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Large-scale spatial reconstitution of pressure and tracer tests responses in a karst aquifer (Lez aquifer, France)

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Spatial characterization of the hydraulic properties in the subsurface is an extensively studied problematic. Inverse problems allow to image those properties by interpreting the information from a dataset of field measurements with a chosen physical formulation of fluxes in a numerical distributed model. However, karst media characterization remains a complex task, due to the fact that the matrix and conduits entities generate a highly contrasted distribution of property values. Furthermore the matrix and conduits compartments respond to different flow physics that can be approached by considering Darcy flow and pipe flow, respectively. Thus, one needs to employ a multi-physics model, an inversion method able to capture the properties contrast, and also to use data providing information on the localization of the conduits network and its connectivity.

We propose a large-scale 2-D application of characterization of the Lez aquifer in southern France, covering a surface of about 250 km². We take advantages of long-terms measurements within the framework of the MEDYCYSS observation site, part of the Karst observatory network (www.snokarst.org) initiated by the French institute INSU/CNRS. Drawdown signals measured in 11 wells and incorporating a periodic response due to a daily pumping at the aquifers spring were thus considered to identify the location of the conduit network. The periodic responses can provide connectivity information between wells in the inversion process, while non-periodic responses permit to better assess the large-scale property values of the whole aquifer. A Cellular Automata-based Deterministic Inversion (CADI) is used to generate a contrasted property field able to reproduce the measured signals in the 2-D distributed numerical model solving Darcy flows. However, pressure data alone remain limited to characterize the fast flows that can occur in the conduits network. Thus, the flow velocities in the preferential flow paths located with the pressure data are then reconstituted by inverting a set of different tracer tests responses at the Lez spring, considering this time a pipe flow physics in the model.

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