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Improved parameterization of sediment trapping in VFSMOD

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The most widely implemented mitigation measure to reduce transfer of pesticides and other pollutants to surface water bodies via surface runoff are vegetative filter strips (VFS). To reliably model the reduction of surface runoff, eroded sediment and pesticide inputs into surface water by VFS in a risk assessment context, an event-based model is needed. The most commonly used dynamic, event-based model for this purpose is VFSMOD. VFSMOD simulates reduction of total inflow (ΔQ) and reduction of incoming eroded sediment load (ΔE) mechanistically. These variables are subsequently used to calculate the reduction of pesticide load by the VFS (ΔP). There are several options in VFSMOD to calculate ΔP, notably the empirical Sabbagh equation (either with original or revised regression coefficients) and a regression-free, mechanistic mass-balance approach (Reichenberger et al., 2017).

Four studies with 16 hydrological events were selected from the experimental data compiled by Reichenberger et al. (2019), representing different levels of data availability and uncertainty. A first set of VFSMOD simulations, with parameterization according to the settings in the tool SWAN-VFSMOD, was run with the aim to compare the performance of the different pesticide trapping equations. The simulations yielded a general overestimation of ΔE, suggesting that the SWAN-VFSMOD parameterization of sediment filtration is too optimistic. However, a reliable prediction of ΔE is important for the reliability of predicted ΔP, in particular for strongly sorbing compounds.

In a second step, a maximum-likelihood-based calibration and uncertainty analysis with the DREAM-ZS algorithm was performed for each hydrological event and the target variables ΔQ and ΔE. Overall a good match of measured ΔQ and ΔE was achieved, but only a few parameters could be well constrained.

In a third step, in order to reduce the observed equifinality, the hydraulic parameters were fixed to the best parameter sets obtained during the second phase, and only sediment filtration parameters were calibrated with DREAM-ZS.

The most important parameter characterizing the incoming sediment in VFSMOD is the median particle diameter DP. A set of empirical equations to predict DP from soil texture (Foster et al., 1985) was used as supporting information in the calibration of DP.

The poster will present an improved, generic parameterization methodology for sediment trapping in VFSMOD that can be used for regulatory VFS scenarios.