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Climate and contaminant transport: the role of within-storm variability on contaminant transport by surface runoff

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Abstract The impact of climate drivers on contaminant transport has been largely neglected. Rainfall variability within a storm event can have a significant impact on the amount of contaminant transport by surface runoff. We seek to better understand how rainfall patterns impact contaminant transport depending upon pesticides characteristics. A bounded random cascade approach is used to generate an ensemble of rain events with specific Intensity–Duration–Frequency characteristics. We explore the effects of the partitioning of rainfall and chemical between fast surface runoff and slow flow in the soil matrix. The hydraulic properties, i.e. effective porosity, suction head and saturated hydraulic conductivity, of a vineyard clay loam soil are investigated. Ten years of 6-min resolution rainfall data from the Alsatian vineyard in France are used to derive the cascade and Intensity–Duration–Frequency relationships. Pesticide transport, both by runoff and infiltration, are modelled by a near-surface mixing model and Green-Ampt infiltration. Much smaller pesticide loading occurred for more weakly and more strongly adsorbing pesticides. The patterns of rainfall generating large surface runoff did not necessarily associate with large pesticide loadings depending on pesticide adsorption. We show that potential shifts in rainfall patterns within storms dramatically impact the frequency of contamination events, even without changes in storm duration and mean intensity return intervals. The framework developed allows a better understanding of risk of pesticide transport by rapid flow processes under changing climate conditions.

Key words pesticides; rainfall; runoff; modelling