Geophysical Research Abstracts
Vol. 13, EGU2011-478, 2011
EGU General Assembly 2011

Characterization of Flow and Transport in Deep Vadose Zone – Implication from Direct Observations

Ofer Dahan (1) and Yaara Rimon (2)

(1) Environmental Hydrology & Microbiology, Zuckerberg Institute for Water Research, Ben-Gurion University of the Negev, Sede Boqer 84990, Israel. E-mail: dahan@bgu.ac.il, (2) Soil and Water Sciences, The Robert H. Smith Faculty of Agriculture, Food and Environment, Hebrew University of Jerusalem, P.O Box 12, Rehovot, Israel.

Water percolation and solute transport through unsaturated sandy formation was investigated using a vadose-zone monitoring system. The monitoring systems enabled in-situ, real-time, monitoring of the temporal variations in vadose-zone water content and water pressure as well as allow frequent sampling of the vadose-zone pore water for chemical and isotopic analysis. Several years of continuous operation of the monitoring systems provided insight into the dynamics of rainfall-induced infiltration events through thick sandy formation. The resultant data allowed tracing of the infiltration progress through the entire vadose zone. Each large rain event initiated an infiltration wave that propagated into the vadose zone and pushed the wetting front further down. The wetting front appeared to progress in a step-like pattern, controlled by the frequency of large rain events and followed by a slower drainage process. It has been shown that the chemical composition of mobile flowing water along the vadose zone is not in equilibrium with the total soluble solute potential of the sediment. This phenomenon is usually attributed to preferential flow. However, wetting-front propagation patterns, as monitored continuously over four rainy seasons through the entire vadose zone, showed relatively uniform wetting-front propagation with no direct evidence for significant preferential flow. The contradictory observations on matrix and preferential flow as governing mechanisms led to conceptualization of the percolation process as pore-scale dual domain flow.

Measurements of vadose zone water pressure through a separate set of VSPs, revealed the critical relationship between temporal variations in vadose zone water contents and water pressure, as well as the dynamic connectivity of the vadose zone gas phase and the atmosphere. As expected, variation in the sediments' water contents, induced by infiltration events, resulted in corresponding variations in pore water pressure. However, the measured responses of water pressure to wetting events were delayed compared to the measured variations in water contents. The delayed pressure response to a wetting process varied with location, as well as between wetting events.

Most of the time, the vadose zone gas phase was found to be well connected to the atmosphere. However, this connectivity was limited during rain events. Therefore, compensation of the measured water pressure against the measured atmospheric pressure is not straightforward. Connectivity of the vadose zone gas phase to the atmosphere was reestablished simultaneously across the entire vadose zone upon redistribution of the percolating water in the upper part of the cross section.