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Watershed Function SFA: Hydrological and Biogeochemical Dynamics from Genomes to Watershed Scales

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Climate change, extreme weather, land-use change, and other perturbations are significantly reshaping interactions with in watersheds throughout the world. While mountainous watersheds are recognized as the "water towers" for the world, hydrological processes in watersheds also mediate biogeochemical processes that support all terrestrial life. Developing a predictive understanding of watershed-scale hydrological and biogeochemical functioning is challenging, as complex interactions occurring within a heterogeneous landscape can lead to a cascade of effects on downstream water availability and quality. Although these interactions can have significant implications for energy production, agriculture, water quality, and other benefits valued by society, uncertainty associated with predicting watershed function remains high.

The Watershed Function project aims to substantially reduce this uncertainty through developing a predictive understanding of how mountainous watersheds retain and release water, nutrients, carbon, and metals to downstream users and stakeholders. In particular, the project is exploring impacts of early snowmelt, drought, and other disturbances on mountainous watershed dynamics over seasonal to decadal timescales. The Watershed Function project is being carried out in a headwater catchment of the Upper Colorado River Basin – the East River watershed, which has rapidly evolved into a 'community watershed'. This site is characterized by significant gradients in elevation, vegetation and hydrogeology. A system-of-systems perspective posits that the integrated watershed response to disturbances can be adequately predicted through consideration of interactions and feedbacks occurring within a limited number of archetypal subsystems, each having distinct vegetation-subsurface biogeochemical-hydrological characteristics.

We are acquiring and using diverse observations and newly developed models to explore bedrock-to-canopy and terrestrial-to-aquatic interactions and exhanges across this site. The work uses a combination of intensive and satellite sites than span the watershed, with an intial focus on the response to early snowmelt along a lower montane hillslope-to-floodplain transect, as well as exploring the aggregated watershed response to the perturbation. A key technological goal is the development of scale-adaptive simulation capabilities capable of incorporating genomic and other small-scale information where and when it is useful for predicting the aggregated watershed response to disturbance.

Through developing and integrating new microbial ecology, geochemical, hydrological, ecohydrological, computational and geophysical approaches, the project is developing cutting edge approaches to study complex

watershed processes and hydrobiogeochemical dynamics spanning genome to watershed scales. This poster will describe project and site and will highlight some of the key recent advances associate with the watershed project.