Understory Growth Dynamics Following High Severity Burn in a Mixed-Conifer Ecosystem

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1. Introduction

Climate change is transforming the landscape of the southwestern United States, where record breaking temperatures and rampant wildfire are becoming more of the norm. In particular, the sky island ecosystems of this region are highly vulnerable. Most importantly, these ecosystems provide many of the resources that sustain the communities developed below them. Therefore, understanding the recovery of these ecosystems from wildfire is important in the context of watershed management.

2. Objective

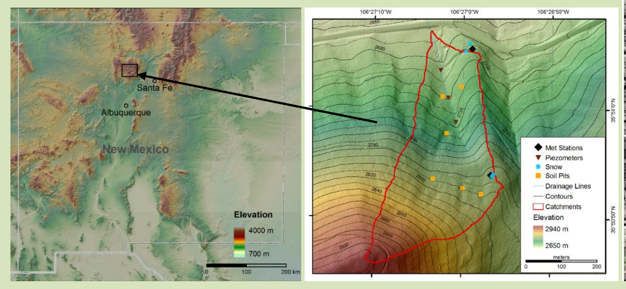
Our objective was to relate the growth dynamics of the understory following high severity burn in a mixed-conifer ecosystem to aspect and other environmental parameters. We expect that this information will be important for understanding both what influences the recovery of understory following high severity burn and also the implications of the dynamics of that recovery on the hydrology of the watershed.

3. Study Site

Our study site included two adjacent watersheds impacted by the 2011 Las Conchas Fire, in the Jemez Mountains of New Mexico.

Elevation: 2,664-2,934 m

Annual Rainfall: 670mm



4. Methods – Sensors

- One watershed also had soil temperature and soil moisture sensors at three different depths taking measurements every ten minutes.
- Two meteorological stations, one lower in the watershed and one higher in the watershed, captured half-hourly measurements of ecohydrological variables such as precipitation and air temperature.

5. Methods – Phenocam Images

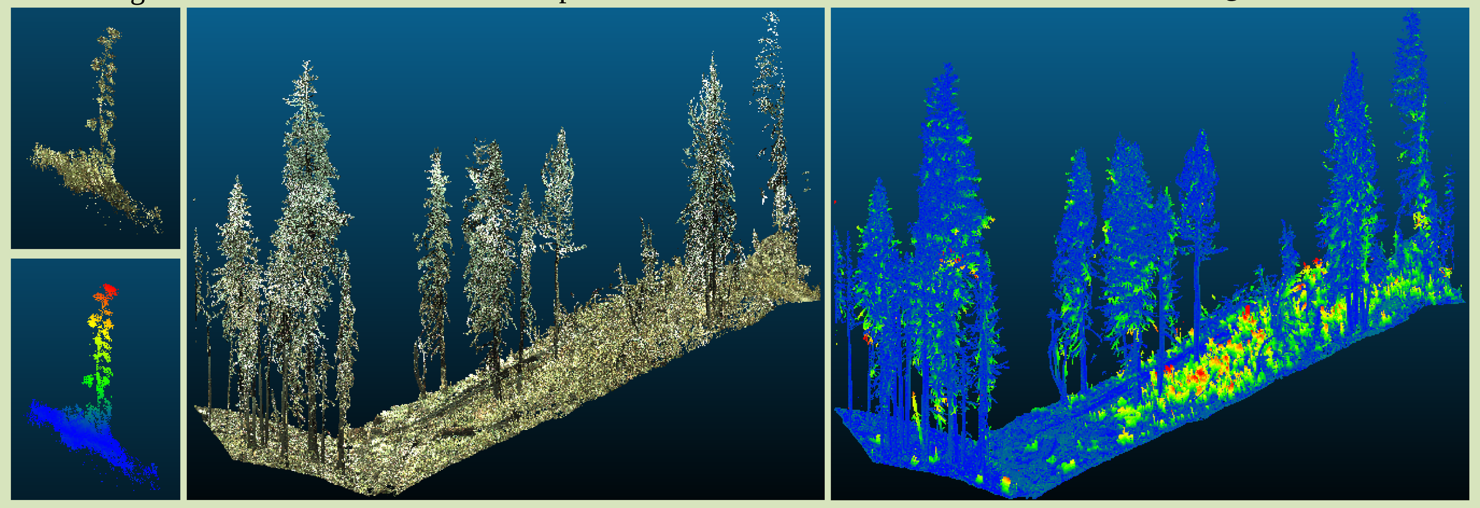
- 10 phenocams at varying elevations and aspects took hourly images for a year post-fire
- These images allowed the vegetation to be observed at any time of the year
- For the images, a “greenness index” was calculated based on the RGB values of the pixels: $I_g = 2 \times green - red - blue$

Camera	Aspect	Elevation	Grass?	Herbs?	Aspens?
1	East-Facing	High	Some	Yes	**No**
2	East-Facing	Middle	Yes	Yes	Very few
3	East-Facing	Low	Yes	Yes	Yes
4	West-Facing	High	Yes	Yes	Yes
5	West-Facing	Middle	Yes	Yes	Yes
6	West-Facing	Low	Yes	Yes	Yes
7	East-Facing	High	Some	Yes	**No**
8	East-Facing	Low	Yes	Some	Yes
9	West-Facing	High	Yes	Yes	Yes
10	West-Facing	Low	Some	Yes	Yes

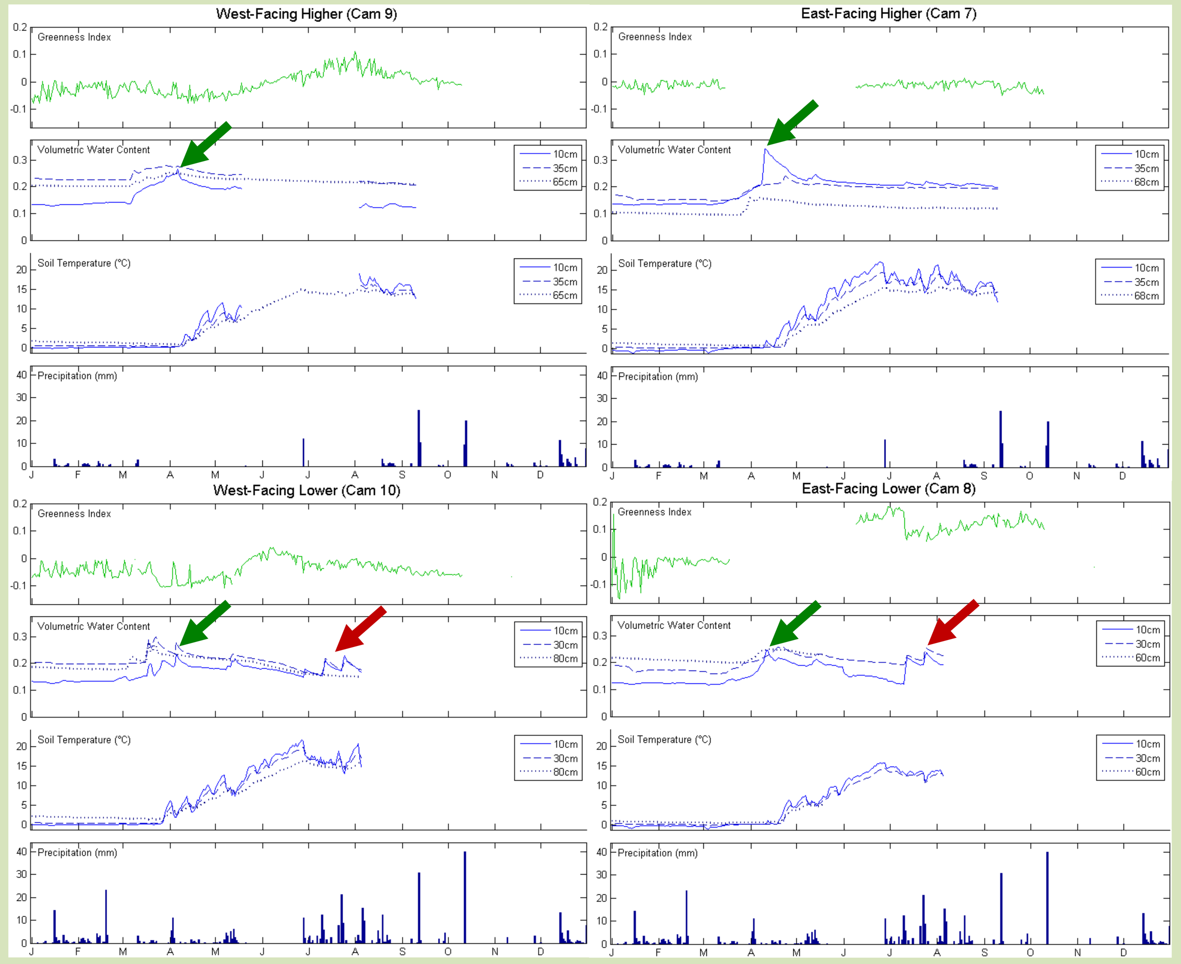
6. Methods – LiDAR

- Four terrestrial LiDAR scans of one of the watersheds were performed between Sept 2011 and May 2013
- LiDAR: scan a laser over an area to get a grid of distances. Combining multiple scans gives a single large cloud.
- Comparing two different point clouds allows visualization of landscape changes at every point in the cloud.
- Point clouds were analyzed using CloudCompare software

3ft. Aspen Seedling — A transect from the point cloud — The same transect compared to another a year later. Warmer colors show a greater difference

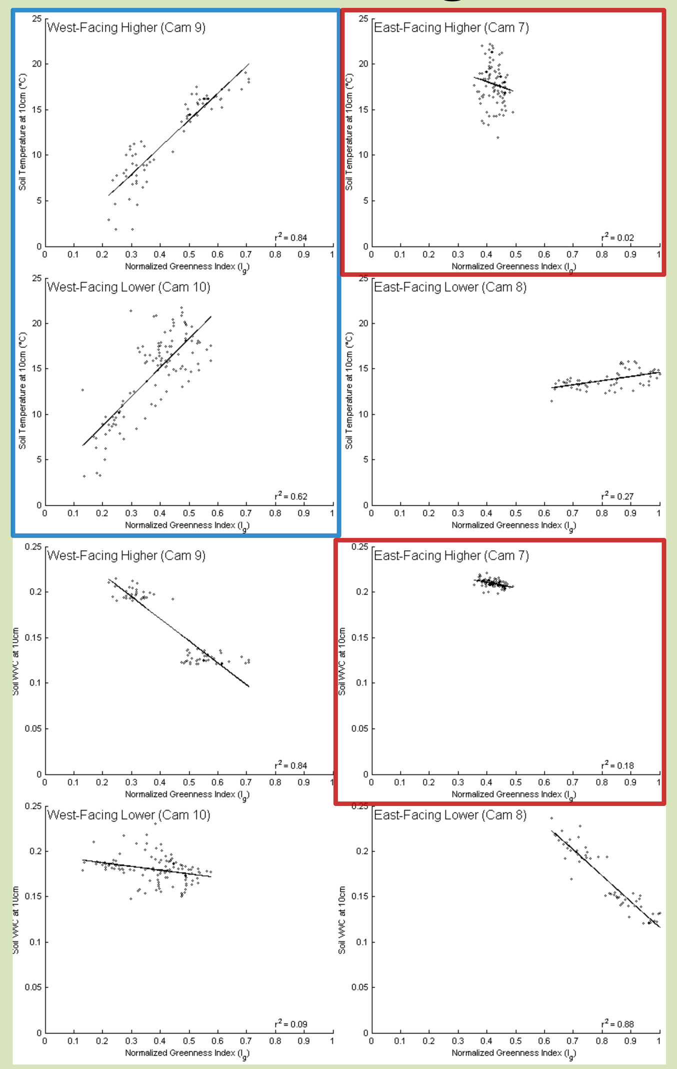


7. Results – Time Series



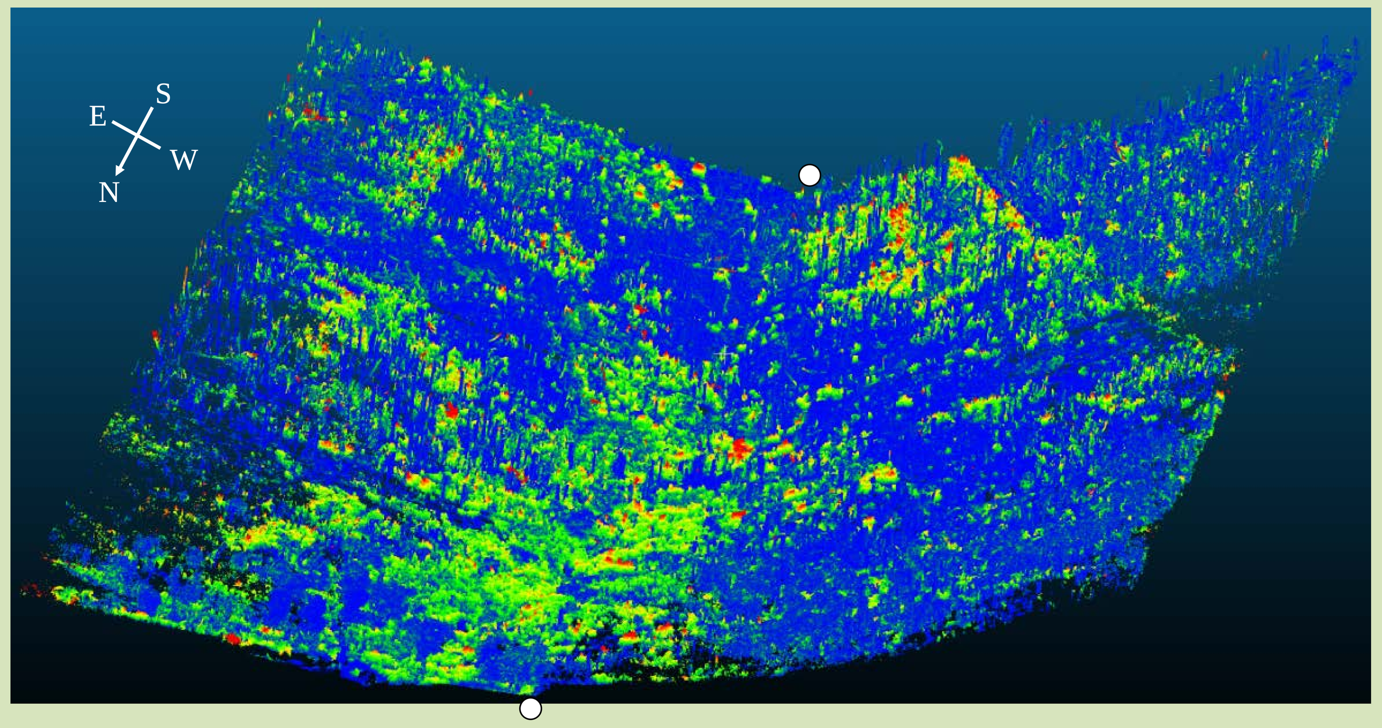
- For all sites, soil moisture increases primarily following springtime snowmelt
- For only the lower sites, soil moisture increases around the monsoon season
- Greenness values of lower sites peaks earlier in the year than for higher sites

8. Results – Regressions



- West facing vegetation dynamics correlated with soil temperature
- East facing high veg dynamics do not appear to correlate with soil temperature or moisture

9. Results – LiDAR



Scan of entire watershed. Valley approximately follows a line between the two white dots on the image. This angle is looking up the watershed (the watershed is north-facing).

- Vegetation dynamics appear different when considered on a larger scale. For instance, vegetation is present on the east-facing higher slope that was not seen in the cameras
- Vegetation appears to be more successful at the point of convergence, especially lower in the watershed
- West-facing aspect appears to be more successful than east-facing

10. Take Home Points

- Vegetation recovery is not uniform across the watershed, but rather is a function of elevation and slope aspect
- Soil temperature, in some instances, is strongly correlated with greenness, while soil moisture is negatively correlated
- Slower post burn recovery of vegetation near the top of the watersheds will have consequences for ecosystem services, such as erosion and downstream deposition control
- LiDAR and Phenocams allow for very fine spatial and temporal scales to be analyzed

11. Acknowledgments

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