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UNCERTAINTY ON SUSTAINABILITY ASSESSMENT IN FRACTURED AQUIFERS UNDER PUMPING CONDITIONS

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Summary.
Sustainability of aquifer developments directly depends on the reliability of the aquifer flow and transport models. In fractured media, these models are put at stake by the complexity of the flow structures. Most of the flows are focused within a limited number of preferential paths. As most current hydraulic and geophysical methods cannot accurately identify these zones, predictions rely on the exploration of a large range of possible permeability structures consistent with the available data.
We handle this question for the problem of the definition of the influence zone of a well in granitic contexts. In these media, water circulates in the shallow weathered zones as well as in deeper connected fracture zones. Fast flows within fractures enable the existence of aquifers at different depths. Because of the complex aquifer connectivity structure, pumping modifies the dynamic of the natural circulations both laterally and vertically. For example, shortcuts induced by fracture zones can significantly enhance circulations far away from the well.
We develop the methodology on the granitic site of Ploemeur (Brittany, France). Ploemeur is a typical example of a 100m-deep aquifer exploited for the water resources of a nearby city. Although intensely studied since 10 years, circulations are still barely known outside of the immediate vicinity of the pumping area. Starting from the existing data, we explore several possible configurations in larger-scale models integrating the full dynamic of the water circulation from the recharge in the weathered zone to the deeper aquifer. We show that the recharge of the 100m-deep aquifer is especially sensitive to the distant structure of the weathered zone and its relation to the zone of intense vertical circulations. Strong connections between surface and subsurface water bodies reinforce the 3D nature of the circulations and the strong interactions between deep pumping and surface recharge.