Aspect, Slope, and Wind Relationships with Burn Severity

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Introduction

The North Pass fire broke out on August 18, 2012 which was caused by lightning. It started near Williams Valley 10 miles north east of Covelo in the Mendocino National Forest and moved to the north and east spreading into the Yolla Bolly Middle Eel Wilderness with a total of 41,983 acres burned and a cost of 30 million dollars to suppress and contain. Like many other wildland fires there are certain components associated with the behavior and intensity of a fire from topographic features such as aspect and slope to biomass such as vegetation type and density. However, this project will encompass slope, aspect, wind speed and direction to demonstrate the influence and relationships with burn severity from the fire.

Taliaferro Study Area

Taliaferro Landslide Area was the focused area of the North Pass Fire in which the burn severity areas show evidence of different fire behavior compared to the beginning of the fire. The level of burn severity was categorized in four levels of severity: high, moderate, low, and unchanged.

North Pass Fire Study Area
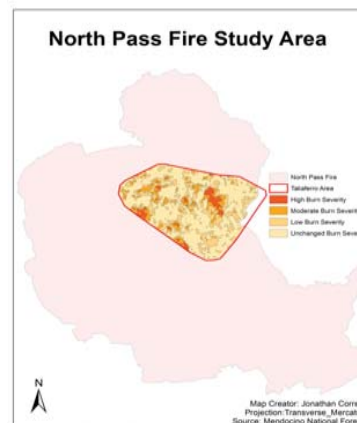
Data & Methods

Geographic & Temporal Data

- Light Detection and Ranging Data Derivatives (LiDAR)
- Mendocino National Forest North Pass Fire Database
- RAWS USA Climate Archive

The burn severity areas were obtained through the Mendocino National Forest North Pass Fire Database in which the data was clipped to the focused study area and acres recalculated. Lidar Data was also obtained through the same agency in which two derivatives were created which was the bare earth and percent slope. After developing the aspect raster a Northness Index was applied to convert from degrees to radians. Zonal Statistics was applied for each level of burn severity to gain mean aspects and slopes; the tables were then exported to excel and graphs were created.
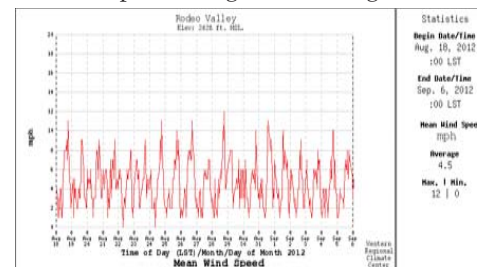
Results & Analysis
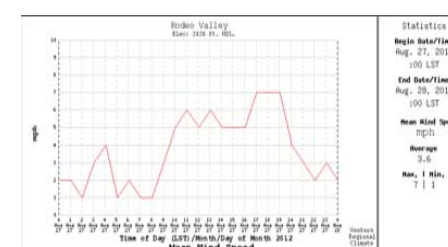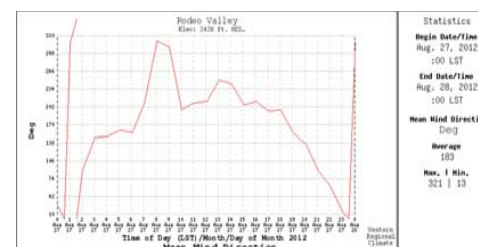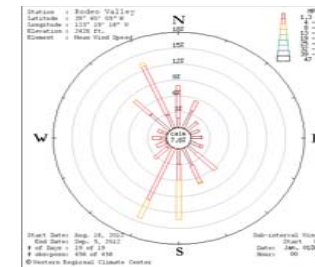
Total area for burn severity areas

Severity	Total Area (Acres)	Standard Deviation
high	246.4	19.7202
moderate	578.8	9.7010
low	1335.6	14.4895
unchanged	3317.8	671.6867

Average Aspect for Burn Severity
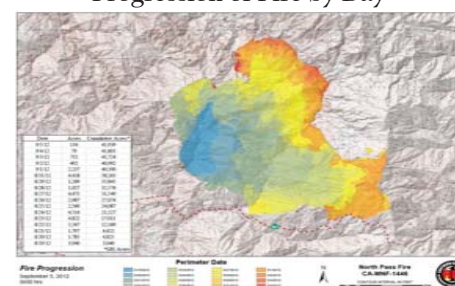

Mean Slope (%) of Burn Severity
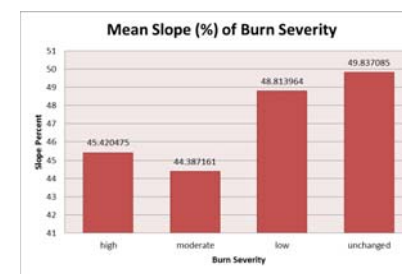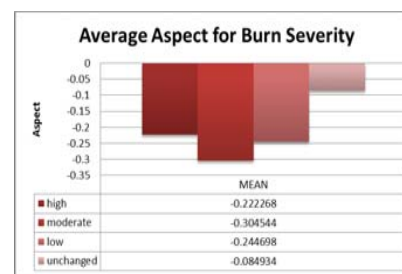
Wind Speed throughout Fire Progression

Mean Wind Direction throughout Fire

Progression of Fire by Day

Conclusion

Slope, aspect, vegetation type and density were all important components of the behavior displayed by this particular fire. However, the main drivers were wind speed and direction. Of these two wind characteristics, direction seemed to have the greatest influence. The firefighters struggled to contain this month long fire because of the shifting fronts which resulted from the frequently changing wind direction. This was also evidenced by the tremendous amount of unburned area within the study area of the fire zone. The wind characteristics also changed the nature of the fire from an intense burn consuming 4,000 acres a day during the first week into a collection of very difficult to contain spot fires during the remaining three weeks.

Future Analyses

- Find the relationships between vegetative density, canopy density, tree height, and temperatures.
- Identify a relationship between crown diameter and tree height to find an approximation of harvestable timber stands for possible salvaged timber in high severity burn areas.
- Use of ground-based LiDAR to better model vegetation types and densities.

References

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2. "Sensitivity analysis of fire behavior modeling with LiDAR-derived surface fuel maps." Sorin C. Popescu, Kaiguang Zhao

3. "Remote sensing techniques to assess active fire characteristics." and post-fire effectsLeigh B. LentileL.D∗, Zachary A. HoldenA∗, Alistair M. S. SmithA∗, Michael J. Falkowski A, Andrew T. HudakB, Penelope MorganA, Sarah A. LewisB, Paul E. GesslerA and Nate C. BensonC

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