Geophysical Research Abstracts
Vol. 16, EGU2014-10361, 2014
EGU General Assembly 2014

Imaging and quantification of preferential solute transport in an undisturbed soil

John Koestel and Mats Larsbo
Swedish University of Agricultural Sciences, Soil and Environment, Uppsala, Sweden (john.koestel@slu.se)

Despite significant advances during the last decades there are still many processes related to non-equilibrium flow and transport in macroporous soil that are far from being completely understood. The use of 3-D X-ray for imaging time-lapse 3-D solute transport has a large potential to help advance the knowledge in this field. We visualized the transport of a potassium iodide tracer (20 mg iodine ml^{-1} H_2O) front through a small undisturbed soil column (height 3.8 cm, diameter 6.8 cm) under steady-state hydraulic conditions using an industrial X-ray scanner. Following an elaborate and time-costly illumination correction approach we yielded a series of seventeen 3-D difference images of density-changes with respect to the start of the tracer application. The spatial resolution was approximately 0.196 mm in all directions. The noise level varied between 3% and 8% of the maximally expected density changes. We related the time-lapse images to iodine concentrations using a linear calibration relationship. The electrical conductivity, assumed proportional to the iodide concentration, was measured in the effluent solution during the experiment. Eighty-five percent of the applied iodine mass was recovered in the effluent and inside the column. The solute transport through the soil predominantly took place within two cylindrical macropores, by-passing more than 90% of the bulk soil volume during the entire experiment. From these macropores the solute diffused into the surrounding soil matrix. We illustrated the properties of the investigated solute transport by comparing it to a 1-D convective-dispersive transport in terms of 1-D resident concentration profiles and to dilution indices, here used as estimates of preferential transport. We, furthermore, showed that the tracer diffusion from one of the macropores into the soil matrix could not be fitted with a cylindrical diffusion equation. We are positive that similar studies will help establishing links between soil structure and solute transport processes and may lead to improvements in models for solute transport through undisturbed soil.