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Mountain Ecohydrology: Modeling runoff production and streamflow in two distinctly vegetated headwater catchments

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Vegetation and terrain are important controls on runoff generation that are susceptible to changes in climate and land use. We investigate the intersection of vegetation and topographic controls on runoff production and streamflow in two watersheds at the Coweeta Hydrologic Laboratory in the southern Appalachian Mountains of North Carolina (USA). We use a combination of isotopic characterization, modeling and empirical observation to understand differences in hydrological processes between these two watersheds. The watersheds are densely vegetated and characterized by steep, relatively planar hillslopes. Weirs at the outlet of each watershed monitor streamflow and a network of shallow groundwater wells monitor runoff production. Precipitation is recorded near the top and bottom of each watershed. One watershed is covered by deciduous broad-leaf trees cover and the other watershed is covered by evergreen conifers. To understand how terrain and vegetation combine to influence runoff generation and streamflow in each of these watersheds, a tracer transfer function hydrograph separation model, TRANSEP, is used to separate storm hydrographs and determine sources of water in the stream. We use 18O as a conservative tracer in stream water, shallow wells, and precipitation, tracking changes in runoff sources and transport within each watershed. Our findings help better define the role of vegetation in hydrological processes in headwater mountain catchments. This research has implications for assessing the impact of insect infestations (e.g. hemlock wooly adelgid, southern pine beetle) on ecohydrological processes. As conifers in these watersheds are replaced by deciduous trees, there are consequences for evapotranspiration, isotope signature, and the overall water budget of mountain headwater catchments.