Title: Drivers of riverine organic matter diversity vary across catchments of the contiguous United States

Authors:

Ryan, Kevin. A., U.S. Geological Survey, karyan@usgs.gov, 0000-0003-1202-3616

Garayburu-Caruso, Vanessa, Pacific Northwest National Laboratory, vanessa.garayburu-caruso@pnnl.gov

Bambakidis, Theodore, Oregon State University, bambakit@oregonstate.edu

Crump, Byron, Oregon State University, byron.crump@oregonstate.edu

Liu, Shaoda, Yale University, liushaoda@bnu.edu.cn

Danczak, Robert, Pacific Northwest National Laboratory

Raymond, Peter, Yale University, peter.raymond@yale.edu

Stegen, James, Pacific Northwest National Laboratory, james.stegen@pnnl.gov

Abstract:

Quantifying the relative influence of factors and processes controlling riverine ecosystem function is essential to predicting future conditions under global change. Dissolved organic matter (DOM) is a fundamental component of riverine ecosystems as it fuels microbial food webs, influences nutrient and light availability, and represents a significant carbon flux globally. The heterogeneous nature of DOM molecular composition (i.e., chemical diversity) and its propensity for interaction (i.e., functional diversity) can indicate riverine ecosystem function across scales. To investigate fundamental drivers of DOM diversity across spatio-temporal scales, we collected seasonal water samples from 42 nested locations within 5 watersheds spanning multiple watershed sizes and stream orders (~5 to 30k km^2) across the United States. Patterns in chemical diversity and calculated putative biochemical transformations of organic matter derived from high-resolution mass spectrometry (FTICR-MS) were assessed across gradients of land use/land cover, hydro-climatology, and water sample physico-chemical properties. No single explanatory factor common to all samples (e.g., upstream watershed area, season) explained patterns of DOM diversity across all watersheds. The data indicate that catchment-specific factors can significantly influence DOM diversity. For example, the number of putative biochemical transformations decreased with increasing percent of coniferous land cover in the Pacific Northwest but increased with coniferous land cover in the Gunnison watershed in Colorado. Similarly, metrics of DOM diversity decreased with the percent of deciduous land cover in the Connecticut basin. Overall, the results highlight the importance of considering land cover when interpreting longitudinal patterns in DOM chemistry and the continued challenge of identifying generalizable drivers that are transferable across watershed and regional scales for application in earth system models. This work introduces a Findable Accessible Interoperable Reusable (FAIR) dataset (>300 samples) to the community for further in-depth exploration.