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Evaluation of the AnnAGNPS model for predicting runoff and sediment yield in a small Mediterranean agricultural watershed

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Four experimental watersheds with contrasting land uses located in Navarre (Spain), and maintained by the local government have been monitored and studied since 1996 (La Tejería and Latxaga) and 2001 (Oskotz principal and Oskotz woodland). As a result, a detailed description and a general characterization of the hydrological and erosion behaviour of these watersheds were published recently by the same authors of this current research. This information is of great utility for evaluation of modelling tools; however, we have been done few efforts until now in this research line.

The Annualized Agricultural Non Point Source Pollution Model (AnnAGNPS) is a well known and widely used model developed by the USDA-ARS and the USDA- NRCS, to assess the hydrologic and water quality responses of watersheds. More precisely, it is a distributed parameter, physically based, continuous simulation, and daily time step model.

The purpose of this study is then to evaluate the AnnAGNPS model capability to simulate runoff and sediment yield with data sets from one of our agricultural watershed: Latxaga.

Latxaga watershed covers an area of 207 ha and is located in the central eastern part of Navarre. Its climate is humid Sub-Mediterranean, with an average annual precipitation of 835 mm, and an average annual temperature of 12.8 ºC. Geologically, the area is underlined by clay marls and sandstones. Prevailing soils are alkaline with a fine texture top-layer. Regarding land use, 80-90% of the total area is cultivated with winter grain crops.

The model was calibrated using two years (2003 and 2004) of continuous 10-min/daily data, whereas another whole year (2005) was used for model validation. The calibration process was carried out by modifying Curve Number (CN) values obtained by standard procedure. CN represents a key factor in obtaining accurate prediction of runoff and sediment yield; besides it is the most important input parameter to which the runoff is sensitive. The target variable was total annual runoff and its temporal evolution during each year. Model performance assessment after calibration was carried out by qualitative (by visual comparison of graphics) and quantitative approaches (using Nash and Sutcliffe's coefficient of efficiency E for monthly values, coefficient of determination R^2 and coefficient of residual mass CRM). The initial values of CN, unique for each land use, were modified; in spite of achieving a satisfactory capability in simulating runoff/sediment yield, CN was anyway splitted up, adjusting the values to the main different stages of each crop. In that way, the model performance dramatically improved. Then, the predicted and measured annual average runoff after calibration were respectively 70.17 and 70.78 mm/ha/year, with R^2= 0.78 and E = 0.77. However, annual sediment yields and peak flows were over predicted respectively by 42% and 26%. Sediment yield were over estimated especially during dry season and the beginning of wet season where (sometimes) some runoff was predicted even though none was in fact recorded. This suggests that during summer/autumn period the hydrologic component of the model was not able to satisfactorily reproduce the interaction between the drier antecedent conditions/high water holding capacity of soils before any event and the small total volume –though high intensity– of the rainfalls.

Regarding model validation, a satisfactory estimation of runoff with E$>$ 0.57 was also obtained.

Finally, it can be stated that AnnAGNPS arises as a promising management tool for our agricultural watersheds.