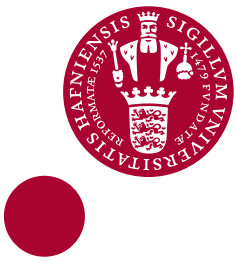

A Bayesian approach for estimation of unsaturated hydraulic parameters using hydrogeophysical data

Zibar, Majken Caroline Looms; Scholer, M.; Binley, A.M.; Irving, J.; Nielsen, Lars

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A Bayesian approach for estimation of unsaturated hydraulic parameters using hydrogeophysical data

M. C. Looms; [1]; *M. Scholer;* [2, 3]; *A. M. Binley;* [4]; *J. Irving;* [2]; *L. Nielsen;* [1];

1. Department of Geosciences and Natural Resource Management, University of Copenhagen, Copenhagen, Denmark.
2. Institute of Geophysics, University of Lausanne, Lausanne, Switzerland.
3. Risk Management Solutions, Zurich, Switzerland.
4. Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom.

Body: Cross-borehole geophysical methods, such as cross-borehole ground penetrating radar (GPR) and electrical resistivity tomography (ERT), have been successfully used over the past decade to monitor infiltration processes in the unsaturated zone. These minimally invasive geophysical methods can provide a valuable link between small-scale cores used for laboratory experiments (typically a few hundred cm3) and the large scaled numerical grids used in catchment modeling. Whilst these methods may offer qualitative information about flow pathways, an important question is how to best utilize the information obtained about the geophysical properties (i.e., dielectric permittivity and electrical resistivity) in order to estimate the unsaturated hydraulic properties of the subsurface. This inverse problem is highly nonlinear, typically with many local minima, making a unique and deterministic estimation non-trivial and, perhaps, futile.

In this study we evaluate whether two data-types (i.e. cross-borehole GPR and ERT data), collected during a forced infiltration experiment into the unsaturated zone, constrain the unsaturated hydraulic parameters at the field site differently. The geophysical data are used directly in the hydrological inversion using a hydrogeophysical data fusion approach; a Markov Chain Monte Carlo-based inversion is used to fully explore the a priori parameter ranges. Detailed information of the depth variation in grain size distribution, from core samples, is used to conceptualize the subsurface, in addition to validating the findings of the inversion.