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Role of karst system in the genesis of flash flood events at the Nîmes city

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The Nîmes city has been forever subject to catastrophic floods events. In the recent past, the most important one occurred on 3^{rd} October 1988 and killed 9 persons among 45000 disaster victims (damages of about 6 x 10^6 EUR). These flash floods are due to the very intensive rainfall events from Cevenol climate influence conjugated with the geographical context of Nîmes at the bottom of a hill. However, karstified limestone of these hills whose Fontaine de Nîmes spring (FdN) located at the centre of the city constitutes the outlet, are in theory favourable to the infiltration of a part of rainwater. A multidisciplinary (geology, hydrogeology, geochemistry, water table monitoring, spring discharge monitoring, signal treatment analysis, modelling) study of the karst system intends to characterize the relationships between surface runoff and groundwater in order to explain why this karst system does not play the expected role of buffer in the floods genesis during rainy events.

The analysis of discharge flow rate at the FdN spring allows to characterize the karst system. The spring appears as an overflow outlet of the karst system blocked at its bottom by Quaternary sediments. This is a first cause of the large ratio Q_{min}/Q_{max} (= 2500) of the spring. The baseflow coefficients are high (0.035 $\pm$ 0.024) which indicates that the saturated zone of the system is well karstified and highly transmissive. The duration of the quickflow is rather short (13 days $\pm$ 5) and the average velocities of infiltration rather high (0.09 $\pm$ 0.02) in the infiltration zone (epikarst) indicate that the system is highly karstified. These characteristics contribute to high discharge rate and fast response at the spring during rainy events. When discharge reaches 11 m^3/s at the spring, the karst system overflows through temporary outlets or sinkholes and the whole karst system contributes to the genesis of floods. During flood events, hydrochemical analysis of water at the spring and at the surface streams show the large

contribution of groundwater to the runoff in the streams.

The interpretation of continuous monitoring of hydraulic heads in wells on the catchment of the system contributes to the understanding of the role of epikarst, saturated zone, annex drainage systems and karst drains in the groundwater flow and flood genesis during rainy events. Inverse modelling of discharge rate at the spring allows to prepare various flooding simulations according to rainfall scenarios.