Coupled active and passive remote sensing to describe the land surface of piñon-juniper ecosystems

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The recent climate in the southwestern US has been punctuated by severe, climate change related drought events. These droughts are characterized by high temperatures coupled with very low precipitation, and result in widespread coniferous tree mortality. Piñon juniper (PJ) woodlands account for > 11% of the land cover in NM alone, and the mortality these systems are currently experiencing may result in an ecosystem state change unprecedented in recent history. Given the extent and severity of the woody mortality in PJ systems, it is essential that we improve our ability to characterize the variability in ecosystem structure exhibited by these heterogeneous ecosystems and constrain the uncertainty in PJ woodland biomass estimation in the context of severe, widespread forest mortality.

We have been tasking multi-temporal high resolution satellite data from WorldView-2 in an attempt to increase our understanding of the variability in canopy reflectance in both intact and disturbed PJ woodlands. We also have acquired full waveform aerial lidar flown for overlapping regions, allowing a detailed spectral and structural description of the PJ land surface. This multi-sensor data integration coupled with ground based field plot validation has improved our ability to: i) create thematic classifications of the vegetation cover in PJ systems, ii) describe the PJ land surface as a distribution of structural traits such as leaf area and canopy height, and iii) provided a framework with which to investigate the capability of combined active and passive data sources to scale biomass estimates from the field plot to the region.

We quantified the contributions from each sensor to the overall users and producers accuracy in our thematic products using a variety of classification algorithms, and discuss the strengths and weaknesses of each approach. We also used our data rich environment to create descriptions of ecosystem state parameters like canopy height and LAI, but describe them in the context of their spatial distribution as a function of disturbance. This allows us to generate hypotheses about how not only the mean of these parameters will vary with disturbance (e.g., decrease in mean canopy height following piñon mortality), but also the parameter variance. In this way we can describe the trajectory of ecosystem properties in the context of widespread mortality. Finally, we describe our current capability to scale plot estimates of PJ biomass to the region using an object oriented approach.