Using remote sensing to determine aboveground biomass of California oak species

Paris Krause, Brieanne Forbes, Dr. Matthew Clark, Dr. Lisa Patrick Bentley

Objectives

1) Use terrestrial laser scanning (TLS) to estimate aboveground biomass (AGB) of local oak species (*Quercus agrifolia* and *Quercus garryana)*

2) Compare TLS AGB estimates to traditional field-based allometric biomass estimates

Background

- Due to climate change, landowners and managers in California are being encouraged to improve forest health through increased management and reductions in greenhouse gas emissions.
- Managers must first quantify a tree's aboveground biomass (AGB) using allometric equations. However, these equations are limited for oak species and new data are difficult and time-consuming to collect.

Hypothesis

We hypothesize that TLS will improve the accuracy of AGB estimates compared to traditional field-based allometric biomass estimates.

Significance

- This research will directly advance the emerging science of applying remote sensing data to obtain accurate representations of vegetation structure, including biomass.
- TLS AGB measurements collected from this study can be used to update current allometric equations and yield models for the studied species to improve management and treatment plans.

Methods

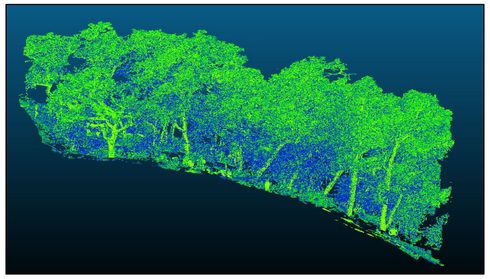

Figure 1. Side view of TLS pointcloud of Plot 1301 at Pepperwood Preserve (Sonoma County).

- We collected TLS data on *Quercus agrifolia* and *Quercus garryana* by scanning 24 20x20 meter plots in Pepperwood Preserve (Sonoma County) using a Riegl VZ-400i scanner during the fall of 2020.
- Traditional tree data (height, diameter at breast height) were also measured for each tree at the time of TLS data collection.
- 3D point clouds of trees are currently being extracted from TLS scans using Riscan and LIDAR360 software.

Figure 2. TLS scanner.

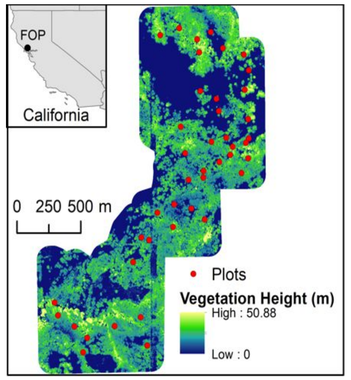

Figure 3. Study plots at Pepperwood Preserve.

Next Steps

- Calculate AGB using quantitative structure models fit to the extracted tree TLS point clouds.
- Calculate AGB from allometric equations for *Quercus agrifolia* and *Quercus garryana*.
- Statistically compare TLS AGB to allometric AGB for each tree, species and plot.

Preliminary Results

Remote sensing (TLS data) can be used to accurately estimate empirically collected DBH measurements. DBH is a component of AGB calculations, so we hope that similar results will also be found for AGB calculations.

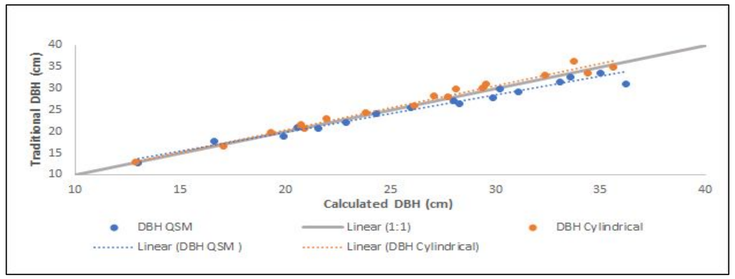

Figure 4. Comparison of traditional DBH (cm) collected by hand in the field to calculated DBH (cm) extracted from 3D points clouds via quantitative structure models (QSM) for all trees (n=17) in plot 1301. DBH was calculated two ways using the QSM: DBH QSM (blue) and DBH cylindrical (orange). The grey line represents the 1:1 line. Both QSM approaches resulted in DBH estimates that were not significantly different from traditional DBH measurements (DBH cylindrical model: $y = 1.0254x - 0.1055$, $R^2 = 0.98$; QSM DBH model: $y = 0.865x + 2.4789$, $R^2 = 0.97$).

Figure 5. 3D point cloud of *Quercus* sp. tree extracted from TLS data.