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Identifying a hydraulic parameterization from on-ground GPR time lapse measurements of a pumping experiment

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We show the potential of on-ground Ground-Penetrating Radar (GPR) to identify the hydraulic parameterization model with a semi-quantitative analysis based on numerical simulations of the radar signal.
A pumping experiment has been conducted at the ASSESS-GPR site to establish a fluctuating water table, while an on-ground GPR antenna recorded traces over time at a fixed location. These measurements allow the identification of the capillary fringe and its tracking through the soil. The typical dynamics of soil water content with a transient water table can be recovered from the recorded radargrams.
The characteristic reflections from the capillary fringe parameterized by the commonly used hydraulic parameterization models are investigated by numerical simulations. The results for the van Genuchten parametrization, for its simplified version with $m = 1 - 1/n$, and for the Brooks-Corey parameterization are compared with the measured signal. This allows to identify the appropriate hydraulic parameterization model. We show that our measurements are not consistent with the commonly used simplified van Genuchten parameterization with $m = 1 - 1/n$.