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Impact of soil structure heterogeneity on the degradation of organic pollutants at the centimeter scale : 3D Modeling using graph based method

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Contaminant degradation by microorganisms is very variable in soils because of the very heterogeneous spatial relationship of contaminant/degraders. Repacked Soil columns were carried out to study the degradation of 2,4D pesticide labelled with C14 for different scenarios of microorganisms and pesticide initial location. Measurements of global C14-CO_2 emission and C14 distribution in the soil column showed that the initial location play a crucial rule on the dissipation of the pollutant. Experiments were simulated using a 3D model able to model microbial degradation and substrate diffusion between aggregates by considering explicitly the 3D structure of soil from CT images. The initial version of the model (Monga et al., 2008) was improved in order to simulate diffusion in samples of large size. Partial differential equations were implemented using freefem++ solver. The model simulates properly the dynamics of 2,4D in the column for the different initial situations. CT images of the same soil but using undisturbed structure instead of repacked aggregates were also carried out. Significant differences of the simulated results were observed between the repacked and the undisturbed soil. The conclusion of our work is that the heterogeneity of the soil structure and location of pollutants and decomposers has a very strong influence on the dissipation of pollutants.