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Effects of soil horizons on vertical continuity of preferred flow domains

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Field studies have shown that vertical water flow through soil, even at the pedon scale, can have significant horizontal spatial variability. Stochastic convective transport models have been developed to describe the influence of this flow variability on solute transport/dispersion. Understanding and predicting the vertical continuity/persistence of preferred (high versus low) flow regions (with depth) remains a challenge. In addition, all soils by definition have at least two soil horizons (layers) and all models require assumptions about the vertical continuity of flow and correlation of hydraulic properties across horizon boundaries. Assumptions about the vertical continuity of flow and correlation of hydraulic properties across horizon boundaries have a significant influence on predicted water flow and solute transport. Because soil horizons (e.g. A and B horizons) have different average hydraulic properties and their boundaries are visually distinct, it is often assumed that soil horizon boundaries disrupt the continuity of preferred vertical flow and result in horizontal mixing/convolution (i.e. the soil horizons are assumed to be independent layers). In general, model development about the hydrological nature of soil horizon interfaces, and flow and transport in layered soils has outpaced fundamental understanding and measurements of processes occurring at soil horizon interfaces. This paper summarizes the results of steady and transient unsaturated flow experiments in a layered, field soil. The horizontal variability of vertical water flow and the continuity/correlation of this flow with depth across a horizon interface was measured using vertical TDR probes. Results from these experiments show that the soil horizon interface significantly influences the spatial pattern of local soil water flux. These results indicate that accurate parameterization of hydrologic models and pedotransfer functions must account for the nature of the soil horizon interface in

addition to the individual average properties of soil horizons.