**Estimating Biomass with Tree-Rings at the Valles Caldera National Preserve**

**Abstract**

Forests mediate the flow of carbon from the atmosphere to the terrestrial biosphere. However, once the carbon enters the biosphere it can be difficult to determine how it is allocated among the various components of the forest (e.g. leaves, woody biomass, roots). A combination of techniques can be used to constrain allocation estimates to these various components, and each brings with it its own uncertainty contribution. We hypothesize that tree cores can be used to derive accurate above ground biomass estimates for the recent past, and can provide insights into how allocation trends might change under projected future climate conditions. We collected tree cores from two forests in the Jemez Mountains of northern New Mexico. Here, we combine tree-ring derived estimates of above ground net primary productivity and eddy-covariance measures of net ecosystem exchange with climate information to determine under what conditions biomass accumulation is maximized. When compared with future projections of southwest climate, we would expect biomass accumulation to above ground biomass to **(increase/decrease).**

**Introduction**

* What is the terrestrial Carbon cycle
  + Why is it important
* Where does the carbon go?
  + How carbon is measured
    - Eddy covariance
    - Allometrics
      * Clark 2001
    - Tree rings
      * Babst et al. papers
* **The Problem**
  + Eddy covariance does a good job of measuring the net exchange of carbon between the atmosphere and the biosphere, however it cannot provide information as to how that carbon is allocated. Also, the eddy-flux record is rather short with the longest towers being up for 15 years.
* **Our proposed solution**
  + Tree rings can provide information beyond the flux record with reasonable estimates of biomass in the recent past.
  + Using the response of trees to climate we can make reasonable inferences as to how the carbon cycle will respond to the projected changes in the south west.

**Methods**

* Two flux towers
  + Upper elevation—Spruce dominated
  + Lower Elevation—PIPO dominated
* Two variable radial plots
  + N=50 trees
* Reconstruct diameter back in time with tree-ring widths
* Use a suite of allometric equations to transform DBH into biomass
* Quantify uncertainties around our BM estimates
  + Compare our plots with overall forest structure
  + Implement 6% mortality to account for the biomass that is no longer there
  + Uncertainty in allometric equations
* Use CRU gridded data
  + Temps
    - Mean
    - Min
    - Max
  + Precip
  + Vpd
  + Pdsi
* Get tree correlation with climate
* Examine 5 extreme years throughout the record
  + Driest (pdsi)
  + Wettest(PDSI)
  + Hottest(mean T)
  + Coolest(meant)
  + Looking to see how the biomass accumulated for these years differs when compared to the mean biomass increment for all other years
* Compare the ANPP derived from the tree-rings with the NEE from the flux tower

**Results**

* Figure1. Map of the Valles Caldera. The upper elevation flux tower (VCM) is dominated by Engelmann’s spruce, and the lower elevations flux tower (VCP) is dominated by ponderosa pine. Approximate foot print and tree-ring plots are outlined for each tower.
* Figure2. Conceptual figure detailing the uncertainties present in tree-ring derived estimates of biomass.
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* Figure 3. Correlation of tree-ring widths with climate drivers.
* Figure 4. Cumulative tree-ring biomass estimates using various allometric equations for A) upper elevation flux tower and B) lower elevation flux tower. Bold Black line shows the mean of all equations used, and grey cloud represents the uncertainty associated with this mean.
* Figure 5. Mean biomass increment for A) upper flux tower and B) lower flux tower. Blue points are the NEE measurements taken by the flux toers

**Discussion**

* **Tree rings can provide reasonable estimates of above ground net primary production.**
  + Uncertainty caveats
  + How well we did
  + How well Flurin did and how we compare
* Climate response
  + What we’ve seen
  + What others have seen
  + Williams et al projection
    - What this could mean for the future carbon at VC