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Conceptual modelling of solute transport in a subsurface drained field using equivalent soil compartments

F. Branger (1), D. de Sesmaisons (1), **J. Tournebize** (2), N. Carluer (1), C. Kao (2), M. Vauclin (3)

(1) Cemagref, UR QELY, 3 bis quai Chauveau, CP 220 F-69336, Lyon Cedex 09, FRANCE, (2) Cemagref, UR HBAN, Parc de Tourvoie, BP 44 F-92163, Antony Cedex, FRANCE, (3) LTHE - UMR 5564, CNRS, INPG, ID, UJF BP 53 F-38041, Grenoble Cedex 09, FRANCE

Subsurface drainage is a widely spread agricultural management device that deeply influences water path and solute transport. Indeed it generates 2D water flows (vertical in unsaturated zone, radial close to the pipe, horizontal in saturated zone at mid drain spacing). As a consequence solute transport is spatially and temporally heterogeneous. Elution curves usually present a typical pattern with a fast peak and long tail.

A dedicated modelling tool was developed from this background. As a coupled Boussinesq/reservoir simplified model is already available for hydrodynamics representation, a conceptual approach is preferred for solute transport.

The soil equivalent compartments approach is based on observation of water flow paths in a 2D drained soil profile and the estimation of travel times of solute particles from soil surface to the drain for different hydrodynamical conditions. Then the soil can be divided into several compartments with quite homogeneous travel times. Solute transport is represented in each compartment using an exponential transfer function parametrized by drain flow and travel time. Adsorption and degradation coefficients for reactive solutes are also added.

Such a solute transport model was implemented and tested against field data for herbicide Isoproturon. First results are encouraging : after calibration, fast breakthroughs after rainfall events are reproduced correctly and simulated pesticide concentrations in drain flow are quite accurate.