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Middle Risle critical zone observatory : monitoring karstic processes evolution in the river, their impacts on surface water/groundwater interaction and their consequences on aquatic ecosystems

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ABSTRACT

The Risle river, in its middle portion, is frequently affected by episodes of major sinkholes development; indeed, in the last decade or so, two major sinkholes developed in the river bed leading to crisis situation with a complete river loss in the underlying groundwater and a dried up river course over distances of several kilometers downstream during the summer season. This resulted in major modifications in hydrogeological and in surface – groundwater interaction processes, with major consequences on water quality, water uses and water dependent ecosystems.

To understand this phenomenon, its impact both on surface-groundwater interaction processes and on aquatic ecosystems and to improve crisis management, a multi-parameter monitoring program called the middle Risle critical zone observatory has been set up, in order to acquire the necessary data and knowledge and develop proper tools to best manage these situations. Several monitoring networks were implemented involving several partners. Exploratory tools and methodologies were also developed. The work carried out in this project notably included setting up monitoring networks for groundwater level, water river level, differential flow in rivers, temperature and conductivity surveys, springs yield, ecosystem surveys (fishes, macroinvertebrates, vegetation) as well as modelling surface, karst and groundwater flow...

Results obtained were numerous including river loss impacts on fishes, macroinvertebrates and vegetation and population recovery rates. Some vegetal species seem to be a reliable indicator for surface/groundwater interaction. The dynamics of local hydrogeological processes are assessed and linked to the consequences on the ecosystems habitats and on water use.

Inverse modelling using an analytical solution of the diffusive wave equation helped assessing for lateral flows during flood events, quantifying spatio-temporal variability for surface water and groundwater exchanges. It also highlighted the important role of the karstic zones both on storage and on river flood peak attenuation processes, thereby protecting downstream villages against floods.

Finally an approach using transfer model based on computing the convolution integral of up to several signals allowed building the first functional scheme of this karst system.