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UAV hyperspectral and lidar data analysis for vegetation applications

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High spatial and spectral resolution remote sensing data are critically needed to classify forest vegetation and measure their structure at the level of individual species and canopies. Here we test high-resolution lidar and hyperspectral data from unmanned aerial vehicles (UAV) and demonstrate a lidar-hyperspectral image fusion method in treated and control forests with varying tree density and canopy cover as well as in an ecotone with a gradient of vegetation and topography in northern Arizona, USA. The fusion performs better (88% overall accuracy) than either data type alone, particularly for species with similar spectral signature, but different canopy sizes. The lidar data provides estimates of individual tree height (R2=0.90; RMSE=2.3m) and crown diameter (R2=0.72; RMSE=0.71m) as well as total tree canopy cover (R2=0.87; RMSE=9.5%) and tree density (R2=0.77; RMSE=0.69 trees/cell) in 10 m cells across thin only, burn only, thin-and-burn, and control treatments, where tree cover and density ranged between 22-50% and 1-3.5 trees/cell, respectively. The lidar data also produces high accuracy DEM (R2=0.95; RMSE=0.43m). The lidar and hyperspectral sensors and methods demonstrated here can be widely applied across a gradient of vegetation and topography for monitoring ecosystem changes.