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Automated multi-point mini-disk infiltrometer measurements of unsaturated hydraulic conductivity

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Unsaturated hydraulic conductivity function K(h) is one of hydraulic characteristics needed for numerical modeling of water flow and solute transport in the vadose zone. Tension infiltrometer is advantageous tool to conduct the measurement of unsaturated hydraulic conductivity in field under near saturated conditions. Manually operated minidisk infiltrometers are often used for performing infiltration experiments, but their disadvantage is that permanent attendance is needed during experiments. Therefore automatization of the tension infiltrometer is desirable.

A new automated multi-disk tension infiltrometer has been designed at the Faculty of Civil Engineering, Czech Technical University in Prague to facilitate the measurements of near-saturated hydraulic conductivity. Infiltration experiment performed by device is simultaneously carried out by six tension mini-disk infiltrometer modules forming a fixed matrix as they are held by a lightweight aluminum frame. This setup is divided into the two groups of three infiltrometers. Each triplet of modules is controlled by Mariotte‘s bottle. Therefore it is possible to conduct six simultaneous infiltration experiments at two different pressure heads.

Amount of infiltrated water is registered via changes of buoyant force of vertical bar attached to the weighing sensor in each infiltrometer module and recorded automatically using datalogger. Cumulative infiltration and volumetric flux are calculated and displayed in real time. Near saturated hydraulic conductivity is determined from cumulative infiltration data using nonlinear optimization and improved procedure of Zhang.

Device developed was to date tested on four experimental locations. Two sites were arable land (Nucice and Kopaninsky stream) and two located in headwater catchments (Sumava and Jizera Mountains). Soils at experimental sites were classified as Cambisols (empirical van Genuchten parameters α and n ranged from 0.007 to 0.043 cm-1 and from 1.13 to 1.54 respectively). The infiltration experiments confirmed, that device is suitable and efficient for determination of unsaturated hydraulic conductivity in broad range of soils.

Another application of newly developed device is presented in detail by Klipa et al., “Seasonal variability of near-saturated hydraulic conductivity on cultivated soil” (EGU2014-6568).

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