Title: **Instream and Hyporheic Zone Contributions to River Corridor Oxygen and CO_2 Dynamics During Particulate Organic Matter Additions**

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Project Abstract:

River corridors are important for aquatic and terrestrial nutrient and organic matter (OM) cycles. Thus, there have been numerous studies to understand the role of the river channel versus the benthic sediment in OM transformations. Yet gaps remain regarding when and where reaction hot spots occur within the river corridor's terrestrial-aquatic interface. Here, we combined experimental and modeling approaches to evaluate the contributions from the channel and from the most biogeochemically active portion of the river sediment – the hyporheic zone– to the aerobic respiration of additional OM. We conducted flume experiments where we intermittently added different masses of OM to the channel. Through monitoring aerobic respiration and other parameters in both the channel and the hyporheic zone, and through robust determination of mass transfer coefficients, we developed a two-box dynamical model representing the hyporheic zone-channel-atmosphere system. We found that under the low channel flow conditions of the experiments and on hourly-to-daily timescales: (1) the aerobic respiration of OM mostly occurs in the channel; (2) the CO_2 concentration in the hyporheic zone always exceeds the CO_2 concentration in the channel, but due to weak hyporheic zone-channel coupling, the hyporheic zone is a small contributor to aerobic respiration of the entire river corridor; (3) the channel-atmosphere exchange flux exceeds the hyporheic zone-channel flux by orders of magnitude; (4) and, the modeled channel CO_2 levels agree markedly better with the observations when the respiratory quotient is 0.5 instead of 1. Thus, under our experimental conditions, the addition of OM resulted in the channel acting as the river corridor's hot spot for aerobic respiration although aerobic respiration was always active in the hyporheic zone.