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Kinematic stormflow generation from two contrasting catchments

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This paper discusses a rapid flow process which may operate in headwater catchments to account for the substantial increase in stream runoff observed during large storm events. It is argued that rainfall at the soil surface causes the transmission of energy so that water is delivered to rapid flow routes and seepage faces by a kinematic process. This pressure wave propagation process only occurs when the soil water content is above a critical wetness threshold. Water is transmitted to a stream channel, either as surface flow or subsurface drainflow, by a dynamic network which expands and contracts during the rainstorm. The results of two contrasting field experiments are presented to substantiate these ideas. At Rowden Moor, North Wyke, a 1 ha underdrained bounded plot was used to examine the relationship between rain storm size and runoff. A linear response was found there i.e. more rainfall lead to increased discharge. This result is due to the structural characteristics of the heavy clay soil and the underdrainage network which is fixed in extent. Holne Moor on Dartmoor, is a typical upland first order stream that does not have a physical limitation on the size of the ephemeral network. For small storms, the rainfall-runoff relationship is linear, like Rowden which implies that the delivery network is fixed and probably by variable source areas. For large storms, runoff increases more rapidly than can be explained by rainfall and this is explained as an increase in the extent of the ephemeral network. The conclusion emphasises the link between subsurface pressure wave propagation and transmission of water to a stream or channel during large rainfall events.