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# The forgetted role of groundwaters on flash flood understanding and modelling in Mediterranean karstic catchments – the example of the Gapeau river (South France)

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The challenge of forecasting "karstic floods" is important in the Mediterranean since karst features on carbonate formations are extensively developed throughout South Europe, Middle East, and Maghreb. Taking into account the hydrological response of karstic units in hydrological models poses real operational problems. This is due to two main reasons: i) the key processes of flood generation are difficult to characterize because of complex and few documented surface water / groundwater (SW/GW) interactions, ii) there are few models representing karst specificities that are easily adaptable for forecasters.

The aim of this study is to characterize the role of groundwaters in flash flood generation in a karstic catchment and to test a lumped model accounting for fast groundwater component to simulate peakflows. The study site is the Mediterranenan karstic catchment of the Gapeau stream (South France), subject to flash floods. In addition to the gauging station at the stream outlet, this basin is monitored since 2013 to record the water level in three springs. The lumped rainfall-runoff model GARDENIA is used to simulate hourly discharge in the stream as well as groundwater level in one spring.

Results of the hydrological analysis show that SW/GW interactions play a main role on flood generation. First, the strong correlations between stream discharge and groundwater level of two of the three springs provide information on very fast underground dynamics. These fast groundwater flows make it possible to anticipate stream peakflows of a few hours. Second, comparing the soil saturation (available over France from SIM ISBA models) and the aquifer saturation (from spring's records), we show that the aquifer saturation level seems to be a key parameter to explain the hydrological response in the stream. Third, the deficit in the water balance indicates that the stream gauging station is not the only catchment outlet, about 40% of the total area not contributing to runoff.

To apply the GARDENIA model, these results involve optimizing the area of the catchment, favoring fast components from underground reservoirs, and constraining discharge simulation by jointly modelling the piezometry of each spring, in order to validate the hydrological behavior. Three modelling structures - differentiated by the number of reservoirs - were compared in order to select the best configuration for flood modelling. The inter-comparison of the different calibration strategies suggests that GARDENIA with two underground reservoirs reproduces the hourly discharge satisfactorily. Despite some underestimations of peakflows for the 2 years floods, the historical 50 year flood is very well predicted by the model, while being calibrated on lower discharges.

These results show the interest of a joint use of hydrological and hydrogeological data, to better understand flooding in karstic areas and better constrain the forecast models. In perspective, a comparison of the GARDENIA model with the model used by the Flood Forecast Service (SPC Med Est) will be proposed to identify the added value of such an operational approach.