Geophysical Research Abstracts
Vol. 19, EGU2017-14540, 2017
EGU General Assembly 2017

The physical model of a terraced plot: first results

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Terrace building have been expanded in the 19th century because of the increased demographic pressure and the need to crop additional areas at steeper slopes. Terraces are also important to regulate the hydrological behavior of the hillslope. Few studies are available in literature on rainfall-runoff processes and flood risk mitigation in terraced areas. Bench terraces, reducing the terrain slope and the length of the overland flow, quantitatively control the runoff flow velocity, facilitating the drainage and thus leading to a reduction of soil erosion. The study of the hydrologic-hydraulic function of terraced slopes is essential in order to evaluate their possible use to cooperate for flood-risk mitigation also preserving the landscape value.
This research aims to better focus the times of the hydrological response, which are determined by a hillslope plot bounded by a dry-stone wall, considering both the overland flow and the groundwater. A physical model, characterized by a quasi-real scale, has been built to reproduce the behavior of a 3% outward sloped terrace at bare soil condition. The model consists of a steel metal box (1 m large, 3.3 m long, 2 m high) containing the hillslope terrain. The terrain is equipped with two piezometers, 9 TDR sensors measuring the volumetric water content, a surface spillway at the head releasing the steady discharge under test, a scale at the wall base to measure the outflowing discharge. The experiments deal with different initial moisture condition (non-saturated and saturated), and discharges of 19.5, 12.0 and 5.0 l/min. Each experiment has been replicated, conducting a total number of 12 tests. The volumetric water content analysis produced by the 9 TDR sensors was able to provide a quite satisfactory representation of the soil moisture during the runs. Then, different lag times at the outlet since the inflow initiation were measured both for runoff and groundwater. Moreover, the time of depletion and the piezometer response have been monitored and analyzed, well corroborating the findings on the kinematics of the terrace plot. Finally, the computation of the specific Curve Number (Soil Conservation Service) of the physical model has revealed values rather large if compared with those reported in the literature. This phenomena was likely caused by the high values of the inflow discharge, the limited cross-width of the model (1 m) and the increasing compactness of the soil owing to the experiment repetition.
These pioneering experiments have produced some remarkable outcomes on the important role of lag-times (runoff and groundwater) of a terraced system as well as many ideas on improving the physical model and its setting in a next investigation.