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# Tracer based investigation of a hillslope subsurface flow network

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We combined tracer experiments under natural and steady state conditions with dye staining techniques to investigate the behaviour and physical characteristics of a hillslope subsurface flow network in an experimental watershed on Vancouver Island, Canada. Our objectives were: 1) to determine the relationship between lateral flow velocities and hillslope length, steady state flow rate, rainfall intensity, total rainfall amount, and antecedent condition, and 2) to determine if the development of preferential flow features is influenced by topographical factors such as slope and contributing area. We calculated average flow velocities by fitting transport models to tracer breakthrough data. The flow velocities were most closely related to the rainfall intensity and changes in flow velocity were large compared to the small changes in flow rates through the hillslope. The flow velocities were also affected by boundary conditions and slope length (an order of magnitude difference between 12 m and 30 m), which highlighted the importance of a representative volume used in the experiment. The dye staining and excavation revealed 1) evidence of past subsurface erosion and deposition of soil and organic material, and 2) a positive correlation between surface topography contributing area and the size and connectedness of preferential features. This supports the hypothesis that contributing area is related to network properties because the amount of subsurface flow influences the enlargement and preservation of the preferential features and is generally proportional to the contributing area. The experiments successfully applied methods commonly used for smaller soil-core experiments to a larger hillslope scale. The presented relationships of hillslope behaviour

and physical characteristics could help to refine models of runoff, slope stability, and solute transport and may have implications for land use.