



Preferential flow, connectivity and Fermats principle: a new perspective on environmental flow

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Preferential/rapid flow and transport is known as the key process in soil hydrology for more than 20 years. It seems to be rather the rule, than the exception. It occurs in soils, in surface rills and river networks. It seems that if connective preferential are present at any scale, they crucially control water flow and solute transport. But why? Is there an underlying principle? A possible explanation is that environmental flow is a manifestation of Fermat's principle. The idea is that the system follows trajectories that minimise the integral of the free energy over time. This implies that flow in a catchment arranges such, that excess water leaves the system in a minimum of time. As a flux is always a product of a driving force and a flow resistance, a minimum resistance along a flow path is a necessary condition that drainage time becomes minimal. In this case connective paths with minimum flow resistance are the first order control for environmental flow.

Along these thoughts the study will present first ideas on a possible theoretical framework, examples how to measure connectivity of flow paths and that the distribution of connective paths is indeed of crucial importance.