Geophysical Research Abstracts
Vol. 16, EGU2014-334-1, 2014
EGU General Assembly 2014

Impact of losing and gaining stream flow conditions on hyporheic exchange fluxes induced by dune-shaped bedforms

Aryeh Fox (1), Shai Arnon (1), and Fulvio Boano (2)

(1) Department of Environmental Hydrology and Microbiology, Zuckerberg Institute for Water Research, The Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Sede Boqer, Israel.(sarnon@bgu.ac.il), (2) Department of Environment, Land and Infrastructure Engineering, Politecnico di Torino, Turin, Italy.(fulvio.boano@polito.it)

The exchange of water between the surface and subsurface environments plays a crucial role in hydrological, biogeochemical, and ecological processes. The exchange of water is driven by the local morphology of the streambed (hyporheic exchange) and the regional forcing of a large-scale hydraulic gradient, which results in losing or gaining flow conditions.

The effects of losing and gaining flow conditions on hyporheic exchange fluxes was measured under various combinations of overlying water velocities and losing or gaining fluxes using a novel laboratory flume system (640 cm long and 30 cm wide) that can be used to enforce gaining or losing fluxes. Tracer experiments were conducted by introducing NaCl as a nonreactive tracer to the recirculating water, and then monitoring the reduction in the in-stream electrical conductivity over time. Hyporheic exchange fluxes were analyzed based on a new conceptual framework, which relies on a solute mass balance that takes into account the losing and gaining conditions.

Experimental results revealed that hyporheic exchange fluxes become smaller as the losing or gaining flux increase. The rate of decline in hyporheic exchange flux followed exponential decay pattern, and was statistically similar under losing and gaining flow conditions. Losing and gaining flow conditions become the dominant mechanisms of water exchange at a threshold flux, which depends on the competitive interaction between the overlying velocity in the stream and the losing/gaining fluxes.

This type of interaction between surface and subsurface flow is expected to regulate nutrient and contaminant transport and microbial activity in streams, and should be incorporated into modeling frameworks that describe solute transport.