Geophysical Research Abstracts,
Vol. 11, EGU2009-7620, 2009
EGU General Assembly 2009

Salt-tracer experiments to measure hyporheic transit time distributions in gravel-bed sediments

M. Van der Perk (1), E.L. Petticrew (2), P.N. Owens (2), R. Hulsman (1), and L. Wubben (1)

(1) Utrecht University, Department of Physical Geography, Utrecht, Netherlands (m.vanderperk@geo.uu.nl), (2) University of Northern British Columbia, 3333 University Way, Prince George, British Columbia, V2N 4Z9, Canada

We performed a series of tracer experiments in large outdoor flumes at the Quesnel River Research Centre, Likely, BC, Canada to quantify the hyporheic transit time distribution in gravel bed sediments. For this purpose, an 18.9 m x 2 m flume was filled with a 30 cm thick layer of well-sorted gravel with a d50 of 39.1 mm. The average longitudinal gradient of the gravel bed was 0.05% The flumes were filled with aerated local groundwater, so that a standing water layer of 20 cm depth over the gravel bed was established. Subsequently, dissolved common salt was added until the water reached an electrical conductivity (EC) between 450 and 550 μS/cm. The flumes were equilibrated overnight to ensure a uniform distribution of the salt concentration across the flume. At the start of each experiment local groundwater (EC = 150 μS/cm) was discharged at a rate of approximately 16 l/s at the upper end of the flume. At 10 m downstream from the inlet the EC was monitored in the water layer until the EC remained constant at a value close to the background value of about 150 μS/cm. The experiment was replicated three times. The measured breakthrough curves were used to calculate the overall transit time distributions of water in the 10 m stretch of the flume. The transit time distribution in the water layer was calculated using the longitudinal dispersion coefficient estimated using the empirical equation of Fischer et al. (1979). For the transit time distributions within the gravel layer we assumed a probability density function as proposed by Marion and Zaramella (2005). These hyporheic transit time distributions were estimated using least-squares deconvolution of the overall transit time distributions. The fitted overall transit time distributions corresponded fairly well to the 'observed' distributions. The 10th percentile of the hyporheic transit time distributions in the 10 m stretch of the flume varied between 45 s and 65 s. The median transit time ranged between 200 s and 295 s and the 90th percentile between 790 s and 1435 s.

References

Fischer, H.B., E.J. List, R.C.Y. Koh, J. Imberger, and N.H. Brooks 1979. Mixing in Inland and Coastal Waters. New York: Academic Press.

Marion, A., and M. Zaramella 2005. A residence time model for stream-subsurface exchange of contaminants. Acta Geophysica Polonica 53: 525-538.