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Separating in-channel and hyporheic transient storage processes in river networks – A path toward improved understanding of fluvial biogeochemistry

M. N. Gooseff (1), M. A. Briggs (2), M. Weaver (1), W. Wollheim (3), B. J. Peterson (4), K. Morkeski (4), and C. Hopkinson (5)

(1) Penn State University, Civil & Environmental Engineering, University Park, United States (mgooseff@engr.psu.edu), (2) Colorado School of Mines, Hydrologic Science & Engineering Program, Golden, United States (martybriggs.1@gmail.com), (3) University of New Hampshire, Institute for the Study of Earth, Oceans and Space, Durham, United States (wil.wollheim@unh.edu), (4) Marine Biological Laboratory, Ecosystems Center, Woods Hole, United States (peterson@mbl.edu), (5) University of Georgia, Department of Marine Sciences, Athens, United States (chopkins@uga.edu)

Hyporheic zones of streams and rivers have been identified as important ecotones, harboring critical habitat and serving as locations of enhanced biogeochemical cycling of stream and groundwater borne nutrients and pollutants. Stream tracer experiments provide a useful approach to characterizing the transport and fate of dissolved stream loads. However, the residence times of stream water and associated dissolved solutes is rarely distinguished between in-channel, surface transient storage zones (STS; e.g., eddies, sides of pools, etc.), and hyporheic transient storage (HTS). These two storage zone types are likely to have very different conditions, with STS having potentially abundant light and dissolved oxygen, and HTS being dark and potentially strongly reducing conditions. We have developed a set of field methods designed to parameterize a 2-storage zone solute transport model so that we can account for STS and HTS exchange independently. We have applied this method to several reaches along the Ipswich River network, a 5th order coastal watershed in northern Massachusetts, USA. Our findings indicate that both the size and the mean storage residence times of STS and HTS zones increase with increasing stream size at baseflow conditions. The application of this 2-storage zone approach will enhance our ability to quantify hydrologic exchange processes and their influence on zone-specific biogeochemical processes across stream networks.