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Modeling Risk-Areas for diffuse Losses of Agrochemicals

P. Lazzarotto (1, 2), V. Prasuhn (2), H. Fluehler (1), **C. Stamm** (3)

(1) Soil Physics, Institute of Terrestrial Ecology, ETH Zurich, Grabenstr. 3, 8952 Schlieren, Switzerland, (2) Swiss Federal Research Station for Agroecology and Agriculture, Reckenholzstr. 191, 8046 Zurich, Switzerland, (3) Swiss Federal Institute for Environmental Science and Technology, Ueberlandstr. 133, 8600 Dübendorf, Switzerland

Modeling contributing areas for diffuse losses of agrochemicals may be often limited by the lack of adequate spatial data. In order to overcome the problem of overparameterization we present a parsimonious rainfall-runoff model based on the hydrologic responses of two soil types including the effects of topography. The 10 parameters needed for the model were obtained by simultaneously fitting the model to discharge from four neighboring catchments in the area of Lake Sempach in the Swiss Plateau. Due to their different soil composition it was possible to extract the hydrologic response of each soil type. Monte Carlo simulations resulted in 8100 accepted parameter sets yielding satisfactory calibrations. For the validation and the prediction of contributing areas (see below) we used 80% the simulations as a measure for the uncertainty of the model output.

A short calibration period of 11 d was sufficient to predict the discharge well in all four catchments during two validation periods. The same parameter set reproduced reasonably well discharge during wet periods of four entire growing seasons. Only during dry conditions the model performance was rather poor. These periods however are of little importance for diffuse losses.

Agrochemicals (with the exception nitrate) are generally lost to surface waters by fast transport mechanisms like surface runoff and preferential flow to tile drains. Conceptually, these processes were represented in the model by a single fast flow component. It originated from all areas of a given soil type with a topographic index above a saturation-dependent critical value. The model simulations showed that under wet

conditions even well-drained soil contributed to fast flow indicating a risk for diffuse losses. Nevertheless the probability of contributing to fast flow was below 10% on more than two thirds of the area even during a major storm flow event. This has important implications for managing these catchments.