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Determination of soil hydraulic properties in a stony soil from field monitoring and lab experiments

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Soils containing rock fragments represent about 30% of the Western Europe surface area. Stoniness modifies soil hydraulic properties like soil water retention and water percolation. The Hydrographic Monitoring Network of Unsaturated Zone in Austria aims to estimate soil water movement and ground water recharge rates.

As pilot project a field site in Styria, Austria, was equipped with soil water content (TDR - buriable Trase) and soil water tension (tensiometers and granular matrix) sensors. The soil texture is a sandy loam with a fraction of rock fragments of 25% in the 0-30 cm soil depth and of 68% in the layer below 30 cm. Data are measured hourly in six depths down to 150 cm.

A field soil water retention curve was determined from the measurements. Observations delivered very low water content values during whole investigation period; values ranged from about 12% at saturation to 7% at matric potential of -200 hPa. Compared to van Genuchten approach based on soil texture water content in the field was much smaller.

In order to check the plausibility of the field data a vertical soil column with free drainage was filled with air dried disturbed soil. The column was repacked with same particle size distribution and bulk density of the in situ soil and was equipped with sensors of the same type. Constant irrigation rate was applied. After steady state condition was reached unsaturated hydraulic conductivity and soil water retention curve were determined. Then irrigation rate was increased stepwise. The lab experiments showed water contents near saturation of about 22% and at -150 hPa of about 12 %.

These values are about 70% higher than those measured in the field.

Deviation in hydraulic properties derived from lab and field data result in high uncertainty of estimated deep drainage and ground water recharge. Discrepancies can be explained either by weakness of TDR technique in stony soils, hysteresis effects or distinct lower boundary at the lab experiment and in the field.