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PESTIPOND: A fate model of pesticides in ponds

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Non-point pollution by pesticides affects the quality of drinking water supplies and aquatic environments. Ponds collecting runoff and erosion fluxes offer a complementary tool to mitigate pesticide transfer to aquatic ecosystems. Pesticides mitigation results from various physicochemical processes operating in the water column, the sediment layer, the vegetation, and the suspended particles of ponds. Many studies on ponds dissipation potential focus on nitrates and suspended sediments, but very little is known about the behavior of pesticides. In order to predict and enhance the dissipation of pesticides in ponds, a new 0D time-dependent model was designed, “PESTIPOND.” The dissipation function of ponds is due to a combination of transport, transfer, and transformation processes of pesticides in an interplay between pond compartments. A previous review helped us identify the main processes of pesticides dissipation in ponds and their controlling factors. A time-dependent environmental fate model is currently developed to describe the behavior of dissolved and particulate pesticides at the pond scale. We tested the performance of this process-based model by simulating the behavior of four molecules with contrasted physicochemical properties (i.e., Aclonifen, chlorotoluron, s-metolachlor, and tebuconazole) in a synthetic scenario representing an experimental pond study. PESTIPOND enabled to compute the outlet concentration of pesticides in ponds based on their inlet concentration. The model simulated the behavior of pesticides in water, sediments, vegetation, and suspended particles of a pond due to sorption, settling/resuspension, volatilization, and degradation processes. The conceptual model is based on pesticide mass-budget equations in pond compartments depending of climate and hydraulic conditions. Sensitivity analysis provides a framework to recognize important variables in the computational model. We adopted the Morris and Sobol methods for the sensitivity analysis of PESTIPOND to identify dominant parameters influencing the model outputs. A preliminary result showed that the prevailing processes determining pesticide fate were sorption and biodegradation for dissolved pesticides and settling for particulate pesticides. The identification of effective mechanisms can be helpful to hierarchize processes based on their contribution to the dissipation function of ponds. This hierarchization may improve the estimation of ponds efficiency with respect to pesticide dissipation. In the future, implementing the PESTIPOND model in SWAT is expected to extend the prediction of ponds dissipation to the catchment scale. PESTIPOND will be particularly helpful to set up dimensioning criteria to design performant and efficient ponds to mitigate pesticides transfer into the

environment.