An improved drip infiltrometer measuring the near-saturated hydraulic conductivity: Pedotransfer development and macropore transport

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The near-saturated hydraulic conductivity is an important parameter in relation to the analysis of heterogeneous transport in the soil macropore system. To a high degree, leaching of phosphorus out of the root zone takes place in the macropores either in a dissolved form or as phosphorus bound to colloids. In this work, a newly constructed and improved drip infiltrometer (DIM) is presented being able to measure the unsaturated hydraulic conductivity in the near-saturated range (i.e. in the range of matric potentials between -0.1 and 3 kPa) on undisturbed soil columns (20 cm by 20 cm). The DIM is a modified version of the classical multistep system establishing gravity flow at decreasing flow rates. The procedure is that the soil column is placed on top of a ceramic plate. Five tensiometers measure the change in the matric potential at different flow rates applied by a drip-irrigation device mounted on the top of the column. By applying a certain inflow at the top and suction at the bottom of the sample, a steady state flow is established based on tensiometer readings showing a constant gradient along the soil sample. This allows the determination of the near-saturated hydraulic conductivity by applying Darcy’s equation. Compared to an earlier version of the infiltrometer, the instrument has been improved in several ways. This involves a high level of automation of the computer program controlling the analysis making it possible to setup a number of settings and constrains in order to optimize the analysis. Examples are given for newly developed pedotransfer functions predicting the saturated and near-saturated hydraulic conductivity. Results were used to model water transport in the vadose zone spatially distributed over Denmark using variation in the hydraulic properties as well as spatially distributed metrological data. Models results ended up with a map pointing out risk areas of macropore transport in relation to the leaching of phosphorus.