Ecohydrological Controls on Watershed Function: Quantifying Dynamic Surface-Subsurface Interactions

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Significant shifts in vegetation phenology, composition, and functional traits that affect plant production and biogeochemical cycles are thought to be driven by changing hydrologic regimes and water distribution in mountainous ecosystems. However, changing hydrologic regimes also directly impact biogeochemical cycles, which in turn can feed back to vegetation function and further changes in the hydrologic cycle. Our goal is to determine the mechanisms underlying feedbacks between hydrologic disturbance, vegetation phenology/physiology, microbial metabolism and biogeochemical cycling, and contribute to novel watershed scaling constructs. We are taking advantage of both natural (seasonal, elevation, topographic) and induced (warming, earlier snowmelt) variation in temperature, water availability, vegetation, and microbial metabolism/biogeochemistry to identify process coupling. Prior to the current snow season we have performed baseline characterization of vegetation distributions, soil and subsurface physical, chemical, and biological properties and have installed instrumentation to monitor dynamic hydrologic regimes within selected plots across the East River watershed and associated catchments. Remote sensing and machine learning using training data from hillslope transects was employed to classify vegetation and to quantify distributions of functional types (shrubs, forbs, grass). During a warmer than average fall, we observed leaf expansion for many species across all elevations. To determine how litter chemistry impacts decomposition rates and nutrient inputs, litter bags were deployed and initial litter chemistry determined using infrared spectroscopy, elemental analysis, and isotope ratio mass spectrometry. Litter chemistry varied significantly between functional types, particularly nitrogen, phosphorus, and aromatic content. Autonomous *in situ* measurements of seasonal temperature and water availability from the surface through the root zone in these plots demonstrated the insulating effect of snow cover on soil temperature regimes and feedbacks between surface soil temperature and soil water movement under snow. We are currently monitoring under-snow biogeochemical processes through analysis of gas fluxes, lysimeter fluids, and soil cores in order to determine nutrient mobilization and retention by the microbial community prior to and during snowmelt. The fate of these nutrients and their interactions with vegetation phenology will be studied throughout the spring/summer snowmelt.