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Long-term hydraulic behavior of heterogeneous aquifers under transient conditions

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With the increasing anthropic and climatic pressure on water resources, knowledge of recharge mechanisms and water transfer is of major importance to better understand destabilization of natural hydrological systems to face possible evolutions in the future. The equivalent response of a groundwater system is generally interpreted as complex, non-linear and hysteretic. Another point of view would consider the current response as the superposition of numerous transient events in a complex medium, which necessarily depends on the past trajectory of the GW and boundary conditions.
Here, we present a multidisciplinary approach to better model long-term system behavior under anthropic and climatic destabilization. Several parsimonious analytical and numerical models were derived considering several flow structures and boundary conditions. These models are set up on a pluri-kilometric aquifer system in fractured context on the Ploemeur site (Britany, H+ hydrogeological) and constrained by various long-term observations such as hydraulic, chemical and deformation data. Two neighboring systems in a similar geological context are compared; one being pumped at a rate of 1.1 Mm3/year since 1991, the other one is still in a natural state. Our models could predict the long-term behavior of hydrological systems and estimate the water balance perturbation and natural flows re-distribution induced by pumping. We show importance of multiple observation types to yield better predictions and the critical importance to represent boundary conditions for GW management.