

Relationships between fine root productivity and variation of canopy height in a temperate forest

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Introduction: Accurate estimation of terrestrial carbon pools is a key focus in an age of concern over global carbon budgets. In the near future a change in climate could changing how carbon is stored both above- and belowground in these ecosystems. Currently, relationships between aboveground forest structure and belowground plant carbon are poorly understood, thus a better understanding of relationships between above- and belowground plant dynamics is drastically needed, largely because forests store a vast majority of terrestrial carbon. This study addresses relationships between in fine root productivity it is influenced by variation in canopy height in a Pacific Northwest temperate forest.



Figure 1: The left panel shows fine roots, any root <2mm in diameter. The right panel shows coarse roots, which are >2mm in diameter. This study focused only on fine roots.

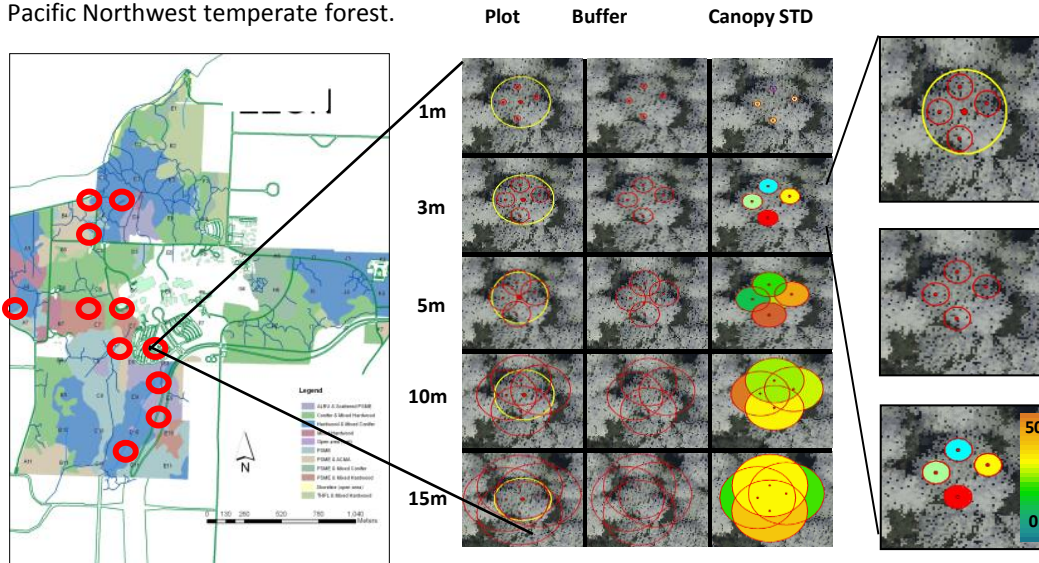


Figure 2: The far left panel shows the EON study area located in the forest reserve around the Evergreen State College in Olympia, WA. Plots used in this study are depicted in red. The middle and right panel show the plot design and the buffer system used in this study. Each of 40 minirhizotron plots were surrounded by 5 types of buffers and calculated for variation in canopy height. The far right panel is an example of how variable canopies can be even small spatial scales.

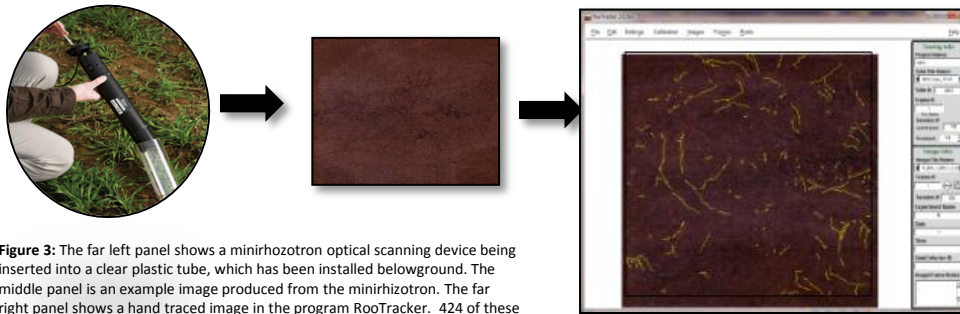


Figure 3: The far left panel shows a minirhizotron optical scanning device being inserted into a clear plastic tube, which has been installed belowground. The middle panel is an example image produced from the minirhizotron. The far right panel shows a hand traced image in the program RooTracker. 424 of these images were hand traced for this study.

Results and Discussion: We found significant negative relationships between variation in canopy height and fine root productivity at the 3 and 5m buffers, where the 3m and 5m buffers explained 25% and 13% of the variation in annual fine root productivity respectively. These data demonstrate that forest canopy structure has the potential to explain a portion of the variation in annual fine root productivity. Additionally, this study provides a baseline for similar studies in need of predicting belowground plant carbon dynamics remotely. Potentially, these results can be used for the creation of repeatable allometric equation for the prediction of belowground carbon using non-destructive remote sensing tools.

Canopy Methods

We used aerial LIDAR flown in 2008 to extract information about the canopy surface. LiDAR rasters were imported into ArcGIS

All 40 minirhizotron plots (10 plots with 4 tubes per plot) were surrounded by 5 types of buffers: 1m, 3, 5m, 10m, and 15m radius.

The standard deviation of canopy height values for all plots with all buffers were calculated using ArcGIS's zonal statistics tool

Root Methods

40 50cm clear plastic tubes were installed in 2008 at a 35° angle and allowed to 'dwell' for 2 years before measuring

Using a minirhizotron optical scanning device tubes were sampled once a month for one calendar year, which produced 424 unique hi-resolution digital images

The 424 root imagers were hand traced and analyzed for annual fine root productivity using the program RooTracker

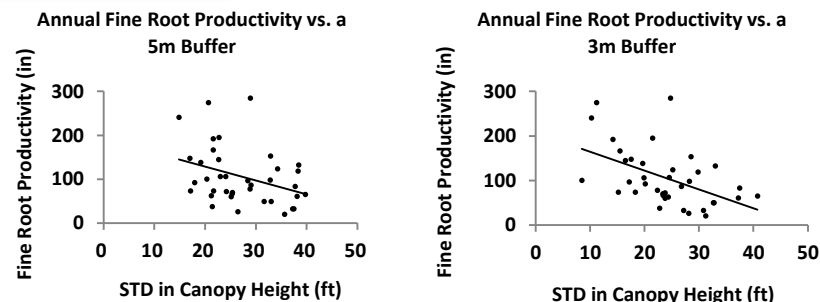


Figure 4: The figure on the left depicts a significant negative relationship between standard deviation on canopy height (ft) and annual fine root productivity for the 3m buffer. The figure on the right depicts a significant negative relationship between standard deviation on canopy height (ft) and annual fine root productivity for the 5m buffer. The 1m, 10m, and 15m buffers were not significant.

THE KEY QUESTIONS:

Is there a relationship between fine root productivity and variation of canopy height?

THE ISSUE: There is an incomplete understanding of the relationship between forest canopy structure and fine root dynamics. Current remote sensing technologies affords us the ability to test these relationships non-destructively.