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Hydraulic Tomography Applications for the Characterization of Karst Structures and their Properties ('Terrieu' Field, SNO Karst, France)

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Hydraulic tomography permits to map the subsurface properties from the information provided by punctual responses measured during a field investigation. In the case of karst fields, hydraulic tomography applications face problematics due to the existence of networks of fractures and conduits in such systems: constrained flows and high contrast in the distribution of the property values. It is then necessary to generate field data able to provide information on these constrained flows and their localization. It is also necessary to set up an inverse problem able the generate distributions of property values that can image the networks of fractures and conduits in the matrix rock.

We have compared the information brought by responses to different pumping signals (constant or oscillatory) to characterize the flows in karst fields. We have also developed and studied different inverse problems to represent contrasted property values distributions with different modeling methods (equivalent porous media or discrete fractures network). Finally, our aim was to apply and test different hydraulic tomography on a same, well equipped, karst field (Terrieu experimental field, studied by the French observatory SNO Karst).

We have associated different sets of measured field data with our different inversion algorithms to compare the imagery results generated by each association data/inversion. Globally, while the different inversion methods we tested all provide interesting results, it appears that oscillatory pumping signals are more efficient than constant signals to characterize the path generated by the constrained flows. In fact the information provided by responses to oscillatory signals at various frequencies are more specific and permit a fast resolution of the inversion by solving the problem in a frequency domain.