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# Magnetic resonance sounding measurements for modeling of water flow transport in variably saturated porous media

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Numerical modeling of water flow in partly saturated porous media requires knowledge of hydraulic properties of the media. The straightforward approach consists of directly measuring K(teta) and h(teta), which is challenging in many practically important applications. In-situ non-invasive measurements of K(teta) and h(teta) are even more difficult and probably impossible. Additionally, K(teta) and h(teta) are both scale dependent parameters. Under favorable conditions, surface geophysical methods may allow non-invasive identification of different geological formations and estimate of the porosity. A few papers report hydrogeological modeling considering water-saturated formations with integrated geophysical data (aquifer geometry, K and teta at saturation). However, modeling of water transport in partly saturated subsurface is more difficult task because it requires more extensive knowledge of soil hydraulic properties.

We use Magnetic Resonance Sounding (MRS) method for non-invasive time-lapse measurements of the water content as an input into numerical modeling tool for hydrogeological modeling. However, MRS is not able to provide h(teta), which rest inaccessible. We propose an approach, which consists of performing infiltration tests (or observation of natural infiltration and monitoring rain water) and measuring corresponding variation of the water content in the subsurface. Then, we use a data base of soils with accurately known hydraulic properties. We try different soils for modeling water transport under our conditions (reproducing our experiment) and select one, which allows fitting experimentally observed variations in the water content. When such a soil is found we obtain K(teta) and h(teta). Thus, instead of looking for true hydraulic characteristics of the subsurface we obtain some equivalent media that allows reproducing our observations. We demonstrate the feasibility of our approach using simple 1-D models and commercially available software packages: HYDRUS for the transport modeling and SAMOVAR for the MRS modeling.