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Linking transient storage parameters to exchange mechanisms and reach characteristics

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A traditional way of investigating transient storage zones in streams and rivers comprises the performance of tracer tests. The information gained from the tests however, is in many ways limited by the geomorphological and hydraulic local conditions under which the test was performed. Consequently, there is a need for more general information about how reach characteristics and combined exchange mechanisms affect transient storage retention that can be expressed by scaling factors between physical, measurable parameters and the integrated total retention in a reach.

A large number of tracer tests have been performed in a wide variety of reaches around the world and in this project we are taking advantage of already collected data as well as new tracer test performed within the study, to quantitatively evaluate how different geomorphic and hydraulic conditions affect the retention of solutes in rivers. By advancing existing physically based models on the local-scale with the combinations of exchange mechanisms we theoretically describe the relative magnitude of exchange mechanisms, and combinations of these, under specific hydraulic conditions and show how exchange parameters associated with different mechanisms are correlated physically. Both hyporheic transient storage zones (HTS) and surface transient storage zones (STS) are considered. Combined vertical exchange with the HTS can be evaluated by superimposing the velocity fields associated with stream features of different size described mathematically by harmonic functions, while exchange with other zones can be treated as independent and after evaluating the relative importance of the associated exchange parameters it can be added to the vertical exchange to obtain the total integrated retention.

Based on the tracer tests, each tested reach is characterised in terms of its geomorphologic and hydraulic features and related statistically to reach-scale parameters evaluated from the tests with a longitudinal transient storage model. Important geomorphologic and hydraulic features used as classification parameters are those that that can be directly linked to specific management measures implemented in streams to increase natural remediation of nutrients and other contaminants. Only field data from reaches where measurements independent of the tracer tests have been done is included in this study in order to correctly analyse dominating mechanisms and combination of mechanisms and to be able to link the retention times to relevant and measurable reach characteristics.