Geophysical Research Abstracts,
Vol. 11, EGU2009-10554, 2009
EGU General Assembly 2009

Relationship between gully erosion and hydrology in a small rangeland catchment

Á. Gómez (1), S. Schnabel (1), J.J. Sanjosé Blasco (2), and J.F. Lavado Contador (1)

(1) University of Extremadura, Geoenvironmental Research Group, Dpto. A. y CC. del Territorio, Cáceres, Spain (alvgo@unex.es), (2) University of Extremadura, Dpto. de Expresión Gráfica, Cáceres, Spain

Gully erosion plays an important role in degradation processes of Mediterranean environments. Relatively little is known about relationships between gully erosion rates and rainfall or discharge in these areas. The aims of this work are: quantifying gully erosion, analyzing its spatial and temporal variability and evaluating its relationships with catchment hydrology. The study was carried out in a small catchment (99.5 ha) located in the SW of the Iberian Peninsula. The topography is undulated with an average slope of 7.6%. Climate is Mediterranean with a pronounced dry season. Annual and inter-annual rainfall variation is high with an annual average of 510 mm. Vegetation cover is formed by a tree layer of Holm oaks (Quercus rotundifolia) and an herbaceous layer characterized by therophytes. The land use is representative of wooded rangelands (dehesa) land use and is based on grazing by sheep and seasonally by pigs.

The channel is a valley bottom discontinuous gully incised into an alluvial sediment fill of approximately 1.5 m. The gully is a second order channel with a tributary joining the main branch at 174 m from the basin outlet. Mean width and depth of the gully is 3.3 m an 0.6 m, respectively. The main channel presents several headcuts along its course including one in the upper limit, while the tributary presents 2 very active headcuts close to the junction. Gully erosion or accumulation volume was obtained by means of 28 fixed cross sections measured with a frequency of 6 months during the period 2001-2007. Cross sections were measured using a laser total station which allows increasing the profile resolution in critical areas (such us bank toes or channel bed). Discharge was determined using a water depth probe installed in a weir at the outlet of the catchment. Rainfall was registered by means of 6 tipping bucket rain gauges distributed over the catchment. Both discharge and rainfall were registered with a resolution of 5 minutes.

Results showed a total erosion of -22.98 cubic meters which represents a rate of -4.17 cubic meters/year. The records presented a high spatial and temporal variability. Large erosion volumes were measured during the 2nd semester of the year (from July to December), while accumulation volumes were registered during the 1st semester (from January to June). This variability was associated with rainfall amount and distribution during the observation periods. In fact, erosion or accumulation volumes were closely related with rainfall in a linear way (with $r=0.90$ and $p<0.01$). Other variables were also related with the amount of sediment loss in the channel such as the number of times event discharge exceeded 1000 cubic meters (with $r=0.76$ and $p<0.01$), the number of times peak discharge exceeded 100 l/s ($r=0.72$ and $p<0.02$) and total discharge ($r=0.66$ and $p<0.03$).

Several processes contributed to the development of the gully: i) headcut retreat, ii) deepening of the channel, iii) widening of the channel due to lateral incision followed by bank collapses. Piping was not involved in the development of the gully. Gully erosion was associated with large amounts of rainfall and water saturation in the valley bottoms, while sediment deposition in the channel was related with sheetwash along the hillslopes during periods with low rainfall amounts.