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Testing AnnAGNPS model in predicting ephemeral gully erosion in Navarre (Spain)

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Gully erosion is a phenomenon that provokes important in-site and off-site damages in Navarre (Spain). Precisely, ephemeral gullies are common erosion features in agricultural fields of this region. Extensive field monitoring has been carried out by the authors in order to quantify this form of erosion, but much less effort was devoted to the modelling of this phenomenon.
In fact, physically based prediction technology to assess the magnitude of ephemeral gully erosion is currently scarce. To address this issue, a conceptual and numerical framework was recently incorporated in the Annualized Agricultural Non-Point Source (AnnAGNPS) model in which ephemeral gully development, growth, and associated soil losses are simulated. However, field evaluation is still limited. This approach incorporates analytic formulations for plunge pool erosion and headcut retreat within single or multiple storm events.

In this work, preliminary results in the evaluation of AnnAGNPS capabilities to estimate ephemeral gully erosion under local (Navarre) conditions are presented.

The study was carried out in a wheat field located in the region of Pitillas, southern Navarre. The climate is continental Mediterranean with a mean temperature of 13ºC and annual rainfall of 500 mm. The soil is loamy and silt-loam in texture. Four ephemeral gullies monitored in situ during 1999-2001 were selected and their morphology (cross-section area, length, width) and associated topographic parameters (drainage area and its main slope) were determined. This dataset was used as reference values to evaluate the AnnAGNPS performance to recreate the dimensions of the observed ephemeral gullies. Climatic data for the same period were used in the simulation. The topographic parameters were computed by AnnAGNPS using a digital elevation model of 5-m resolution. Gully initiation should be indicated by the user.

Overall, very poor results were obtained in the simulation. However, if upslope drainage area and its slope is manually inputted the model performance much improved, but still with an underestimation of 35% on average. Errors in the volume estimation are mainly due to discrepancies in the recreation of channel length.
This first approach suggests that the analytical formulations of the model for predicting ephemeral gullies are satisfactory. However, for an automatic determination of the topographic parameters in gentle landforms a high-resolution DEM should be used.