CAREER: Unveiling the role of catchment physiography in the hydrologic response of headwater streams
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Understanding the physics that drives the hydrologic response of a catchment to precipitation inputs is fundamental to predict water supply, water quality, and to estimate the effects of climate change on water resources. The hydrologic response depends on the water input, movement, and mixing, whose relationships vary depending on the ability of a catchment to store water largely control by terrain physiography (geology, geomorphology, and topography). Tracers (e.g., water stable isotopes) can be used to estimate metrics of storage such as transit time (time it takes for water to move through a catchment) but we lack explicit mechanistic links between terrain physiography and the movement and storage of water in the landscape. The lack of a mechanistic understanding of these relationships is therefore a barrier to our ability to predict spatial variability in water supply. My goal is to understand the temporal-spatial variability of rainfall-runoff generation in headwater streams using LiDAR derived metrics of storage potential and tracer data. Understanding runoff generation in these streams is critically important because headwater streams control the overall water supply and water quality of larger rivers.

This study has the potential to transform the current approach to estimate water storage and to incorporate it in multiscale hydrologic modeling. I will integrate water stable isotopes and electrical conductivity as tracers, hydrometric data collected by a NSF LTER site, and LiDAR in catchment-scale models to predict event transit times and storage in unmonitored locations. This research will form the structure for an educational program to engage the public in activities that enhance their understanding of the water movement in the context of climate change.