Poster #21-41

Geophysical Characterization of Bedrock Properties of the East River Watershed: From Subsystem to Watershed Scale

Sebastian Uhlemann[1*], Baptiste Dafflon[1], Burke Minsley[2], Kenneth H. Williams[1], Craig Ulrich[1], Haruko Wainwright[1], and Susan Hubbard[1]

[1] Lawrence Berkeley National Laboratory, Berkeley, CA
[2] U.S. Geological Survey, Denver, CO

Contact: suhlemann@lbl.gov

BER Program: SBR
Project: Berkeley Lab Watershed Function SFA
Project Website: watershed.lbl.gov

A critical aspect to improving our predictive understanding of watershed hydrobiogeochemical dynamics is quantifying the influence of bedrock properties on subsurface flow and transport over a range of space and time scales. To obtain a watershed-scale understanding of the subsurface physical properties of the watershed, we link data of several scales by jointly interpreting geological, remote sensing, airborne Electromagnetic (AEM), detailed geophysical, and wellbore data. Subsystems of subalpine to montane environments were characterized using electrical resistivity tomography (ERT) and seismic refraction tomography (SRT). All of these sites were located within the Mancos shale unit. While subalpine environments generally show high electrical resistivities and high seismic wave velocities, indicative of competent bedrock, the sampled lower montane environment shows considerably lower values in both resistivity and seismic wave velocity. Borehole coring and logging data acquired at the same locations show a distinct change in bedrock characteristics, with subalpine environments having low bedrock porosity and lower montane environments having considerably higher porosities. From this data, we obtained petrophysical relationships that link electrical resistivity and seismic wave velocities to estimated porosities. These relationships were then applied to the spatially extensive AEM data, which also showed a pronounced change in bedrock porosity from low values in subalpine to high values in montane environments. The observations on the subsystem and watershed scale are in agreement with hydrological monitoring and modelling data, confirming the link between geophysical parameters, ecotypes, and subsurface flow properties.
We investigate the relationship between local and regional geophysical data with geomorphological and environmental indices to upscale the insights we gained at the subsystem scale to the watershed scale. Eventually, this will allow us to build a 3D model of the subsurface physical properties of the watershed. Such a comprehensive data set forms the basis for quantifying the distributed bedrock-through-canopy responses of the watershed to perturbations, and how these contribute to a cumulative downgradient discharge-concentration signature.