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► **To cite this version:**

Léna Abasq, Nicolas Surdyk, Marc Lambert. Using simple pseudo-3D hydrogeological modelling and a simplified agronomical representation to build a pertinent decision-making tool for local stakeholders: the Vivier karstic spring (France) case study. Eurokarst 2018, Jul 2018, Besançon, France. hal-01734793

HAL Id: hal-01734793

<https://brgm.hal.science/hal-01734793>

Submitted on 15 Mar 2018

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Using simple pseudo-3D hydrogeological modelling and a simplified agronomical representation to build a pertinent decision-making tool for local stakeholders: the Vivier karstic spring (France) case study

Léna Abasq^{*†1}, Nicolas Surdyk¹, and Marc Lambert²

¹Bureau de Recherches Géologiques et Minières (BRGM) – BRGM – France

²Syndicat des Eaux du Vivier (SEV) – SEV – France

Résumé

The Syndicat des Eaux du Vivier (Vivier Water Agency - SEV) is a public agency monitoring the production, treatment, distribution and quality control of drinking water in Niort town in western France. The municipal drinking water supply mainly comes from a karstic resurgence, the Vivier spring, which is registered as a "Grenelle" priority water supply since 2013. There is a strong pressure from agriculture, which is illustrated since the 90' by nitrate concentration that exceed the European drinking water standards. There is also an increasing pressure on water quantity, mainly due to irrigation and drinking water demand, particularly in low water periods when the karst can be subject to collapses due to the low pressure in the karstic galleries. Modelling the hydrogeology of the area will help to optimize the effective quantitative and qualitative water resource management.

Hydrogeological and agronomical modelling is done using the BICHE-MARTHE software chain, developed at the BRGM. Comparing observed and simulated groundwater levels, stream flows, springs flows and overflow at the Vivier spring gives satisfactory results considering the limited knowledge on the area. This part of the modelling has been strengthened by a comparison with a sensibility approach with GARDENIA regarding irrigation and with an approach using neural networks. The model integrates Agricultural practices observed in the catchments area to simulate nitrate transfers. The resulting nitrate concentrations are correct for the Vivier spring and its associated catchments (Gachet I and III) and stays within a reasonable range for other observation points on the catchments area.

Modelling, together with the learnings of the measurements campaign analyses, allows us to better understand how the Vivier hydrosystem works. The spring has two supply methods: a short one-year-cycle, during which meteoric waters get through the karstic system and join the Vivier spring, and a multi-year cycle during which the effective rainfall slowly percolates through non-karstic rocks.

Basic simulations are conducted to better identify the impact of agricultural and quantitative pressures on the water supply. They outline the karstic system sensibility to any

*Intervenant

†Auteur correspondant: l.abasq@brgm.fr

change in the groundwater pumping plan, which induce an immediate effect on the spring flows.

Simplified scenarios for the nitrate pressure reduction suggest that the system reacts quite slowly due to the multi-year cycle: a significant shift in the nitrate concentration takes a decade. These scenarios also evidence the high sensibility of nitrate levels to the annual effective rainfall.

This tool is intended to be used as a regional pilot in the decision-making process regarding drinking water quality. Perspectives include enhancements in the description of the agronomical system (through recent software developments at BRGM) to test multiple scenarios of agricultural evolution in terms of regulation or climate change.

Mots-Clés: Case study, Modelling, Nitrate, Karst, MARTHE, BICHE