Geophysical Research Abstracts
Vol. 17, EGU2015-1494-2, 2015
EGU General Assembly 2015

Dissolved Oxygen Concentration Profiles in the Hyporheic Zone Through the Use of a High-Density Fiber Optic Measurement Network

William Jeffrey Reeder (1), Annika Quick (2), Tiffany B Farrell (3), Shawn G Benner (2), Kevin P Feris (3), and Daniele Tonina (1)

(1) University of Idaho, Department of Civil Engineering, Boise, United States (reed4827@vandals.uidaho.edu), (2) Boise State University,Department of Geosciences, Boise, United States (annikaquick@u.boisestate.edu), (3) Boise State University,Department of Biology, Boise, United States (tiffanyfarrell@u.boisestate.edu)

The majority of chemical reactions in riverine systems occur within the hyporheic zone (HZ). Hyporheic exchange, flow into and out of the hyporheic zone, represents a primary control over those reactions because the flow rate will determine the residence time and amount of chemical constituents in the HZ. Hyporheic flow can be conceptualized as discreet streamlines that collectively represent a broad distribution of residence times. Within this context, dissolved oxygen (DO) concentration becomes a primary indicator of the redox and biochemical state of the HZ including, for example, the fate of carbon, contaminant behavior, nutrient cycling, stream DO levels and nitrous oxide (N_2O) production. River systems have been identified as a significant source of N_2O emissions, contributing an estimated 10% of anthropogenically generated N_2O. The primary biochemical transformations that lead to N_2O production are nitrification (NH^{4+} to NO^{3-}) and denitrification (NO^{3-} to N_2) reactions that are mediated by microbes living in the HZ. Current theory describes a process in which DO enters the stoss side of the HZ and is consumed by respiration and nitrification in the upstream, oxic portion of the streamlines leading to a progressive partitioning of the HZ from oxic to anoxic. This conceptualization, however, has not been well validated in a physical sense, due to inherent difficulties associated with measuring chemical concentrations in the HZ. To test current theory, we measured HZ DO concentrations, in a large-scale flume experiment, almost continuously for five months using a multiplexed optical network and a precision robotic surface probe system. We were able to measure DO at higher spatial and temporal resolution than has been previously demonstrated. These measurements, coupled with detailed numerical modeling of HZ flowlines, allowed us to map HZ DO concentrations spatially and over time. Our findings validate the models that describe the consumption of DO through microbial processes. Additionally, our results show that residence time is a strong predictor of DO concentration within the HZ.