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Phosphorous retention in a remediated stream – evaluation of a 32P tracer experiment

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The increased attention to surface water quality problems together with the revealed importance of the stream water –hyporheic zone system for solute retention has highlighted the potential for surface water systems to mitigate solute export to downstream recipients. As a consequence, the number of stream restoration projects during the last decades has increased significantly. However, to be able to design remediation measures as well as to assess the effectiveness of implemented measures, quantitative knowledge of the hydrodynamic (substance independent) and the biogeochemical processes (substance dependent) retaining the solute along the transport pathway is needed.

In this work, we present the findings from a simultaneous injection of tritiated water (3H20) and phosphate (32PO4-) with the overall aim to evaluate the effectiveness of remediation actions implemented along a 6 km stretch of a small agricultural stream in Sweden. In contrast to many other tracer tests where different types of proxy substances are used, a key advantage of the study is the use of the substance of environmental interest (in this case phosphorous), which enhances the significance of the results. In addition, the unique radioactive signal from the injected tracer allowed us to distinguish the added phosphorous from other diffuse sources of phosphorous from the surrounding landscape.

By using a physically based transport model to evaluate the tracer breakthrough curves at a number of subsequent sampling stations, we were able to contrast the response of different stream reaches both with respect to hydrodynamic and biogeochemical retention. In particular, we found a substantial importance of vegetation on the retention of 32P, when comparing established reaches with dense in-stream vegetation with newly implemented reaches where vegetation was completely absent.