



The effect of emerging wetland vegetation on solute transport processes

Tobias Schuetz, Markus Weiler, and Jens Lange

University of Freiburg, Institute of Hydrology, Faculty of Forest and Environmental Sciences, Freiburg, Germany
(tobias.schuetz@hydrology.uni-freiburg.de, 0049 761 2033594)

The occurrence of aquatic vegetation in shallow, slow flowing systems such as wetlands, estuaries or shallow rivers strongly influences solute transport processes. Vegetation communities or even single plants may affect hydraulic characteristics of wetland systems through the appearance of preferential flow paths and physico-chemical retention processes (e.g. sorption, microbial degradation, light decay). We studied the impact of emerging wetland vegetation (*Phragmites Australis*, *Thypha Latifolia* and *Juncus Conglomeratus*) and sediment accumulation on the changes of conservative and non-conservative solute transport processes. We carried out four different multi-tracer experiments in March and August 2010 in a 258 m² constructed free water surface wetland in south-western Germany. Tracer breakthrough curves resulting from two different tracer injection methods (slug injection and constant rate injection) characterize the properties of the wetland in early spring (with initial vegetation of one plant per m²) and in summer (with dense vegetation cover and additional sediments). Solute transport was simulated by the transient storage model OTIS and compared to the different breakthrough curves. The conservative tracer bromide was used to quantify the 30% decrease of wetland volume (spring to summer) and the change of preferential flow areas relative to storage zones and their exchange rate. While the relative mean residence time decreased on average by 10 % (increase of preferential flow paths), the relative fraction of storage zones increased from 42% in spring to 61% in summer. Then, the calibrated OTIS was modified to include sorption processes and light decay. As such, the sorptive, but light insensitive fluorescent dye Sulphorhodamine B and the slightly sorptive, but photo-degradable dye Uranin could be simulated. Sorption (linear isotherm, reversible) was found to be higher if vegetation density increases. Light decay was on average 50 times higher in non-shaded flow channels. Finally, we validated this approach by predicting the transport of the sorptive and photo-degradable dye Eosin.

The closed boundaries of the wetland system (underlying clay layer, defined input and output) allowed us to use an integrative multi-tracer experiment and 1-D modelling approach to quantify the overall characteristics and effects of the emerging vegetation in wetlands and their implication for conservative and non-conservative solute transport.

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