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Non-invasive monitoring of flow and transport processes in soil columns with MERIT

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A spatially and temporally highly resolved non-invasive monitoring and characterisation of soils and aquifers is often required. The new developed Magneto-Electrical Resistivity Imaging Technique (MERIT) is applied to fluid flow and solute transport processes monitoring. MERIT combines tomographcial electrical potential (ERT) and magnetic field measurements (MMR) owing to a constant excitation current. By combining both methods the inversion problem get less ill-posed and the resolution of the model parameter, i.e. the electrical conductivity, is increased. The theoretical and practical aspects of the application of this technique will be presented.

Two different scenarios in a soil filled cylindrical column were examined. First a varying moisture content and second a varying salt concentration of the pore fluid. For these scenarios several synthetical data sets of electric potential and magnetic field data were computed. The results of the numerical experiments were used to make the technical specifications of the MERIT scanner hardware to monitor the assumed processes adequately.

Experimental data for both scenarios were gathered and its noise properties were investigated to give an estimate of the measurement quality. Furthermore the noise properties were incorporated into the further processing by a 3D inversion algorithm to reconstruct the electrical conductivity distribution from the data. The inversion results we obtain from the data are in agreement with the assumed model. Inspite of the fact that further improvements in the experimental setup must be performed, it can be concluded that MERIT is a valueable non-invasive technique to investigate the flow and transport phenomena in such soil columns.