Plant communities famously vary in their allocation of carbon resources to aboveground shoots and belowground roots; the balance of which has an outstanding role in carbon sequestration and nutrient cycling within ecosystems. Much literature and research has been allocated to understanding and mapping aboveground shoots, however there is a lack of literature on belowground roots, especially on a large scale. Many studies are dedicated to understanding rooting systems of specific plant communities; however the purpose of this study is to model fine root biomass. Fine root biomass was collected by the National Ecological Observatory Network from 35 sites across the United States. Climate, pedological, and ecological factors were then used to create a predictive model of Beta. Where Beta is the non-linear least squares fit of the cumulative fine root proportion at depth. Beta was best predicted by the climate ratio and NLCD class, however failed to be modeled at sites with extreme climate types, such as those of high aridity.

### Abstract

Belowground Biomass Sampling Methods

- Soil samples of a known volume were taken from three vertical profiles down the face at 10 cm intervals down to 1 m and at 20 cm intervals from 1 m to the final pit depth of 2 m.
- Samples were then sieved to extract root mass, and categorized based on coarse, fine, live, and dead characteristics.
- Where fine roots (<2mm) and coarse roots (>2mm)
- Roots were then dried at 65°C for 48 hours and weighted.
- This study will focus only on fine live and dead roots, as many of the sites that were sampled contained no coarse roots.

#### Belowground Biomass Sampling Methods

**Fine Root Proportion at Depth**

In each panel(right), lower Beta values indicate shallower rooting profiles, while higher Beta values indicate deeper rooting profiles. The Beta value is the non-linear least squares fit for Beta using the equation Y=1-B*D for 27 out of the 35 NLCD class and climate ratio models were tested in multiple variable combinations with ecological, climatic, and pedological factors of a single variable, two variables, or three variables. 62 models were tested resulting in NLCD class and Climate Ratio (Mean Annual Precipitation/Potential Evapotranspiration) as the best predictors.

**Prediction of Beta under Extreme Climate Types**

Figure 5: Climate Ratio and NLCD were used to model Beta at 33 sites with complete ecological and climatic data. The adjusted R² decreased from 0.45 to 0.18, this can be seen due primarily to the addition of sites with extreme climate ratios, with an increase in sites from the desert southwest (D13MOAB, D14SRER, D14JORN, D15ONAQ), and the addition of a humid continental climate site (D16ABBY).

**Conclusions**

- NLCD Class and Climate Ratio are the best predictive factors for modeling Beta.
- Two models with different variable factors may be needed to create a separate model for the sites under extreme climate ratios. However those with climate ratios between (0.3-1.5) may be modeled using simplified NLCD class and climate ratio.

**Future Directions**

- Investigate using a more accurate ecological predictor instead of NLCD class, which accounts for age and density of vegetation.
- Explore the relationship between soil physical/chemical properties and belowground biomass in deep soil profiles
  - Clay content
  - C:N ratio
  - % N
- Create a predictive model which focuses on sites sampled under extreme climate types.

### References


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![Soil Pits Sampled as of July 2015](image)

**Soil Pits Sampled as of July 2015**

- Each pit (2m deep and approximately 1.5m wide) was dug adjacent to the NEON Observation Tower.
- Every site undergoes a standardized collection of belowground biomass, and soil physical and chemical properties.
- The soil pit root sampling effort allows estimation of the proportion of roots sampled at a given depth, and generates a baseline estimate for belowground biomass distributions with depth across all NEON sites.

**Future Directions**

- Investigate using a more accurate ecological predictor instead of NLCD class, which accounts for age and density of vegetation.
- Explore the relationship between soil physical/chemical properties and belowground biomass in deep soil profiles
  - Clay content
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**References**

