Evaluation of vertical connectivity in regulated river reaches using a multiparametric measuring approach

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ABSTRACT: The vertical connectivity in the hyporheic zone of alluvial rivers represents an important dimension for many aquatic species including macroinvertebrates but also for the reproduction of gravel-spawning fish. It is widely known that the infiltration and accumulation of fine particles into the riverbed (clogging) can severely impact the vertical connectivity, especially in regulated river reaches because of altered flow and sediment regimes. The process 'riverbed clogging' is also frequently named as a reason for failing the 'good ecological status' according to the Water Framework Directive (WFD).

Although the phenomenon 'clogging' has been studied for decades, no standardized quantitative and physical-based criteria are available to assess riverbed clogging. Available measuring methods range from qualitative approaches such as visual inspections (mapping) to single-parameter based approaches that are not sufficient to encompass the complex and interactive processes of clogging. Therefore, we developed a multiparametric approach (MultiPAC) consisting of measurements and analyses of particle size distributions, porosity values, hydraulic conductivities and dissolved oxygen contents (DOC). This novel approach enables a quantitative description of clogging and an identification of clogged layers in stratified riverbeds as the hydraulic conductivity and the DOC are measured in vertical profiles (over 50 cm sediment depth). We applied the approach before and after several restoration measures (artificial flushing and bed alterations) in a near natural by-bass channel and in a residual river reach. We could identify clear benefits of the measures in restoring the vertical connectivity, especially in the upper 15-20 cm of the riverbed.

Currently, we are working on the development of a rivertype-specific evaluation approach of clogging by investigating reference reaches in Germany (according to WFD) to obtain reference values for the measured physical variables of MultiPAC. Additionally, biological sampling including macro invertebrates and the interstitial fauna with subsequent DNA-analyses are conducted. Together with an assessment of catchment characteristics this concept results in a unique dataset that can serve as a basis for a quantitative evaluation approach of clogging. First analyses of the collected data show exciting findings regarding the degree of clogging and its abiotic and biological descriptions.