Investigating the impact of the widespread differential mortality of Pinus-edulus in piñon juniper woodlands: informing remote sensing with eddy-covariance.

Dan Krofcheck (Krofcheck@Gmail.com) - University of New Mexico, Marcy Litvak (PI), Nate Mcdowell, LANL; Robert Sinsabaugh, UNM Biology; Andrew Fox, NCAR (Co-PIs).

Piñon-juniper (PJ) woodlands across the southwestern US are currently experiencing the effects of a pronounced climate change related drought. Recent increases in temperature combined with decreased precipitation and insect pressure is resulting in the selective mortality of Pinus-edulis (piñon) in these ecosystems, dramatically altering the physical structure of the system in a patchy and heterogeneous manner. Of specific interest is how events like this will alter ecosystem carbon uptake patterns. Our overall goal is to improve existing mechanistic understanding of how these disturbance regimes and the resulting changes in ecosystem structure affect our ability to predict carbon uptake in PJ woodlands.

We have been continuously monitoring the carbon uptake patterns of a pair of experimental PJ woodlands in central New Mexico using eddy-covariance since 2009. We killed all of the adult piñon in the 4 ha footprint of one of the woodlands and left the other intact as a control. In an effort to scale our measurements to the region and landscape, we have been integrating a wide variety of ground, air, and space borne remote sensing components with the ground-based fluxes.

Our analyses suggest that Landsat scale data are better suited to predicting spatial variability in carbon uptake regimes due to disturbance than more coarse scale sensors, but at 30 x 30 meters the cover specific responses to overstory mortality are undetectable. Our use of high spatial and temporal resolution satellite data from the RapidEye constellation of sensors (5 x 5 meter) has shown that the rapid regrowth of the understory following piñon mortality is pronounced enough to alter seasonal patterns of canopy greenness measured by the used normalized difference vegetation index (NDVI) yet has little effect on gross primary productivity (GPP), potentially overestimating greenness based approaches of remote GPP prediction in disturbed regions. Further, our understanding of these semi-arid systems suggests that a strong decoupling exists between canopy greenness and GPP except during periods of sufficient soil moisture. Specifically, in both healthy and disturbed woodlands regressions between tower measured GPP and ecosystem NDVI were insignificant during periods of seasonal episodic drought. We show how simple models of carbon uptake based on greenness can be improved by including a measure of canopy wetness.