Influence of stream morphology on metabolism and reactive solute transport

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Transient storage zones can be locations of intensive biogeochemical processing in streams, enhancing reach-scale nutrient uptake and metabolism. Despite this, the relationship between stream morphology, solute transport, nutrient cycling, and ecosystem functioning remains largely unresolved. We investigate the influence of stream channel morphology on transient storage, whole-stream respiration and nutrient uptake in two upland streams using coupled injections of the reactive tracer resazurin (Raz) and $^{15}N\text{-}NH_4^+$. Raz, a weakly fluorescent dye, irreversibly transforms to resorufin (Rru) under mildly reducing conditions, providing a proxy for aerobic respiration. We also evaluate whether Raz transformation is correlated to rates of nutrient uptake, to confirm if Raz can be a predictor of the relationship between transient storage and nutrient retention.

Pulse injections of Raz, NaCl, and uranine were added to two 3rd-order streams in the Harz Mountains, Germany, which are characterized by differing sub-reach channel morphology (riffles, glides and pools) and sediment characteristics. Continuous time series of electrical conductivity, Raz, Rru and uranine concentrations were measured in-situ at four evenly spaced locations along ~1km reaches, and used to calculate sub-reach travel time distributions and aerobic respiration rates. 24-hr constant rate injections of $^{15}N\text{-}NH_4^+$ and NaBr immediately preceded the Raz injections. Water, biofilm, macrophyte and organic matter samples were collected at the sub-reach scale to evaluate reach and sub-reach ^{15}N uptake and transformation, and the significance of biofilms for N uptake processes.

Preliminary results indicate distinct differences in sub-reach travel time mean and distribution, with the slowest mean velocities occurring in the reaches with the largest proportion of pools. Respiration rate coefficients, consistent for headwater streams, are highest in the reaches with the slowest mean velocities, suggesting that the pools could contribute to increased metabolically active transient storage.