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CENTRIFUGATION SCENARIOS FOR DETERMINATION OF SOIL PARAMETERS

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Summary. We discuss the numerical modelling of unsaturated-saturated flow in porous media under centrifugation. We develope an efficient numerical approximation which is a good candidate for solving inverse problems involving the determination of soil parameters. Mathematical model for unsaturated flow is based on Richard's nonlinear and degenerate equation expressed in terms of effective saturation and head using Van Genuchten-Mualem ansatz with soil parameters . Determination of these parameters is a usually time consuming and requires expensive measurements. The acceleration can be achieved by using centrifugation. Recently, the method of centrifugation has been applied by [J.Šimunek, J.R. Nimmo; Water resources research, 2005]. Anyhow the measurements are based on datas from electrical signals from electrodes installed in the sample. We want to avoid this using only global characteristics, e.g., rotational momentum and gravitational center of the sample and their time evolution during centrifugation. Aditionally, we can use injected and expelled water amount from the sample during centrifugation. These global characteristics require only simple measurements, but cannot fully replace the informations on saturation distribution along the sample. We propose the centrifugational scenario and the efficient numerical software for evaluation of corresponding measurements, so that determination of soil parameters will be relyable. We are facing the numerical difficulties coming from the degeneracy of the Richard's equation. There appear two free boundaries (between saturated-unsaturated-dry zones of the sample) which are not known a priori and they are included in the global solution. It depends on the centrifugational scenario if both, or only one of them appears. Our numerical method is based on space discretization and reducing the problem to an ODE system coupling it with algebraic equation, by means of which we keep mass ballance correct. We have developed numerical modelling of interface evolution in terms of ODE which significantly improves the effectiveness of numerical realization. The numerical dispersion is small and doesn't shadow the senzitivity of our global characteristics on soil parameters. We discuss the numerical experiments on senzitivity and using Levenberg-Marquard method we demonstrate, that the global characteristics are sufficient for determination of soil parameters.