based on the analysis of the morphology of tree stems, exposed roots and surface micro-topography using data obtained with a Terrestrial Laser Scanner. Specifically, botanical evidences were used to estimate the antecedent level of the soil surface. Afterwards, previous and current surfaces were confronted in order to obtain a volume of soil loss in the area influenced by the tree canopy, as well as for the open spaces. On the other hand, the age of the trees in the study area was estimated by means of an existing tree growth model. Finally, soil erosion rates were calculated using the volume of soil loss and the estimated age of every tree. The sampling was carried out in a farm in the Spanish province of Cáceres, with a two-layered vegetation, of grasses and scattered trees (*Quercus ilex*). Climate is Mediterranean with mean annual temperature of 16°C and an annual rainfall of 620 mm. Soils are very shallow, developed on schist, with low amounts of organic matter and classified as distric Leptosols. A representative hillslope was selected for the sampling, obtaining a point cloud of approximately 90 million points in an area of 44179 m² and a mean slope of 10%. A total of 133 trees were processed, with ages ranging from 49 to 336 years.

Mean soil loss rates below tree canopies and in the open spaces were 1.47 mm y⁻¹ and 1.67 mm y⁻¹, respectively. High soil erosion rates were estimated for young trees while lower rates resulted for the older ones. A negative relationship was obtained for soil erosion rates and tree ages, pointing out to land-use intensification during the past. The data reveals three different periods with distinct erosion rates, the first spanning from approximately 1660 to 1840 with very low values similar to natural rates, a second period until the beginning of the 20th century with 0.25 mm y⁻¹ and the third one including approximately the last 100 years with 2.11 mm y⁻¹. These results agree with historical information on deforestation and cultivation in the area. Research is being intensified in other study areas in order to prove these preliminary results and to improve the methodology.