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Use of dye-tracer infiltration patterns for the macropore parameterization of a physically based model (SWAP)

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ABSTRACT

Preferential flow is known to influence infiltration, soil moisture content distribution, groundwater response and runoff production. Several hydrological models are capable of simulating preferential flow, using different concepts. Model parameterization of preferential flow is however often limited to indirect optimization using outflow or discharge measurements, thereby limiting the insight into model performance concerning soil moisture distribution. In this study we use a physically based macropore concept, embedded in the SWAP model, in combination with dye infiltration patterns to parameterize macropore infiltration for three locations in a catchment: hill top, hillslope and valley bottom. The model with the calibrated macropore parameters is then applied and validated under natural field conditions, using detailed soil moisture content, rainfall and discharge data.

The results show that the macropore model parameters can be easily optimized to reproduce the dye-tracer infiltration patterns. The simulations of the infiltration patterns show much better results with the macropore model than without macropores. However, using the tracer infiltration patterns, the optimized maximum depth of macropores is completely dependent on the maximum depth of stained area, while the macropores are known to extend deeper into the soil. For long term simulations the wetting of deeper layers is too slow for both the simulations with as well as without the macropores. Runoff production is better simulated with the macropores. For the simulations without macropores the soil saturated conductivity used is very high, nevertheless runoff production is too high.