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Modelling the hydrological response of a small mediterranean forested catchment: exploring the potential influence of the riparian-stream connection

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It is well known that hydrological modelling over long periods in Mediterranean catchments still represents a complex challenge, since Mediterranean regions share the hydrological processes from both wet and dry environments, following a seasonal pattern that induces remarkable particularities in hydrological behaviour (Gallart et al 1997). Several authors have pointed out for these areas three recognizable periods during the same hydrological year: a long dry season; a wetting-up period (during which large rainfall events may produce little or no response at the flow gauge station); and finally a wet season. The transition period, from dry to wet conditions, has been noted as a critical point for the hydrological and hydrochemical behaviour of Mediterranean catchments and, generally, rainfall-runoff models can not reproduce properly the shape of the associated hydrograph (Anderton et al., 2002, Piñol et al., 1997). The aim of this research was to improve the understanding of the hydrological processes occurring in a small Mediterranean catchment, Fuirosos (Catalonia, Spain). This catchment was previously analyzed by other authors (Bernal et al., 2004) using a semidistributed model called INCA, developed for humid-template climate (Wade et al., 2002 and Whitehead et al., 1998). The INCA model was not able to reproduce reasonably well the dry season and the wetting-up sequence, characteristic of this catchment, neither to find a unique set of parameters to simulate the complete observed period. Hence, the challenge was to progressively improve the perceptual understanding of the catchment, as suggested by Beven (1991) and Piñol et al., (1997), and to reproduce, as well

as possible, the observed hydrograph of this ephemeral stream, with special attention to the processes that govern the drying-up and wetting-up sequence. Moreover it has been tested the influence that can exert the riparian zone in drying-up the stream and during the early wetting-up sequence.

To achieve this objective it has been developed a semidistributed conceptual model working at daily time steps, which has to be considered, at the moment, as a useful analysis tool that lead to the observed hydrograph for this particular catchment. The developed model is based upon a spatial splitting of the territory in representative hydrological units (HRU). In each one of these units the conceptual scheme consists of a series of 5 connected tanks, each one representing different water storages in the soil column. The vertical connections between tanks describe the precipitation, evapotranspiration, infiltration and upper and lower percolation processes (the last one allowed only when soil moisture content exceeds a threshold value). The horizontal flows describe the four different observed responses: the overland runoff, interflow, quick base flow and finally a very slow base flow. These responses correspond to four layers in the soil profile, characterized by different saturated hydraulic conductivity.

Each HRU drains directly into the channel network, described as a linear tank which is connected with an additional tank, representing the riparian zone. The results obtained are quite satisfactory for the complete observational period, since the Nash and Sutcliffe efficiency index is 0.76, while the balance error in terms of observed and simulated total volume is less then -5 %. The temporal and spatial validations had a similar performance. The developed model has reproduced quite well the catchment response during the dry and the transition period, even though the results cannot be considered totally satisfactory during the early wetting-up period. The inclusion in the model of bi-directional water fluxes between stream and riparian tank was absolutely necessary to simulate the complex transition period characteristics of the Mediterranean hydrology.