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Jean-Baptiste Charlier, David Pierre-Yann, Sandra Lanini, Roger Moussa

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Charlier Jean-Baptiste[1], David Pierre-Yann[2], Lanini Sandra[1], Moussa Roger[3]

[1] *BRGM, Montpellier, France*
[2] *BRGM, Rouen, France*
[3] *UMR LISAH, Montpellier, France*

j.charlier@brgm.fr

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ABSTRACT

In karst basins, flows in the hydrographic network are mainly controlled by surface water/groundwater (SW/GW) interactions. These interactions are mostly studied in streams during low water periods, but the question remains open when one needs to quantify them during flood events. The aim of this study is to investigate SW/GW interactions in a karstic stream using a flood routing model in order to improve the knowledge of the temporal distribution of lateral flows and to quantify them all along the year. For that, an inverse modelling approach using an analytical solution of the diffusive wave model accounting for lateral flows is applied on a karstic reach. The "inverse model" enables to calculate the lateral flow evolution using as input both discharge data from two successive gauging stations. The study site is the karstic reach of the Iton river in French Normandy (40 km), characterized by lateral outflows and inflows (losses and springs). The analysis of discharge-groundwater level relationships made it possible to identify the most correlated piezometers with baseflow. The discharge-discharge analysis at the flood event time scale shows that the peakflow attenuation in the stream decreases strongly when the piezometric levels are exceptionally high, highlighting a threshold effect from karst aquifer. To investigate SW/GW interactions during flood, lateral outflows were simulated for 33 flood events. We showed that the peakflow attenuation was the result of the combination of high flood wave diffusion in the stream channel but also of losses that increase when stream discharge increases. A last step consisted of simulating discharge at the downstream station knowing discharge at the upstream one and taking into account groundwater lateral flows modelled from piezometric levels. The good performance of the model confirms that diffusion is indeed the phenomenon that governs most of the flooding through the karstic zone. The influence of the stream losses is buffered by this phenomenon as well as by the drainage of the karst aquifer in the downstream zone of the basin. The new methodology proposed in this work opens challenging perspectives towards a modelling framework for the analysis of short time step lateral inflows/outflows in rivers leading to a better understanding of SW/GW interactions in karstic zones.