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Hydrological behaviour of a karstic temporary river

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In the Mediterranean basin, many small rivers are characterized by the alternation of long dry periods cut by short flush flood events. During the dry periods, the riverbed may fall completely dry, except in some sections where human inputs contribute to feed the river.

In this context, this study addresses the hydrological behaviour of the Vène River (catchment area of 67km^2; South of France). The catchment is characterized by three sharply contrasting geology and land use zones: urban zones (3%), vineyards (21%) and permanent crops (13%) and karstic scrubland areas (63%). The river is fed by two karstic springs: the first one is the river spring, the second is located 1km upstream the outlet. Three nested basins are gauged: K station gauges the upstream karstic spring plus a 1.4-km^2 catchment; S station (35km^2) cuts the river down the middle; V station (67km^2) is located at the outlet. Each gauging station is equipped with automatic level and conductivity loggers. Three automatic rainfall stations are located on the catchment area. Data are available since August 2002. DEM, land use map and soil map are also available.

A conceptual model, MERCEDES, was used to analyze the hydrological behaviour of the Vène catchment. The MERCEDES model is a distributed hydrological modelling tool that is included in ATHYS package. The basin was discretized on a 50-meter square grid, using the DEM data and the drainage network was defined. On each grid element, a reservoir production function was defined taking account soil and land use characteristics. Its contribution was transferred to the outlet by a specific translation-storage routine. MERCEDES model was applied using a 5-minute (or 1-hour) time step, at the event scale (or for long term simulations). The model allowed to explain the different hydrological processes and to quantify quite precisely the functioning thresholds in this intermittent hydrological system.

The great variability of rainfall controls the hydrological behaviour of the catchment. From one year to another the hydrological balance varies in great proportions. So the influence of each land-use area varies from one year to another. The annual hydrological balance is highly affected by the karstic external inputs (75% of total flow during the wettest years but less than 10 % during the driest ones). The agricultural areas contribute significantly to the discharge, during base flow period.

The period of time with very low flow ($<$ 80L/s) at the outlet had a variable extend from one year to another. Two kinds of floods are observed: small floods without any karstic influence at the outlet (runoff coefficients lower than 6%) and karstic floods when one or the two karstic springs are flowing.

The natural areas do not contribute directly to the runoff during rainfall events. The infiltration on these zones directly feds the karstic aquifer and contributes to spring discharges: at least 70% of the flood volume is due to karst, during the karstic floods. The urban areas play a major part during intense autumn rainfall events. These zones are characterized by a rather constant runoff coefficient which value compares well to the extent of urbanisation and explains the whole volume of small floods. Even if the agricultural zones have a significant influence on runoff processes during intense rainfall events, they do not contribute directly to the flood peak. Interflow in the unsaturated zone seems to be the major hydrological process of the agricultural zones.