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Fluorescence tracers as a reference for pesticide transport in wetland systems

Jens Lange (1), Elodie Passeport (2), and Julien Tournebize (2)

(1) Universität Freiburg, Inst. of Hydrology, Freiburg, Germany (Jens.Lange@hydrology.uni-freiburg.de, +49 761 2033594), (2) CEMAGREF, Anthony, France

Two different fluorescent tracers, Uranine (UR) and Sulforhodamine (SRB), were injected as a pulse into surface flow wetlands. Tracer breakthrough curves were used to document hydraulic efficiencies, peak attenuation and retention capacities of completely different wetland systems. The tracers were used as a reference to mimic photolytic decay (UR) and sorption (SRB) of contaminants, since a real herbicide (Isoproturon, IPU) was injected in parallel to UR and SRB. Analysis costs limited IPU sampling frequency and single samples deviated from the tracer breakthrough curves. Still, a parallel behavior of IPU and SRB could be observed in totally different wetland systems, including underground passage through drainage lines. Similar recovery rates for IPU and SRB confirmed this observation. Hence, SRB was found to be an appropriate reference tracer to mimic the behavior of mobile pesticides (low KOC, without degradation) in wetland systems and the obtained wetland characteristics for SRB may serve as an indication for contaminant retention. Owing to the properties of IPU, the obtained results should be treated as worst case scenarios for highly mobile pesticides.

A comparison of six different wetland types suggested that non-steady wetland systems with large variation in water level may temporally store relatively large amounts of tracers (contaminants), partly in areas that are not continuously saturated. This may lead to an efficient attenuation of peak concentrations. However, when large parts of these systems are flushed by natural storm events, tracers (contaminants) may be re-mobilized. In steady systems vegetation density and water depth were found to be the most important factors for tracer/contaminant retention. Illustrated by SRB, sorption on sediments and vegetation was a quick, almost instantaneous process which lead to considerable tracer losses even at high flow velocities and short contact times. Shallow systems with dense vegetation appeared to be the most efficient SRB/contaminant traps. For photolytic decay no reference contaminant was studied, but the results found for UR may serve as a valuable proxy for this process.