Geophysical Research Abstracts, Vol. 8, 09629, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09629

A novel approach for stochastical modelling of preferential transport at the field and catchment scale

E. Zehe (1), L. Samaniego (2), A. Bárdossy (3)

(1) Institute of Geoecology, University of Potsdam, (2) Computational Environmental Systems (CES), UFZ Centre for Environmental Research Leipzig-Halle, (3) Institute of Hydraulic Engineering, University of Stuttgart

Preferential/rapid flow and transport is known as the key process for the fate of contaminant agro-chemicals for more than 20 years. Nevertheless, predicting environmental impact of pesticide transport at scales larger than the small field scale remains still an unsolved problem. In recent years researchers proposed various approaches ranging from range from simple effective approaches, over double porosity approaches to a approaches based on mathematical morphology mostly with the intention to exactly predict leaching i.e. the temporal evolution of the pesticide concentration in the soil. While this might work at well investigated field plots this strategy has to fail at larger scales. Preferential flow and transport is crucially determined by subsurface structures especially the connective preferential pathways that link the surface to the subsoil and these crucial information is never be exactly available at larger areas. From a statistical point of view the essence of rapid/preferential flow is a skewed or even bimodal pdf of travel times into the subsoil, where pesticide degradation is slow. This skewed or fat tailed pdf of travel times is due to the presence of structured heterogeneity in the subsurface, especially interconnected structures/preferential pathways link the soil surface and the subsoil. Fast travelling solute molecules in preferential flow paths will never mix with slow molecules in the matrix, hence the distribution of travel times will have a fat tail and early arrival. Travel times into the subsoil that are shorter than app. one half life time of the pesticide are critical because this fraction of the pesticide will persist more 10-100 times longer and likely cause a contamination of shallow groundwater. For assessing the risk of shallow groundwater contamination with pesticides at the catchment scales the key question to predict which fraction of the pesticide travels into the subsoil within times that are short against the characteristic half live of the

pesticide (before it degrades). Within the present study we will present a stochastical approach for predicting rapid flow and transport in structured soils at the field scale and catchment scale. To this end we employ a physically based process model for flow and transport as virtual landscape. We will show travel times of pesticides in a heterogeneous medium that contains macropores may be characterised by a skewed/ fat tailed pdf with moments that are conditioned by a) event dependent parameters such as soil moisture, precipitation characteristics and b) media characteristics. In particular the moment of the pdf that determines the spatial distribution of connective pathways that link the soil surface and the subsoil are strongly related to the moments of the pdf of travel times. Which proofs clearly that rapid flow in structured soils is a structural phenomenon. Better predictions of rapid flow require better a understanding and characterisation of spatial structures and there connectivity in the soil.