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Adapting LISEM to improve modeling of pesticide transfer by runoff and erosion

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Surface runoff and erosion represent major processes of pesticides transport from agricultural lands to aquatic ecosystems. Even if pesticide runoff models have been steadily improved in recent years, they remain only partially successful in correctly predicting pesticides transfers to surface waters. This could be partially explained by the limited ability to integrate (1) the spatial variability of pesticides deposition after application both on target and non-target areas, (2) the impact of rainfall variability within a storm event on the amount of pesticide transport and (3) the partitioning of pesticides between the aqueous and solid phases. The objective of this study is therefore to provide a simple modelling approach for pesticides mobilisation from the near surface soil layer. It may enable to identify the periods and source areas of contamination within a catchment. The Limburg Soil Erosion Model (LISEM) was chosen to develop this new pesticide module. This model is well designed to describe the agricultural landscape components and their impact on the runoff and erosion with high resolution rainfall data. LISEM is a fully distributed hydrological and soil erosion model that provides event-based predictions for agricultural plots and small catchments accounting for plant interception, surface storage in micro-depressions, soil detachment by rainfall, throughfall and runoff and the influence of tractor wheelings and paved roads. LISEM was validated for different soil and land use contexts. A simple mixing layer model was implemented to simulate the pesticide mobilisation at the soil/water interface and the partitioning between the dissolved and sorbed phases. This new model was applied on a 49 ha agricultural catchment with corns and sugar beets (Alsace, France). The output in terms of runoff, erosion and chloroacetanilides transport were compared to the data collected during an entire period of herbicide application from March to August 2012. A sensitivity analysis revealed that several key parameters influence the simulation results such as depth of the mixing zone and sorption coefficient.