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Argonne Wetland Hydrobiogeochemistry SFA

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Within wetlands, movement of water and biogeochemically catalyzed transformations of its constituents determine the mobility of nutrients and contaminants, the emission of greenhouse gasses into the atmosphere, carbon (C) cycling, and the quality of water itself. The long-term objective of the Argonne *Wetland Hydrobiogeochemistry* Scientific Focus Area (SFA) is the *development of a mechanistic understanding and ability to model the coupled hydrological, geochemical, and biological processes controlling water quality in wetlands and the implications of these processes for watersheds commonly found in humid regions of the United States.* To accomplish this, the Argonne *Wetland Hydrobiogeochemistry* SFA studies wetland hydrobiogeochemistry with a focus on a riparian wetland field site within Tims Branch at the Savannah River Site. This site is representative of many riparian wetlands found in humid regions of the Southeast that have C-rich soils and high Fe content. However, it is unique in that it received large amounts of contaminant metals and uranium as a result of previous industrial- scale manufacturing of nuclear fuel and target assemblies. Understanding the function of the wetlands in relation to control of water quality, including the concentration of metals and uranium within the soluble and particulate components of groundwater and surface waters of Tims Branch addresses the goal of the SBR Program to *advance a robust, predictive understanding of watershed function*.

The overarching hypothesis of our work is that *hydrologically driven biogeochemical processes that create redox dynamic conditions from the nanometer to meter scales are a major driver of groundwater and surface water quality within riparian wetland environments*.

We identified three major components (focus areas) of the Tims Branch riparian wetland that represent critical zones containing hydrologically driven biogeochemical drivers, which determine water quality: *sediment, rhizosphere, and stream*. These three focus areas are interdependent and are considered as a whole for a systems-level understanding of our overarching hypothesis. Within these three focus areas, we identified two common thematic knowledge gaps that inhibit our ability to predict controls on water quality:

1. *In-depth understanding of the molecular-scale biogeochemical processes that affect Fe, C, and contaminant speciation within the wetland sediment, rhizosphere, and stream environments; and*
2. *In-depth understanding of hydrologically driven biogeochemical controls on the mass transfer of Fe, C, and contaminants within wetland sediment, rhizosphere, and stream environments.*

Holistically addressing hypotheses related to these two knowledge gaps organizes the SFA in its development of a hydrobiogeochemical conceptual model of the Tims Branch riparian wetland.