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ABSTRACT TITLE: Understanding the role of landscape structure in coupled carbon and water dynamics

ABSTRACT: One of the largest knowledge gaps in environmental science is the ability to understand and predict how ecosystems will respond to future climate change. The links between vegetation, hydrology, and climate that control carbon sequestration in biomass and soils remain poorly understood. Topography is known to strongly influence microclimate; yet, investigations using natural gradients associated with topography have yielded equivocal conclusions concerning the environmental controls of carbon dynamics. Our study examines how tree response to drought varies between species and across topography in a montane headwater catchment. Foliar $\delta^{13}C$ was compared between a wet and dry year to characterize changes in water use efficiency (WUE) in the area's two dominant tree species: ponderosa and lodgepole pine. Lodgepole pine had a significant increase in $\delta^{13}C$ in the dry year, whereas, ponderosa pine did not significantly change from the wet to dry year. Topographically-derived GIS surfaces for incoming solar radiation and topographic wetness index were used to model spatial variability in drought response. Improved spatial models may better predict topographical influence on drought sensitivity. The stark contrast in the WUE response of ponderosa and lodgepole pine highlights the importance of understanding variation at the individual catchment scale to effectively model and predict regional and global tree response to drought and shifts in species range under changing future climate conditions.