Eyes on Earth: Evaluating the utility of Landsat satellite imagery for detecting forest management impacts on drought resilience in Stanislaus National Forest, California

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LANDSAT Imagery **Unable** to **Detect Impacts** of **Forest Management** in Sierra Nevada Mixed Conifer Forest

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BACKGROUND:

- Tree mortality is increasing across the globe because of climate change and historical fire exclusion.
- Prescribed fire, forest thinning and their combination are tools that forest managers are employing across the West to increase forest resilience to drought and wildfire.
- LANDSAT satellite imagery offers a potential method to measure temporal changes in forest water balance in response to forest restoration activities from space.

METHODS

1. Calculated the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Moisture Index (NDMI) in Google Earth Engine from LANDSAT imagery from 2008-2022 for treated versus untreated mixed conifer forests in the Stanislaus NF in the Sierra Nevada, CA.
2. Used zonal statistics within each polygon in the study over the time-series to quantify mean NDVI and NDMI in treated versus untreated areas in peak drought months July through September.
3. Plotted mean NDVI and NDMI by year for analysis.

Results

- Thin and Thin & Burn treatments removed vegetation and results in decrease in NDVI and NDMI post-treatment.
- Extreme drought years trigger a drop in NDVI and NDMI in contro and burn only treatments.
- Severe droughts after treatment causes NDMI to converge among treatments in recent years due to tree mortality in control and burn only treatments.
- Landsat does not detect the increased drought resilience of treated stands during post-treatment drought years that we observed on the ground in field forest surveys.

Index Calculations

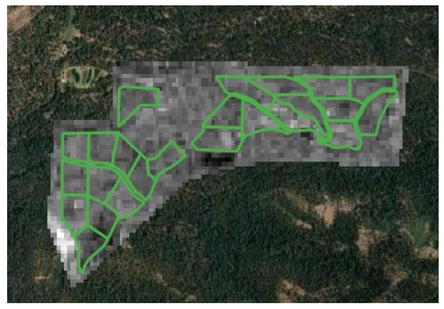
Normalized Difference Moisture Index

$$NDMI = \frac{NIR - SWIR}{NIR + SWIR}$$

Normalized Difference Vegetation Index

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

NIR = Near Infrared
SWIR = Short Wave Infrared
RED = Red



Sample Satellite Image Covering Study Area
24 treatment plots, total 250 acres
~60 Pixels per plot

Scan to read more about the forest thinning study behind this research.

Conclusions

- Our results differ dramatically from similar studies in drier forest types.
- NDMI and NDVI does not detect fine-scale impacts of forest management in wet forest cover types like mixed conifer forest.