Geophysical Research Abstracts
Vol. 18, EGU2016-15918, 2016
EGU General Assembly 2016

Hydrological response of a subhumid watershed after a greening-up process, an example in South East Spain

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Many watersheds in the Mediterranean are subject to land use changes and hydrological control works that can have important effects on their hydrological and geomorphological response. In such contexts, a better understanding of the hydrological processes and their linkage to the geomorphic evolutionary trends would help territory planners and other stakeholders to face off soil and water body degradation, optimising efficiency and cheapness of planned interventions.
This study focuses on a catchment in SE Spain, Upper Taibilla (320 km2, Segura basin), which suffered an important greening-up process with increase of forest cover, decrease of agriculture activities and installation of hydrological control works during the second half of XX century. The objective was to characterize the changes in the hydrological response of the catchment in relation to the changes in their drainage area.
Firstly, the actual hydrological response to precipitation was analysed at aggregated (i.e. monthly, seasonal and annual) scale, using 15 years of the most recent runoff observations collected at the outlet of Upper Taibilla river (specifically at the inlet of Taibilla reservoir). Based on the actual distribution of soil land use and texture, the studied sub-basins were discretised by a GIS software in a system of homogenous hydrological units, in order to identify the most critical areas producing surface runoff. This actual aptitude to produce runoff was compared to the sub-basin hydrological response of 1930-1940s (that is before reforestation works and check-dam installation), in order to analyse the eventual presence of evolutionary trends in basin hydrology and the whole efficiency of these works in mitigating runoff impacts.
Furthermore, considering that computer prediction models are important tools for planning land use changes and other management works in basins, the applicability of two hydrological models for predicting surface runoff in the studied sub-basins was evaluated. To this aim, the continuous simulation AnnAGNPS and HEC-HMS models were applied at aggregated and event scales respectively. Their reliability in predicting surface runoff was measured by quantitative indexes (e.g. coefficient of determination and efficiency, main statistics, summary and difference measures), using the available hydrological databases. The models were then calibrated by adjusting the initial Curve Number values (the empiric parameter to which the model is very sensitive), which allowed the improvement of their runoff prediction capacity.
Finally, the calibrated AnnAGNPS model was applied in Upper Taibilla under different land use scenarios, in order to derive indications and criteria for future decisions of watershed management. On the whole, the study investigated on how management and land use change are effective on the hydrological response of watersheds and needs to be explored for watershed management purposes.