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Dye staining and excavation of a lateral preferential flow network

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Abstract. Preferential flow paths have been found to be important for runoff generation, solute transport, and slope stability in many areas around the world. Although many studies have identified the particular characteristics of individual features and measured the runoff generation and solute transport within hillslopes, very few studies have determined how individual features are hydraulically connected at a hillslope scale. In this study, we used dye staining and excavation to determine the morphology and spatial pattern of a preferential flow network over a large scale (30 m). We explore the feasibility of extending small-scale dye staining techniques to the hillslope scale. We determine the lateral preferential flow paths that are active during the steady-state flow conditions and their interaction with the surrounding soil matrix. We also calculate the velocities of the flow through each cross-section of the hillslope and compare them to hillslope scale applied tracer measurements. Finally, we investigate the relationship between the contributing area and the characteristics of the preferential flow paths. The experiment revealed that larger contributing areas coincided with highly developed and hydraulically connected preferential flow paths that had flow with little interaction with the surrounding soil matrix. We found evidence of subsurface erosion and deposition of soil and organic material laterally and vertically within the soil. These results are important because they add to the understanding of the runoff generation, solute transport, and slope stability of preferential flow-dominated hillslopes.

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