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Capillary rise in partially water repellent soils – measurements and modeling

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In water repellent soils water transport processes are different from transport processes in non repellent soils. In most soils the extent of water repellency, expressed by the contact angle between fluid and solid phase, is not static but changes with time (e.g. due to fluid flow velocity).
One method to precisely determine the contact angle is the capillary rise method using water and additionally a liquid with a contact angle close to zero (e.g. ethanol). Usually this method is used to determine static contact angles, by fitting the original or a simplified version of the Washburn equation to the measured data. The classical Washburn theory assumes a constant contact angle between the solid phase and the liquid. In this work we test different modification of the Washburn equation accounting for dynamic change of contact angles.
Several capillary rise experiments with soils of different water repellency with water and ethanol were carried out. The inflow of water and the water contents in eight different heights within the soil columns were detected with high temporal resolution.
The original Washburn equation and different modifications are fitted to the data. Since different model formulation may have different numbers of free adjustable parameters an information criterion like the AIC is applied to find the best model.