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Climate, soil and vegetation controls on the rapid transport of pesticides : A minimalist probabilistic approach.

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Preferential flow and surface runoff in field soils has long been recognised as a significant contributor to the transport of agrochemicals to streams and groundwater. In particular it has been noted often that it is the timing and nature of rainfall since application that is one of the principal controls on significant transport of these chemicals. In this study the climate soil and vegetation controls on these first fast transport events is put into a simple probabilistic framework. We consider fast transport events to be triggered when thresholds in soil and/or climate processes are exceeded. For example macropore flow can be considered to occur when the rainfall rate exceeds the soils infiltration capacity or alternatively when the storm volume is sufficient to lead to saturation excess. The timing of these events since application can be cast as first passage time problem allowing analysis of the transient stochastic soil moisture and pesticide processes. Posing the soil water storage function parsimoniously and simply describing fast flow processes as occurring when thresholds in either storage or rainfall are exceeded we derive analytical expressions for the distributions, moments and frequencies of passage times of various rapid transport processes. This allows a first order assessment of the chemicals potential mobility in a climate, soil and vegetation context.