



Threshold flow events: Interrelationships between the variability of their triggering, their magnitude and soil moisture

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Given that we often cannot measure preferential flow directly, there is a need to better understand how the variability of a measureable quantity, like soil moisture for instance, relates to the timing and magnitude of such flow events. Like surface runoff, preferential flow is triggered by thresholds in infiltration capacity or soil moisture. Where rainfall can be described as discrete and intermittent the rapid and threshold nature of these flows lends themselves to a similar description, discrete and episodic.

We derive analytical expressions for the variability of the time between these threshold flow events and for the soil moisture trigger we further derive expressions for the flux variability and apply existing expressions for soil moisture variability. We then go on to explore the interrelationships between flux, timing and soil moisture as dependent upon the statistical structure of rainfall. Across an aridity gradient temporal variability and soil moisture variability tends to peak where losses from soil moisture storage balance the gains from rainfall. Flux variability increases with greater aridity. The relative flux variability is always greater than the relative timing variability. These results describe how systematic changes in timing, flux and soil moisture variability would be expected to occur when there are changes to climate. Therefore where only part of a process is observable, we may be able to predict potential changes to the

other components of interest.