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Modelling surface flows on small farmed catchments during events taking into account overbank of ditch network

J. Ghesquiere, R. Moussa

Institut National de la Recherche Agronomique, U.M.R. LISAH, Montpellier, France.
(ghesquie@ensam.inra.fr / Fax: +33 4 67 63 26 14)

Hydrological response during flood events in farmed catchments is a perilous exercise due to the large variability in space of hydrological processes that are due to human impact causing hydrological discontinuities such as field limits, terraces, ditch network. This last discontinuity is very common in mediterranean farmed catchments. Ditch networks influence greatly the runoff by concentrating flows, drains the water table or replenishes it by reinfiltration of the runoff water. During extreme flood events, overbank of the ditch network can have an influence on the distribution of water in a mediterranean farmed catchment. During this overbank process not only in the shape of the flow cross-section is changed but also in the pathways followed by the flow. Taking this process into account could help better understand the runoff process during extreme flood events. The purpose of this study is to assess the role of overbank in the ditch network during flood events. The study area is the small headwater farmed catchment of Roujan located in Southern France. The main hydrometeorological equipment consists of a complete meteorological station, rain gauges, a tensio-neutronic and a piezometric measurement network, and multiples water flow measurements. We developed a model to simulate the major hydrological processes. MHYDAS is a physically based distributed hydrological model. It has been developed to take into account hydrological discontinuities. The model divide the catchment in a series of interconnected hydrological unit taking into account the discontinuities. Runoff from each unit is modelled using spatially distributed rain with a deterministic model based on the pounding-time algorithm. Then the runoff is routed through the ditch network using the analytically resolved diffusive wave equation. Overbank flow is modelled by modifying the connections between hydrological units and ditches.

A multi-criteria and multi-scale approach is used to calibrate and validate the model for the water flow measurements. The application of MHYDAS on the extreme flood events of the last decade has enable to identify the ditches where overbank flows occur and to calculate a discharge at various points of the ditch network. Results show that for the most extreme flood event, nearly half of surface runoff occur due to overbank flow. Discussion shows that in this elementary catchment, water emerging as runoff travels by multiple routes and the main hydrological processes are affected by the spatial variability of soils, topography, land use and cover, climate, and human-induced changes and management of the landscape such as the ditch network.