Poster #21-57

Snowmelt Dynamics Influence the Distribution of Microbial Communities and Carbon Pools in a Riverbed Ecosystem

Michael J. Wilkins[1], Audrey H. Sawyer[1], Kenneth H. Williams[2], Casey M. Saup[1], Amelia Nelson[1], and Savannah Bryant[1]

[1]Ohio State University, Columbus, OH
[2]Lawrence Berkeley National Laboratory, Berkeley, CA

Contact: wilkins.231@osu.edu

BER Program: SBR
Project: University Award

The hydrology of upland catchments in the western US is dominated by seasonal snowmelt that generates peak river discharge in spring and early summer, and low flow conditions for much of the remainder of the year. These snowmelt events are tightly linked to large-scale biogeochemical perturbations within such watersheds. Terrestrial organic carbon and other solutes are exported from hillslopes to the river channel, while increases in river discharge alter patterns of hyporheic mixing and solute processing in the riverbed. To investigate how mixing processes across the hyporheic zone affect carbon and metal processing, both discrete sampling and continuous monitoring efforts have been employed around a characteristic meander on the East River, CO.

Depth resolved temperature probes have been used to infer temporal patterns of flux across the sediment-water riverbed interface. Results have revealed strong river water down welling during periods of snowmelt-linked high discharge that contrast with groundwater up-welling signals during base flow. These hydrologic dynamics exert a strong effect on riverbed pore water geochemistry and microbiology.

While more carbon is exported from the catchment during high flow conditions, the chemistry (and therefore lability) of the DOC pool changes significantly across seasonal time scales. During snowmelt and associated high river discharge, river water carbon chemistry is more homogenous. Due to river water down welling, this signal is distributed into riverbed pore fluids up to 60 cm depth. Contrastingly, under low flow conditions when up-welling groundwater has a greater influence in the riverbed, more diverse and potentially labile carbon compounds are detected in both pore fluids and river water. These mixing patterns also have implications for the riverbed microbiome; under up-welling conditions, microbial communities are more depth stratified, while greater depth-resolved mixing of populations occurs when river water penetrates into the riverbed. These coupled geochemical and microbiological shifts likely affect the rate and extent of carbon and metal processing

These observational data are being complemented by ongoing modeling efforts to understand (1) seasonal transport and degradation of different carbon pools in the hyporheic zone of an upland river, and (2) the influence of spatial patterns in hyporheic mixing on pore water chemistry and microbial communities. The data-enabled models will be used to explore scenarios of carbon processing under a changing climate in mountain watersheds, and better understand how hydrology influences the biogeochemical heterogeneity of streambed environments.