Model-driven hydro-geophysical characterization of the groundwater-surface water interaction zone

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Biogeochemical activity in the 300 Area groundwater surface water interaction zone (SIZ) is highly influenced by stage-driven river water intrusion. Columbia River water supplies oxygen and select nutrients whereas groundwater supplies nitrogen that collectively regulate the biogeochemical function of microbial communities within the SIZ (see posters by Stegen et al., and Roden et al.). Because of this, the capability to predict biogeochemical activity in terms of contaminant behavior and carbon cycling within the SIZ depends critically on the capability to predict groundwater-surface water mixing dynamics (see poster by Chen et al.). To do so, the hydrogeologic structure that governs flow and transport within the SIZ must be adequately constrained.

We are using flow and transport calculations, coupled with geophysical simulations, to guide geophysical experiments aimed at constraining the hydrogeologic structure of the SIZ. In the first step, a conceptual flow and transport model of the SIZ is used to identify critical features that must be constrained in order to accurately predict biogeochemical processes. In the second step, coupled hydro-geophysical simulations are used to design and assess the feasibility of using geophysical data to inform the flow model concerning the critical features identified in the first step. In the third step, field geophysical data are collected, using optimized data collection strategies identified in the second step. In the fourth step, the geophysical data are used to constrain the critical features identified in step 1. Step four is accomplished by 1) incorporating geologic contact information identified by geophysical images into the flow model discretization, or 2) using time-lapse geophysical measurements directly in a coupled hydrogeophysical inversion. In this poster, we demonstrate the approach using high resolution underwater spectral induced polarization imaging to constrain riverbed structure, which has been shown to significantly impact groundwater-river water interaction (Hammond et al., 2010). We also demonstrate the approach using underwater, high resolution, time-lapse electrical resistivity data to inform the flow model of groundwater surface-water interaction near the riverbed, to approximately 5m depth.