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Estimating the evolution of atrazine concentration in a fractured sandstone aquifer using lumped-parameter models and taking land-use into account

J. Farlin (1), T. Gallé (1), M. Bayerle (1), D. Pittois (1), C. Braun (1), H. El Khabbaz (1), P. Maloszewski (2), and M. Elsner (2)

(1) CRTE, CRP Henri Tudor, Luxembourg (julien.farlin@tudor.lu), (2) Institute for Groundwater Ecology, Helmholtz Zentrum Munich

The European water framework directive and the groundwater directive require member states to identify water bodies at risk and assess the significance of increasing trend in pollutant concentration. For groundwater bodies, estimating the time to trend reversal or the pollution potential of the different sources present in the catchment require a sound understanding of the hydraulic behaviour of the aquifer. Although numerical groundwater models can theoretically be used for such forecasts, their calibration remains in many real-world cases problematic. A more parsimonious lumped-parameter model was applied to predict the evolution of atrazine concentration in springs draining a fractured sandstone aquifer in Luxembourg. Despite a nationwide ban in 2005, spring water concentrations of both atrazine and its metabolite desethylatrazine still had not begun to decrease four years later. The transfer function of the model was calibrated using tritium measurements and modified to take into account the fact that whereas tritium is applied uniformly over the entire catchment, atrazine was only used in areas where cereals are grown. We could also show that sorption processes in the aquifer can be neglected and that including pesticide degradation does not modify the shape of the atrazine breakthrough, but only affects the magnitude of the predicted spring water concentration. Results indicate that due to the large hydraulic inertia of the aquifer, trend reversal should not be expected before 2018.