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Estimation of soil hydraulic properties and preferential flow at agricultural hilllslope under controlled conditions

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Soil vadose zone is one of the most complex terrestrial systems due to various processes occurring within its boundaries. The first Croatian critical zone observatory SUPREHILL was established to specify subsurface preferential flow and nonlinear agrochemical transport processes. Combining laboratory and numerical methods with extensive sensor-based equipment will result in a wide range of data allowing us to accurately estimate heterogeneities on a local scale. The presented study includes estimation of soil hydraulic properties (SHP) and water flow experiments under controlled conditions. Undisturbed soil cores (250 cm^3) were taken in three repetitions at the top, middle and the bottom of the hillslope to estimate SHP using the HYPROP and WP4C techniques. Undisturbed soil columns were taken at the hilltop, middle, and the bottom of the vineyard hillslope from the row and interrow area. Soil columns are 25 cm high and 16 cm in diameter with soil moisture sensors and tensiometers set inside each column. Each soil column was irrigated three times per day during two-week period. Results obtained using HYPROP showed very similar SHP in the investigated depth which indicates uniform soil structure along the hillslope (top soil layer). HYPROP derived SHP showed very low values of hydraulic conductivity, but the sensors in columns reacted shortly after irrigation which indicates higher hydraulic conductivity. Since soil cores for HYPROP are relatively small compared to the soil columns, the presence of preferential flow is minimal, and some flow pathways present on the larger scale are not accounted for. Therefore, preferential flow will be further identified and quantified using a dye tracer, and experimental results will be shown. For additional preferential flow identification and quantification, later in the research, we will combine CT-scanning of undisturbed soil columns and numerical simulations.