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Evaluation of runoff prediction capability at the event scale in a large olive-grove Mediterranean watershed with AnnAGNPS model

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The distributed parameter and continuous simulation AnnAGNPS model was implemented in the Anzur watershed (Andalusia, Spain) to evaluate its prediction capability of surface runoff under the Mediterranean semi-arid conditions. The experimental watershed (308 km2) is mainly covered by olive groves (more than 75% of the area); the prevalent soil texture is silt loam.
Model implementation was performed using a 5-year database with hydrological, geomorphologic and land use data on the experimental watershed. Two hundred and forty-two runoff events were modelled by AnnAGNPS and compared to the corresponding observations recorded at the watershed outlet through the statistical, efficiency and difference indexes commonly used in modelling experiences. The analysis was carried out at event, monthly and yearly scales, considering all the events and a separate analysis was performed on a selection of 46 erosive events (following rainfalls higher than 13 mm), in order to assess AnnAGNPS suitability to simulate those events determining the highest erosive rates under semi-arid conditions.
The initial parameterisation was established by following AnnAGNPS model and literature data arranged for a watershed with similar characteristics. Then, the model was calibrated by adjusting of Curve Numbers which meant the best values Nash-Sutcliffe coefficient and root mean square error.
Before calibration extreme runoff events were strongly overestimated by the AnnAGNPS model, while prediction capability of the ordinary runoff volumes was more accurate, but always unsatisfactory (coefficients of efficiency of Nash and Sutcliffe E « 0 and correlations between predicted and observed events close to zero). After many calibration trials (with CN 35 for olive grove for soil hydrologic group “B” instead of 31 default value) model performance slightly improved, even though its prediction capability of runoff was poor at all the analysed time scales (best E < 0.30).
The inaccuracy shown by the AnnAGNPS model in runoff simulation may be attributable to some factors, as the large watershed area (beyond the limit suggested by model developers) where the travel times are longer than a day, the apparition of aquifers associated to limestone lithologies (contributing to generate surface flow) and the quality of some hydrological and geomorphologic data within the experimental database (which affected hydrological process modelling). Furthermore, the satisfactory model capability in simulating potential evapo-transpiration losses let us state that the inaccuracy shown by AnnAGNPS in simulating runoff volumes was basically due to its difficulty in modelling water balance of the soils and the water losses for infiltration under the experimental conditions.
New calibration strategies based on the adaptation of hydrological parameters to seasonal changes and the analysis of base flow are needed in order to assure a higher reliability in utilising the model in the Mediterranean environment as a practical tool in approaching erosion problems and land use planning.