Advancing Understanding, Modeling, and Scaling of Hyporheic Zone Terrestrial Aquatic Interfaces and their Impacts on Watershed Function

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River corridor systems in snow-dominated, mountainous regions often express complex biogeochemistry and river water nutrient indicators as a function of hydrologic exchange variability and snowmelt conditions. Watershed ecological control points (ECPs) (e.g. hyporheic zones, riparian hollows) are important for solute and nutrient processing at small scales, yet can have major impacts on large scale watershed exports. A major motivating factor of our work is a five-year concentration-discharge (C-Q) time series which display declines in inorganic nitrogen over time and down the watershed network, indicating the importance of the passive or active nature of these ECPs. Within this work, we demonstrate using a rich data-informed modeling approach, that during the spring snowmelt season, these zones support specific flow, biogeochemical, and microbial conditions that are more passive, leading to chemo-dynamic C-Q curves on the rising limb of the hydrograph. During the growing season, temperature, plants, microbes, and hydrologic gradients shift dramatically and activate ECP biogeochemistry as a major control on in-stream nutrient conditions, leading to chemo-static C-Q curves. The reliance of active or passive ECPs on the timing of meltwater infiltration, including the possibility of a longer vernal window under future climate change indicates the importance of ECPs as controls on river-based indicators of river corridor hydro biogeochemical function, and may reveal that ECPs can serve many roles throughout the year.

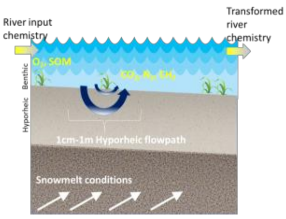

Figure 1: Hyporheic zones are important TAI features that transform river water which is a reflection of watershed function.