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Insights into the role of lateral hyporheic exchange on biogeochemical cycling as a function of varying annual discharge in the East River, CO, USA

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Riverine discharge and solute concentrations can provide an integrated signal of watershed hydrological and biogeochemical processes. Concentration-discharge (C-Q) relationships have been widely used to investigate these processes, providing information on source water mixing/contributions, weathering processes, and temporal changes on seasonal to decadal time scales. Arora et al. [1] recently introduced a powerful new differential C-Q (DC-DC) approach, which uses the changes in solute concentrations and discharge between sampling stations on a river to infer lateral transport within multiple reaches of a mountainous headwater catchment. In this study, we expand on the work of Arora et al. [1] to include a lower elevation reach of the East River which is characterized by a larger floodplain with a meandering river and no significant perennial surface inflows, therefore enhancing our ability to observe lateral exchange of water and solutes through the floodplain sediments. We present differential C-Q results for a range of solutes, including major cations, anions, and nutrients, as a function of the seasonal snowmelt hydrological perturbation for multiple water years. Solute concentrations in intra-meander (shallow groundwater) zones are also studied to help elucidate and support findings at the reach-scale. Results indicate that lateral hyporheic exchange and floodplain biogeochemical cycling play a significant role in the export of solutes in this reach of the river, and furthermore, that these processes are temporally dynamic.

References

[1] Arora, B., Burrus, M., Newcomer, M., Steefel, C. I., Carroll, R.W.H., Dwivedi, D., Dong, W., Willaims, K.H., and Hubbard, S.S. (2020). Differential C-Q Analysis: A New Approach to Inferring Lateral Transport and Hydrologic Transients Within Multiple Reaches of a Mountainous Headwater Catchment. Frontiers in Water 2(24).