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Geophysical imaging to inform hyporheic solute transport dynamics

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Traditional characterization of hyporheic exchange relies upon solute tracer studies and spatially sparse set of observations in streams and monitoring wells. Recent advances have overcome these limitations through the use of near-surface electrical resistivity (ER). Coupling electrically conductive stream tracer studies with ER methods provides spatially continuous information about the exchange of tracer between the stream and aquifer. Here, we demonstrate the use of electrical resistivity tomography to image hyporheic exchange in both two and three-dimensions. Tomograms are used to construct tracer breakthrough curves across multiple transects, by comparing images during the tracer study to background (pre-tracer) images. The spatially complete images are next analyzed using temporal moment analysis, to compress the temporal trends into descriptive statistics and identify dominant solute transport processes (e.g., transient storage dominated, advection dominated, etc.). The spatially complete data set is a dramatic improvement over traditional methods, which would otherwise provide only reach-averaged values, or single observations in space. Using ER, solute dynamics may be analyzed throughout the heterogeneous subsurface, improving our ability to identify flowpaths at different temporal scales of stream connectivity. Future application will enhance our ability to understand the fate and transport of stream solutes in near-stream aquifers.