Geophysical Research Abstracts
Vol. 19, EGU2017-15254-1, 2017
EGU General Assembly 2017

Coupled long term simulation of reach scale water and heat fluxes across the river groundwater interface and hyporheic temperature dynamics

Matthias Munz (1), Sascha E. Oswald (1), and Christian Schmidt (2)

(1) University of Potsdam, Institute of Earth and Environmental Science, Potsdam, Germany, (2) Helmholtz Centre for Environmental Research – UFZ, Department of Hydrogeology, Leipzig, Germany

Flow pattern and seasonal as well as diurnal temperature variations control ecological and biogeochemical conditions in hyporheic sediments. In particular, hyporheic temperatures have a great impact on many microbial processes. In this study we used 3-D coupled water flow and heat transport simulations applying the HydroGeoSphere code in combination with high frequent observations of hydraulic heads and temperatures for quantifying reach scale water and heat flux across the river groundwater interface and hyporheic temperature dynamics of a lowland gravel-bed river. The magnitude and dynamics of simulated temperatures matched the observed with an average mean absolute error of 0.7 °C and an average Nash Sutcliffe Efficiency of 0.87. Our results highlight that the average temperature in the hyporheic zone follows the temperature in the river which is characterized by distinct seasonal and daily temperature cycles. Individual hyporheic flow path temperature substantially varies around the average hyporheic temperature. Hyporheic flow path temperature was found to strongly depend on the flow path residence time and the temperature gradient between river and groundwater; that is, in winter the average flow path temperature of long flow paths is potentially higher compared to short flow paths. Based on the simulation results we derived a general empirical relationship, estimating the influence of hyporheic flow path residence time on hyporheic flow path temperature. Furthermore we used an empirical temperature relationship between effective temperature and respiration rate to estimate the influence of hyporheic flow path residence time and temperature on hyporheic oxygen consumption. This study highlights the relation between complex hyporheic temperature patterns, hyporheic residence times and their implications on temperature sensitive biogeochemical processes.