Geophysical Research Abstracts
Vol. 16, EGU2014-890, 2014
EGU General Assembly 2014

Quantifying water and air redistribution in heterogeneous sand sample by neutron imaging

Jan Šácha (1), Martina Sobotková (1), Vladimíra Jelínková (1), Michal Sněhota (1), Peter Vontobel (2), and Jan Hovind (2)

(1) Czech Technical University in Prague, Civil Engineering, Department of Irrigation, Drainage and Landscape Engineering, Prague 6, Czech Republic (jan.sacha.1@fsv.cvut.cz), (2) Spallation Neutron Source Division, Paul Scherrer Institut, Villigen, Switzerland

Significant temporal variation of quasi saturated hydraulic conductivity (Kqs) has been observed to date in number of infiltration experiments conducted mainly on heterogeneous soil of Cambisol. The change of quasi-saturated hydraulic conductivity cannot be precisely described by existing models. The Kqs variations has been recently attributed to a changing distribution of the entrapped air and water within the sample. It is expected that air is moved to the preferential pathway and acts as a barrier there. To support this assumption a ponded infiltration experiment was conducted on a soil sample packed into the quartz glass column of inner diameter of 34 mm. The sample composition represents simplified heterogeneity of the natural soil but also allow the easy quantitative water content determination in individual subdomains of the sample. The matrix formed by a fine sand was surrounded with regions of coarse sand representing preferential flow pathways. The Kqs was determined from the known hydraulic gradient and measured volume flux. The experiment was monitored by neutron radiography. Volume of water in the sample calculated from neutron projections matched very well with actually infiltrated volume in the sample during first 40 second after beginning of infiltration. From the acquired radiographic images the 3D tomography images were reconstructed to obtain the spatial distribution of the water content within the sample. Difference between water volume calculated from radiography and tomography images was no more than 5%. While the total amount of water determined by NR within the sample during the quasi steady state flow remains practically constant (27.9 cm3 at the beginning and 28.6 cm3 on the end of infiltration) the water content in the coarse fraction decreases (from 0.333 to 0.324) and the water content in the fine fraction increases (from 0.414 to 0.436) in 5 hours. Similarly to previous experiments performed on natural Cambisols, the results support the hypothesis that the effect of the gradual Kqs variations is caused by the entrapped air redistribution and the build-up of bubbles in preferential pathways.