INTEGRATED MODELING OF CARBON AND NITROGEN CYCLING IN RIVER CORRIDORS AND WATERSHEDS

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Process-based watershed models that couple subsurface, land-surface, and energy budget processes are highly desired at the watershed and basin scales to answer a wide range of science questions. The river corridors play important roles in watershed carbon and nitrogen cycling and the removal of excess nutrients. At basin scales, the incorporation of hydrologic complexity and molecular information on microbiome structure (i.e., species composition and distribution of enzyme-encoding genes), microbial expression (i.e., RNA transcription and protein translation), and metabolomes (i.e., reactants and products) will greatly improve a river corridor model (RCM) in capturing distinct water quality signatures across variations in land use, hydrogeology, climate, and disturbances. We have developed an RCM that resolves reactions occurring in both the water columns and in the river corridors as impacted by the hydrologic exchange flows (HEFs). Applying this RCM to the Columbia River Basin (CRB), we found that the physical properties influencing HEFs and land use are the primary controls of the spatial variability in river corridor denitrification. Next, we will enhance the mechanistic foundation of the RCM by linking dynamic river flow processes and heterogeneous terrestrial inputs with variable temperatures and reaction kinetics (informed by molecular properties) to investigate water, energy, and solute fluxes across the river-groundwater interface under both baseline and post-fire conditions. Our approach can be generalized beyond CRB and applied to other basins facing environmental disturbances and water challenges of national significance.

PRESENTER BIO: Dr. Chen is a senior Earth scientist at the Pacific Northwest National Laboratory. Her research focuses on understanding and predicting how watershed and river corridor systems respond to various anthropogenic and environmental disturbances, including dam operations, agricultural activities, and extreme climate events (e.g., wildfires, flooding, etc).