From Rifle to RMBL: MODEX activities at Berkeley Lab's East River Watershed Study Site

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As part of its Subsurface Biogeochemistry Watershed Function Scientific Focus Area (SFA), Berkeley Lab and its collaborating institutions have initiated Modeling-Experiment (MODEX) activities within the upper East River watershed designed to assess the impact of climate disturbance on the retention and release of water, nutrients, carbon, and metals from mountainous systems. The East River SFA Watershed Study Site encompasses the drainages of the East River, Washington Gulch, Slate River, and Coal Creek. The 300km^2 watershed is located northeast of Crested Butte, CO at an average elevation of 3266m. Spanning 1420m of topographic relief, pronounced gradients exist in hydrology, geomorphology, biome type (montane, subalpine, alpine), and extent of impact by mining and mineralized rock, with Slate River and Coal Creek more heavily impacted by heavy metals than the East River and Washington Gulch drainages. The watershed receives an average of 980mm of precipitation per year, the bulk of which falls as snow, and is representative of many headwaters systems within the upper Colorado River Basin. The more 'pristine' East River drainage covers an area of 180km^2 and is home to the Rocky Mountain Biological Laboratory (RMBL), which provides an extensive experimental and observational database critical to quantifying ecohydrological functioning within the watershed. RMBL facilitates data generation and sharing related to meteorology, phenology, experimental warming, plant water utilization, and coupled vegetation-microbiology studies of direct relevance to the SFA and its DOE-funded partners.

Excursions in stream water discharge are driven primarily by snowmelt, with summer/fall rainfall inducing punctuated increases in flow. Hydrogeochemical data indicate strong variations in water isotope composition of stream waters within the catchment as a function of time suggesting distinct and seasonally dependent reservoirs contributing to flow. Initial observations suggest varying responses in nutrient concentration to stream flow, with nitrate and sulfate generally positively and inversely correlated with discharge. Primary export of dissolved organic carbon accompanies the annual spring freshet, with episodic release accompanying discrete summer/fall rain events. Hyporheic exchange between the East River and its floodplain deposits induces sharp gradients in redox active elements, such as iron, sulfur, and carbon, with gaining reaches exhibiting evidence of reducing conditions resulting from processing of solid and aqueous phase constituents.

The catchment is being modeled at 10m resolution using ParFlow, a parallel, integrated hydrologic model. Driven by meteorological forcing, ParFlow is able to capture land surface processes and represents surface and subsurface interactions through saturated and variably saturated heterogeneous flow.