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Comparison of soil water potential sensors

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Temporal and spatial monitoring of soil water potential and soil water content are necessary for quantifying water flow in the domains of hydrology, soil science and crop production as knowledge of the soil water retention curve is important for solving Richards' equation. Numerous measurement techniques exist nowadays that use various physical properties of the soil-water complex to record changes in soil water content or soil water potential. Laboratory techniques are very useful to determine static properties of the soil water retention curve, and have been used to show the impacts of hysteresis. Yet, other spatiotemporal dynamics resulting from for example growing root systems, biological activity, periodic tillage and their impact on the soil structure cannot satisfactory be quantified in static setups in the laboratory.). To be able to quantify the influence of soil heterogeneity, and spatiotemporal dynamics on the soil water retention curve, an in situ approach combining soil moisture and soil water potential measurements could provide useful data.

Such an in situ approach would require sensors that can measure a representative part of the soil water retention curve. The volumetric soil water content is often measured using time domain reflectometry, and has gained widespread acceptance as a standard electronic means of volumetric water content measurement. To measure the soil water potential, water filled tensiometers are used in most studies. Unfortunately, their range remains limited due to cavitation.

Recently, several new sensors for use under in situ conditions have been proposed to cover a wider range of pressure head: Polymer tensiometers, MPS (Decagon) and pF-meter (ecoTech). In this study, we present the principles behind each measurement technique. Then we present the results of a fully controlled experiment where we compared two MPS sensors, two pF-meter sensors and two POT sensors in the same repacked soil. It allows us to discuss advantages and disadvantages of each method. A CS616 volumetric water content probe was installed to compare in situ measured retention curves with laboratory measured retention curves for each method.