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Experimental analysis and modelling of the oxygen balance in the hyporheic zone of the Kharaa River (Mongolia)

M. Hartwig and D. Borchardt
Helmholtz-Centre for Environmental Research, Germany (melanie.hartwig@ufz.de)

The hyporheic zone has important functions for the aquatic ecosystem like beeing a habitat for a variety of organisms and a reactor for a multitude of transformation processes. But these functions are dependent on the availability of oxygen. Under oxygen depletion for example, the habitat for macroinvertebrates and fish gets lost, and denitrification or the dissolution of phosphorous occurs. Then again, the input, retention time and depletion of oxygen is for most of the part dependent on the morphology and the sediment properties.
Therefor, the aim of the study is the process analysis of the oxygen balance within the compartments surface water column and hyporheic zone along a river gradient and under consideration of sediment input. The study area of the Kharaa River (Mongolia) is suitable for that reason as it is close to natural conditions and an identifiable point source of suspended sediment enables a causal analysis of the clogging problem.
For the numerical analysis a two-compartment model on the riffle scale was conceptualized. According to that an intensive monitoring program was conducted in spring and late summer of 2010 and 2011 including methods for the characterization of the hydraulics, the exchange as well as biogeochemical properties. The model concept was implemented in AQUASIM and calibrated with the data.
The data show a decreased interaction of surface and interstitial water along the river gradient, in particular the diversity of oxygenation and therefor potential transformation processes within the hyporheic zone decreased. And the functional loss for habitat and production could be proved to be impaired by suspended or infiltrated sediments. The results of the numerical analysis demonstrates, at which state the clogging process can become critical for the hyporheic functioning.
This study provides important information in order to identify critical conditions for the aquatic ecology as well as for the self regulation of the river under different loads of suspended solids.