Abstract

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Modeling of aquifers on sub-basin and basinal level: Distributive numerical models for fractured porous aquifers

Fractured porous media, as can be found in the Sangamner region, are among the most challenging hydrogeological systems to study under both saturated and, especially, unsaturated flow conditions. The highly non-linear coupling of phase saturation and flow in space and time and scale-dependence of the flow and transport dynamics clearly qualify such media as complex systems. Understanding and predicting saturated and unsaturated flow dynamics in fractured media is of high importance for various applications. Up to 75% of worldwide aquifers are fractured and karstified, making them an important target for water resources management and vulnerability assessment.
Here we want to discuss the scales and processes associated with hydrodynamics in fractured porous media. Depending on the availability of field data and computational resources, distributive field-scale modeling approaches can represent fractured systems by (a) single-continuum, (b) multi-continuum, or (c) discrete fracture network models. Finding a suitable modeling approach for regional hydrogeological studies often turns out to be an iterative process: Starting from simple volume-effective single-continuum models and simple estimates for boundary conditions, such as surface recharge, regional catchment boundaries, water balance sources and sinks, large-scale heterogeneities such as fault zones, models can consecutively be adapted to reflect the increased understanding of the whole hydrological system. While this process seems straightforward its requires a clear communication between numerical modelers and experienced field geologists and hydrologists/hydrogeologists in order to capture the correct physical processes and to determine the right level of abstraction in terms of model parameterization.