Improving Knowledge and Predictions of Hyporheic Zone Respiration via Continental-Scale Iterative ICON-ModEx Science

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Project Abstract: *This element of the PNNL River Corridor SFA is focused on improving predictive understanding of hyporheic respiration.* The Earth's biogeochemical and water cycles are tied closely to river corridors and stream respiration. Microbes in hyporheic sediments have a wide range of influence over river corridor biogeochemistry; hyporheic zones contribute from 4 to 96% of stream respiration. This project addresses the uncertainty of predicting this variation. We are combining public data, artificial intelligence (AI) and mechanistic modeling, ICON principles, and model-experiment (ModEx) iteration via crowdsourced sampling across the contiguous United States (ConUS). ICON principles, facilitated via the ICON Science Cooperative, are used by Integrating AI modeling with biogeochemistry, Coordinating protocols to be consistent with previous efforts, Openly sharing ideas and data, and Networking with stakeholders to increase mutual benefit of outcomes. The project started with data from the Worldwide Hydrobiogeochemical Observation Network for Dynamic Rivers (WHONDRS) to develop a suite of AI models to predict respiration rates at unsampled locations across the ConUS. Due to limited data, the model has biased predictions at high respiration rates. The project is working to improve the model and determine which variables drive hyporheic zone respiration rates. To address inaccuracies in model predictions, we guide volunteers to high priority locations across the ConUS for new sample collection. Both open stakeholder engagement and model needs will determine sample collection and data generation. Results will be fed back into the model to make new predictions and guide additional sampling, with the aim of multiple ModEx iterations. Once the respiration model is refined, it will be incorporated into basin-scale mechanistic hydro-biogeochemistry modeling, which will quantify how basin-scale fluxes of carbon and nutrients are impacted by variation in hyporheic respiration.