Coupling SKS and SWMM to solve the inverse problem based on artificial tracer tests data in karst aquifers

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Objectives

The main objective is to answer whether we can constrain a simulated conduit network geometry using artificial tracer tests data. To do so, we propose a systematic search procedure using a pseudo-genetic algorithm (SKS) and a flow and solute transport simulation routine (SWMM).

Study area: the Baget karstic system (Pyrenees Mountains, France)

The karstified part of the basin is characterized by metamorphic Jurassic to Cretaceous dolomites, limestones and calcareous marls.

The study area is located in the downstream part of the watershed.

Systematic search procedure

SKS – Stochastic Karst Simulator

Borghi et al. (2012, 2016)

The simulated RTDs are compared to the observed RTD derived from artificial tracer tests performed in 2018, using the Nash-Sutcliff Efficiency coefficient (NSE).

Results

The simulations that reproduce the observed RTD quite satisfactorily (here we chose NSE > 0.8 as criterion to accept a simulation) constitute a set of equiprobable conduit network geometries. These simulations honor both geological priors (lithology, faults, fractures) and artificial tracer tests data.

The approach can be extended as a weighting factor for the Karst Network Development coefficient (K) implemented in karst vulnerability mapping method such as EPIK.

References:


Artificial tracer test campaign (modified from Sivelle et al. 2020)

Simulated conduit networks, modified from Sivelle et al. (2020)