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Polymer tensiometer with ceramic cones: a case study for a Brazilian soil.

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Laboratory outflow experiments, in combination with inverse modeling techniques, allow to simultaneously determine retention and hydraulic conductivity functions. A numerical model solves the pressure-head-based form of the Richards' equation for unsaturated flow in a rigid porous medium. Applying adequate boundary conditions, the cumulative outflow is calculated at prescribed times, and as a function of the set of optimized parameters. These parameters are evaluated by nonlinear least-squares fitting of predicted to observed cumulative outflow with time. An objective function quantifies this difference between calculated and observed cumulative outflow and between predicted and measured soil water retention data. Using outflow data only in the objective function, the multistep outflow method results in unique estimates of the retention and hydraulic conductivity functions. To obtain more reliable estimates of the hydraulic conductivity as a function of the water content using the inverse method, the outflow data must be supplemented with soil retention data. To do so tensiometers filled with a polymer solution instead of water were used. The measurement range of these tensiometers is larger than that of the conventional tensiometers, being able to measure the entire pressure head range over which crops take up water, down to values in the order of -1.6 MPa.

The objective of this study was to physically characterize a Brazilian red-yellow oxisol using measurements in outflow experiments by polymer tensiometers and processing these data with the inverse modeling technique for use in the analysis of a field experiment and in modeling. The soil was collected at an experimental site located in Piracicaba, Brazil, 22° 42 S, 47° 38 W, 550 m above sea level.