

Worldwide Hydrobiogeochemical Observation Network for Dynamic River Systems (WHONDRS)

Amy Goldman^{1*}, Vanessa Garayburu-Caruso¹, Xingyuan Chen¹, Emily Graham¹, Tim Scheibe¹, Kelly Wrighton², and James Stegen¹

¹Pacific Northwest National Laboratory, Richland, WA; ²Colorado State University, Fort Collins, CO

Contact: (amy.goldman@pnnl.gov)

Project Lead Principal Investigator (PI): Tim Scheibe

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This element of the PNNL SFA will identify globally-consistent versus context-dependent distributions of dissolved organic matter (DOM) chemistry, including how physical features and disturbances (particularly wildfire) modulate these distributions. For large-scale models to represent DOM chemistry, DOM characterization is needed across environmentally divergent river corridors and factors that drive variation in DOM chemistry need to be understood. Global-scale WHONDRS data indicates that organic molecules (i.e., metabolites) that comprise DOM and that occur in <5% of rivers (i.e., the transient metabolome) have molecular formulae with relatively consistent elemental ratios. These data also show that the core metabolome (i.e., molecules within DOM that occur in >95% of rivers) has relatively consistent elemental stoichiometry. What is not yet known is whether chemical features (elemental ratios, thermodynamics) of the transient metabolome are organized by environmental features such as stream order or vegetation, and the degree to which disturbances impact chemical properties of the transient and core metabolomes.

We will use data from previous and ongoing WHONDRS sampling campaigns to understand factors leading to coherence and variation in chemistry of both the transient and core metabolomes. This will be done by quantifying distributions of elemental ratios, thermodynamic properties, and inferred biochemical transformations across global samples. Machine learning (e.g., regression trees) will be used to relate differences in transient/core metabolome chemistry to environmental factors such as stream order, disturbance history (e.g., time-since-wildfire, flow variability), and watershed characteristics (e.g., area, net ecosystem productivity, vegetation). As part of this effort, we will continue community-enabled collection of WHONDRS sampling kits to continue to expand the environments across which metabolomes and associated microbial communities and geochemistry are characterized. An area of emphasis will be sampling in coordination with other SBR SFAs immediately following post-fire rainfall events due to the large influence of these events on transporting pyrogenic materials into river corridors. To do so, we will organize ‘rapid response’ teams ahead of time in areas likely to experience wildfire. The resulting data will be used to evaluate the degree to which wildfire alters river corridor metabolomes and associated features (e.g., does wildfire alter elemental ratios of individual DOM molecules, relative to globally consistent elemental ratios and do microbial communities change simultaneously). This information will fill fundamental knowledge gaps that currently impede our ability to properly represent DOM chemistry and microbial communities in hydrobiogeochemical models.